The Relationship Between Greenspace Access and Income in Philadelphia

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Introduction

The incorporation of greenspace into urban settings has been shown to improve the social and environmental health of cities in a multitude of ways. The benefits are wide-reaching and include: improved water and air quality, rainwater runoff control, a reduction in the urban heat island effect, improved physical and mental health, and community pride.

However, numerous studies across disciplines have shown that low-income individuals typically have lower levels of access to urban greenspace in terms of both proximity and quantity. This inequity has serious implications for the fields of urban ecology and environmental justice.

To build upon this line of research, my goal in this project was twofold: 1.To conduct a preliminary investigation into the relationship between tract greenspace coverage and average tract income in Philadelphia, and 2. To identify tracts that are both low-income and lacking greenspace coverage.

Methodology

1. Imagery and data acquisition
2. Masking of Landsat imagery to city boundaries
3. Creation of training polygons and supervised classification; utilizing Landsat bands 6, 5, 4
4. Reclassification of land covers into binary: greenspace and non-greenspace
5. Calculation of greenspace binary pixel ratio by census tract
6. Exclusion of census tracts with no income data or no population data
7. Weighting of greenspace ratio by population count per tract
8. Statistical analysis of mean income and greenspace distribution
9. Isolation of lowest-income neighborhoods lacking greenspace

Data Sources

- Philadelphia Census Tracts (2010), City of Philadelphia
- Landsat 8 Philadelphia Imagery 07-30-2017, U.S. Geological Survey
- Philadelphia Census Tracts Population Estimates, 2017 American Community Survey
- Philadelphia Census Tracts Mean Household Income (Past Twelve Months), 2017 American Community Survey

References

1. Casey, J., James, P., Cushing, L., Jesdale, B., & Morello-Frosch, R. (2017). Race, ethnicity, income concentration and 10-year change in urban greenness in the United States. International Journal of Environmental Research and Public Health, 14(12), 1546.
2. Heckert, M. (2013). Access and equity in greenspace provision: A comparison of methods to assess the impacts of greening vacant land. Transactions in GIS, 17(6), 808-827.
3. Heynen, N., Perkins, H. A., & Roy, P. (2006). The political ecology of uneven urban green space: The Impact of political economy on race and ethnicity in producing environmental inequality in Milwaukee. Urban Affairs Review, 42(1), 3-25.
4. Jennings, V., Johnson Gaither, C., & Gragg, R. S. (2012). Promoting environmental justice through urban green space access: A synopsis. Environmental Justice, 5(1), 1-7.

Results

- Average mean household income for all census tracts with sufficient data: $60,769
- Average ratio of greenspace to non-greenspace by census tract (% Greenspace): 0.199 (Fig.2)
- Average ratio of greenspace normalized by population for all census tracts with sufficient data: 0.000096 (Fig.3)
- Low-income neighborhoods containing the least greenspace were isolated via an attribute query
  - Chosen tracts fