Big Data Analytics Symposium - Fall 2019

Analytics Project: From a Concrete Jungle to a Concrete Farm

Team Name: Cube Farmers^3

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Abstract: Our proposed solution and analytics look at general food consumption patterns and New York City's distribution system. We advocate for the integration of vertical farms in the city's neighborhoods. The proximity of vertical farms to an individual neighborhood can better meet the demands of the local population and unlock access to healthy foods to those historically neglected.

Motivation

Who are the users of this analytic?

Urban planners, municipalities, food distributors and farmers

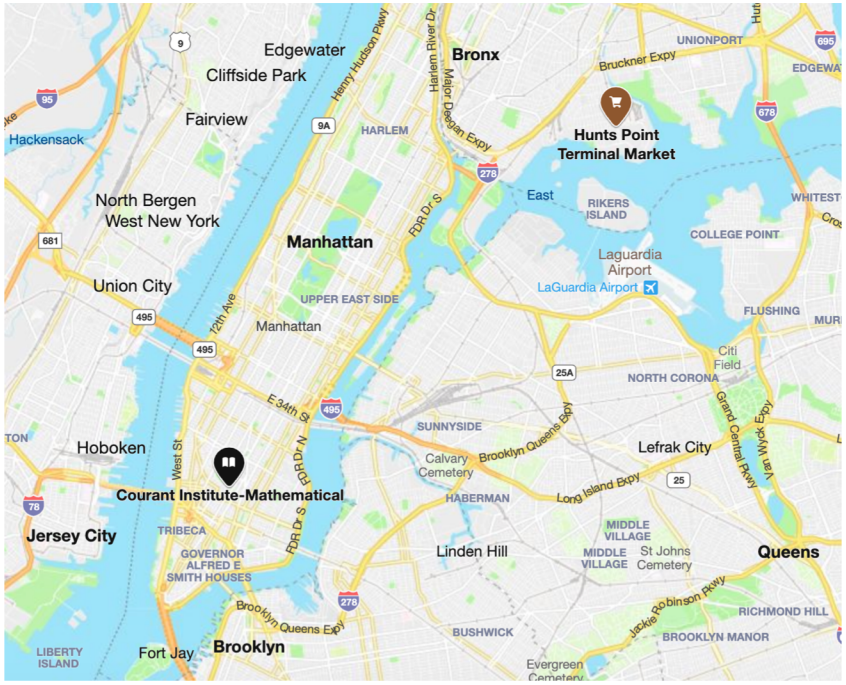
Who will benefit from this analytic?

Humans and the planet (particularly urban planers, urban residents, environmentalists, and farmers)

Why is this Analytic Important?

The planet must produce more food in the next four decades than all farmers in history have harvested over the past 8,000 years. New and sustainable methods for food production and distribution must be explored and prioritized, particularly for urban areas. We see vertical farms as part of a broader sustainable solution aimed at addressing environmental, socioeconomic, and health issues.

Hunts Point Terminal Market



- Largest produce market in the world
- 2,500 fruit & vegetable grocers
- 210 million packages of produce per year
- $2.3 billion in sales per year
- 15,000 truck visits per day (12,000, or 80% headed outbound)

What is Vertical Farming?

Vertical farming is the practice of growing crops in vertically stacked layers. Vertical farming often incorporates controlled environments, which aims to optimize plant growth, and soilless farming techniques such as hydroponics, aquaponics, and aeroponics.

Indoor Vertical Farm

Hydroponics

Benefits of Vertical Farming

- Reduce traffic congestion
- Reduce greenhouse gas emissions
- Reduce water intake
- Unlock access to healthier foods
- Younger farmer population

Data Sources

1) **Name:** Neighborhood Tabulation Areas

   Description: Contains boundaries of Neighborhood Tabulation Areas defined by the NYC Department of City Planning by aggregating census tracts from the 2010 Census.

   Size of data: 1.8MB (shapefile format)

2) **Name:** American Community Survey (ACS) Data Tables

   Description: The ACS is an extensive nationwide survey conducted over five years, providing estimates on demographic, socioeconomic, and housing characteristics. The NYC Department of Planning filters this data and limits to the city.

   Size of data: 4.6 MB (demographic and socioeconomic datasets for the 2013 - 2017)

3) **Name:** Food Availability Per Capita

   Description: Provided by the Economic Research Service (ERS) of the USDA and includes estimates for over 200 commodities, including individual fruits, vegetables, and grains, for years up to 2018. According to the ERS, this data serves as a proxy for actual food consumption.

   Size of data: 0.5MB (fresh vegetable food availability)

4) **Name:** Retail Food Stores

   Description: Retail Food Stores in New York, last updated in June 2019, is a listing of all retail food stores in the state of New York licensed by the Department of Agriculture and Markets.

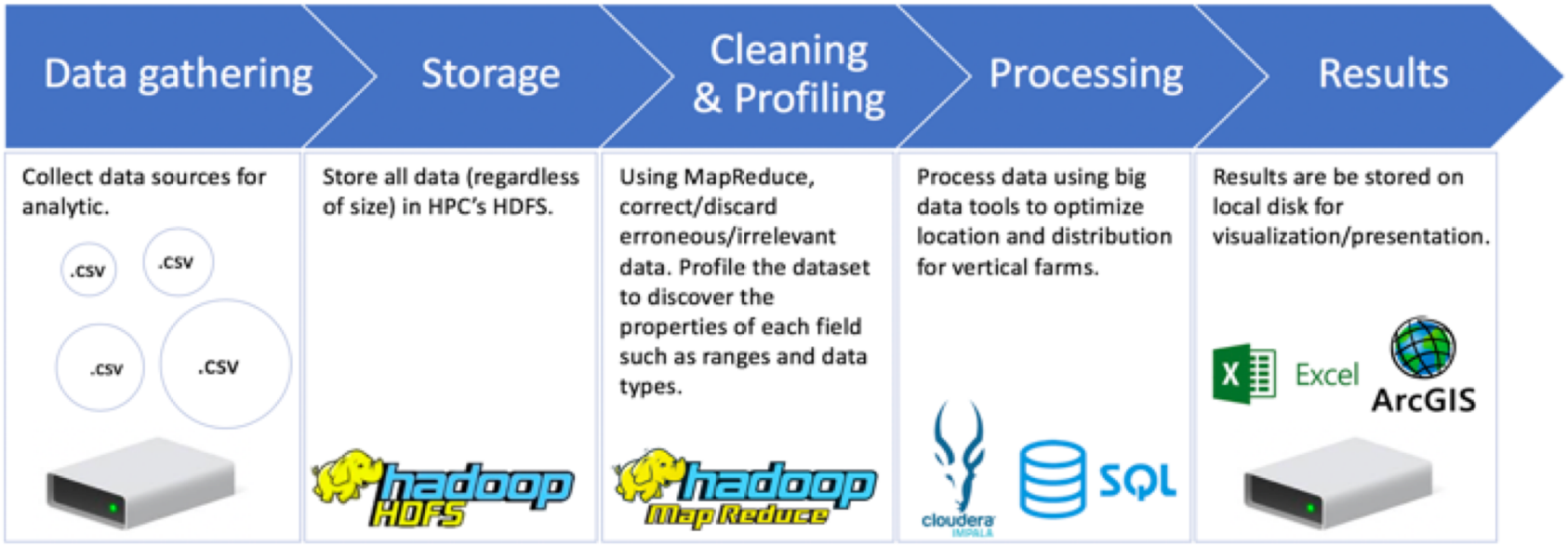
   Size of data: 7MB

5) **Name:** Instacart Online Grocery Shopping Dataset

   Description: 3 million grocery orders for more than 200,000 Instacart users.

   Size of data: 2 MB (products & departments), 109 MB (orders), 577 MB (prior orders)

Design Diagram & Analytics Platforms



Platform(s) on which the analytic ran:

- NYU HPC DUMBO Cluster
- Excel
- ArcGIS

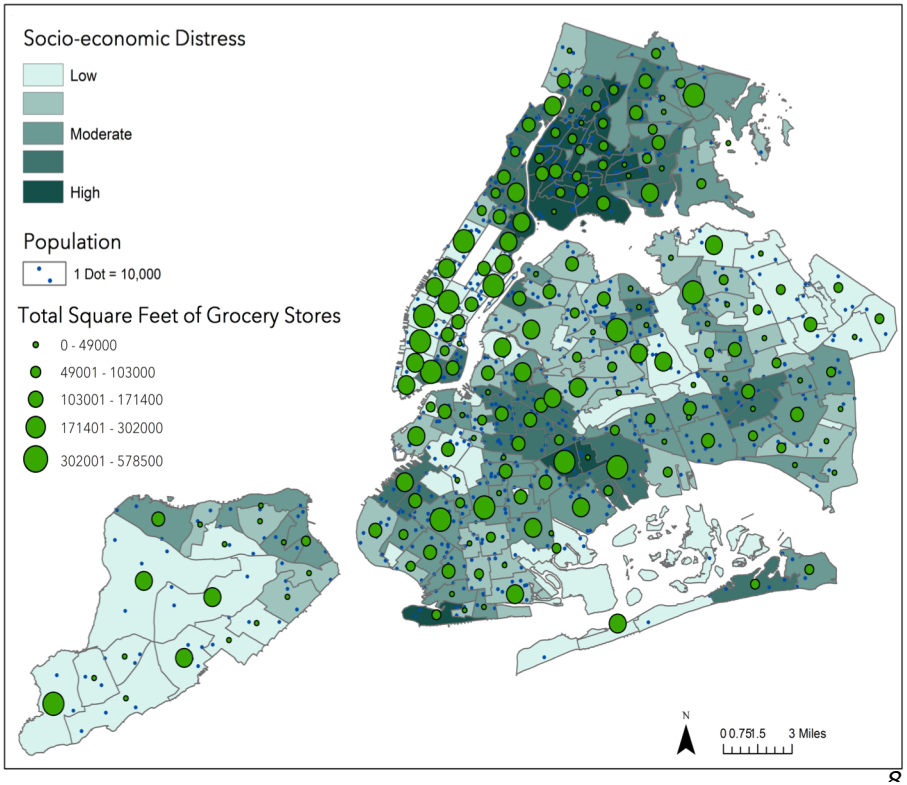
Results | Suitability Zones

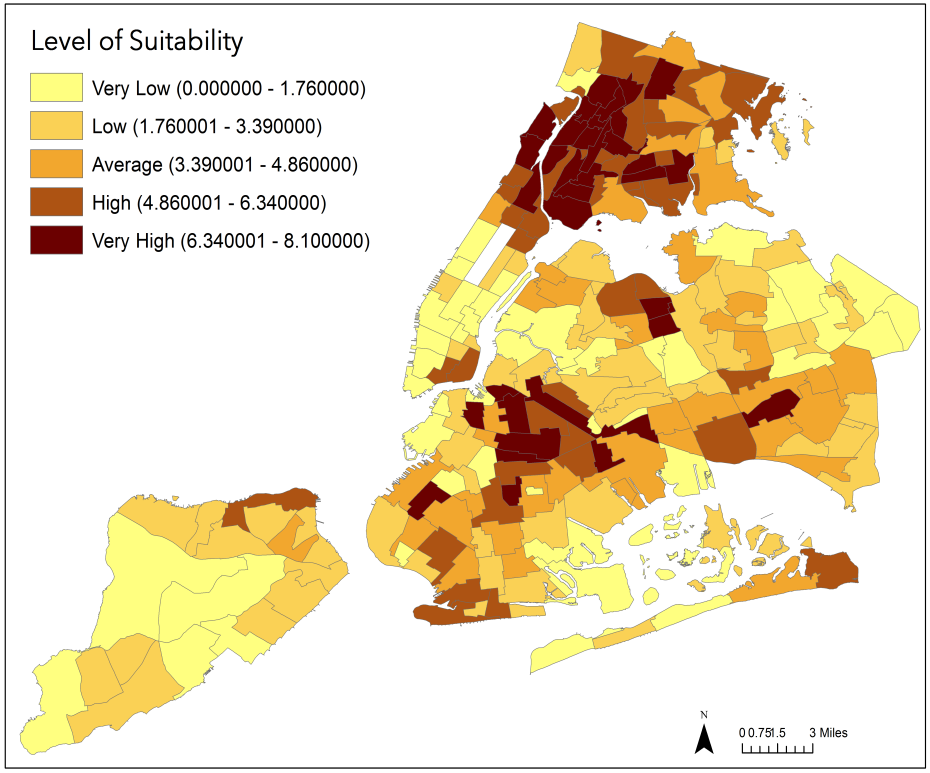
Suitability Score Factors

Based on levels of socio-economic distress, population density, and grocery store availability, we calculated a suitability score for each neighborhood.

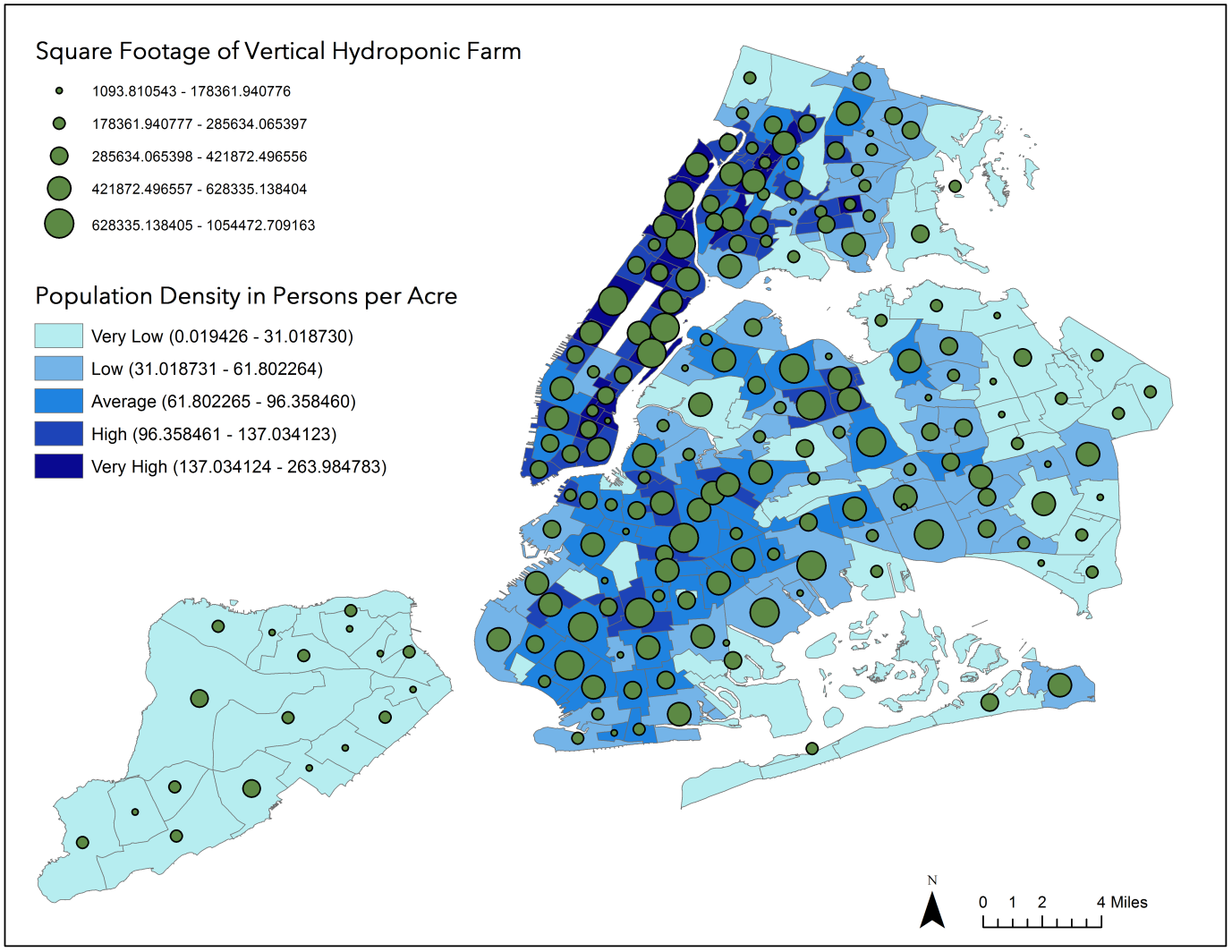
Level of Suitability

A higher suitability score indicates that a neighborhood is more likely to benefit from a vertical farm. Suitability zones were created to bucket neighborhoods.

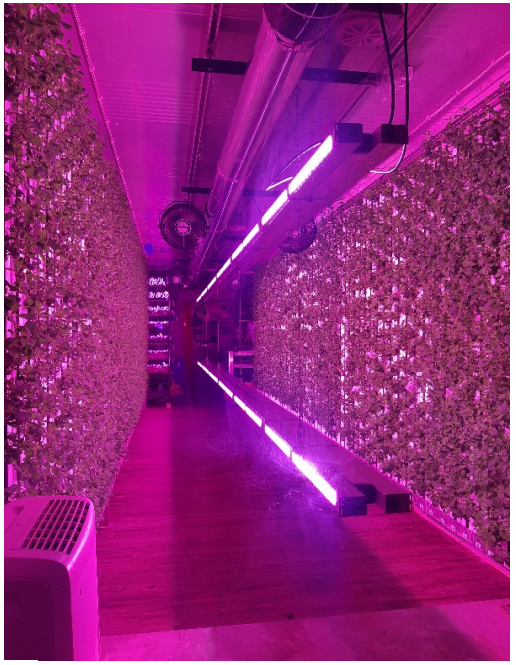




Results | Area Needed for a Vertical Farm

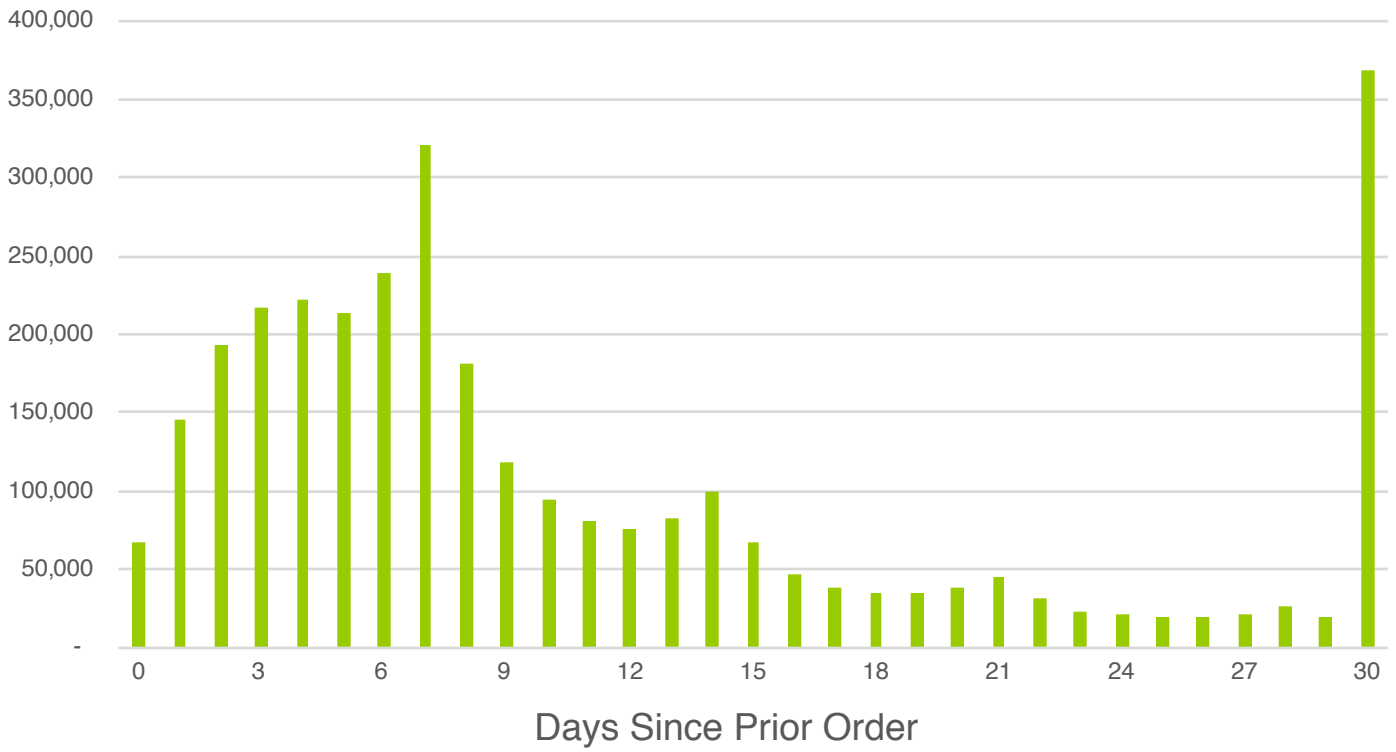


Our Trip to Square Roots Vertical Farm!



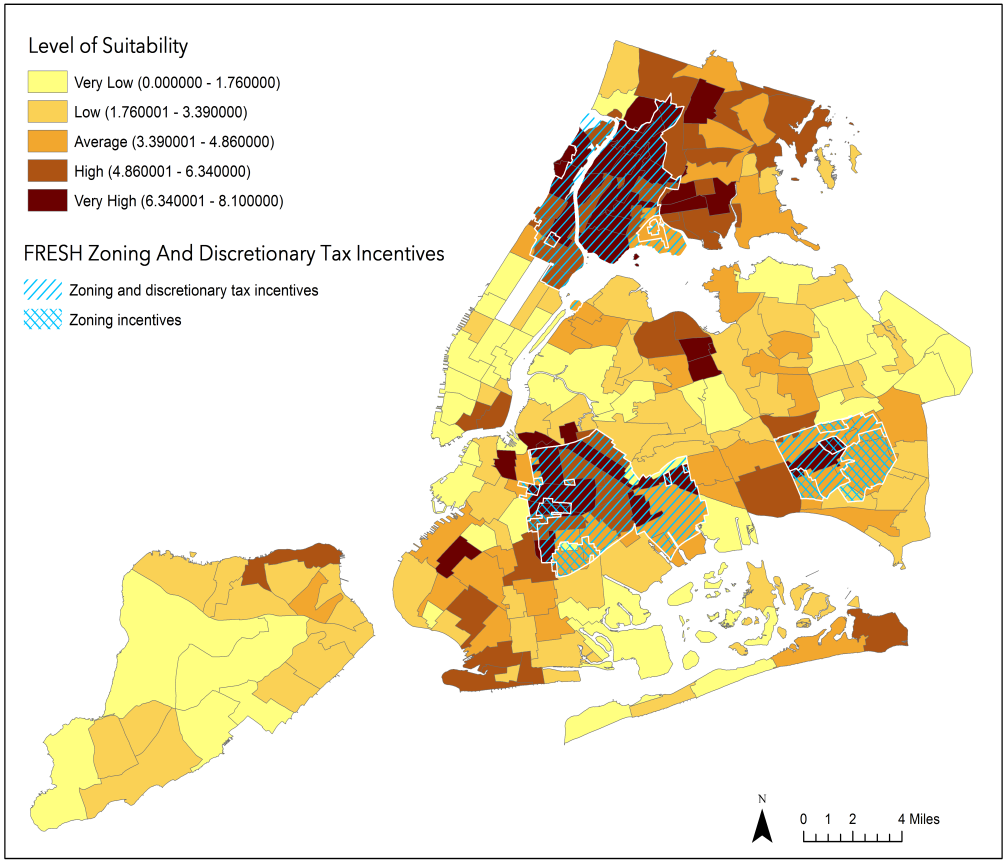
From a Concrete Jungle to a Concrete Farm

Results | Frequency of Instacart Reorders



- Excluding orders placed thirty days or higher, 57% of the orders occurred within seven days of a customer's previous order.
- This data point would help a vertical farm understand how often they would need to crops to meet the demand of the area they feed.

Goodness of Analytic



- The Food Retail Expansion to Support Health (FRESH) program offers zoning incentives and financial benefits as a way to introduce fresh food options in underserved areas
- Our suitability scores overlaid with the locations where FRESH offers zoning and / or discretionary tax incentives aligns well with our areas of high or very high suitability

Summary

- Diminishing farmland, access to healthy food, climate change, and an aging farmer population are motivators for new and sustainable food production/distribution methods
- Vertical farms can be a sustainable solution for New York City and NYU and should be further researched
- Based on factors such as socio-economic distress, population density, and grocery store availability, we identify a reasonable plan for prioritizing the integration of vertical farms
- Square footage estimates for growing leafy greens show constructing vertical farms is viable
- Using big data and analytics, vertical farms can align what they grow and when they grow to food purchasing habits of their catchment zone; better satisfy consumer demand and minimize food waste

The largest square footage requirements based on estimated crop yield is roughly 1 million square-feet

- IKEA in Brooklyn is 346,000 square-feet
- IKEA's footprint is floor space only, but vertical farms can take advantage of wall space and stack crops on top of one another

Obstacles & Acknowledgements

1) **Missing Data :** Location information for nearly 2,500 data points was missing which led to a faulty analysis of non-existing food deserts
2) **Mapping the Missing Values :** The DUMBO cluster did not have the Google maps package installed so HPC helped with a solution that was used to map missing values by neighborhood

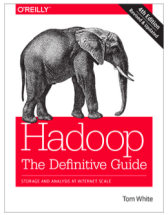
NYU - **High Performance Computing**

SQUARE ROOTS - **Square Roots**

ArcGIS - **Esri - ArcGIS**

hadoop - **Apache Hadoop**

ARTEMIS - **Alison Kopf, CEO of Artemis**



- **Tom White: Hadoop: The Definitive Guide**

Google Maps API

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Thank you!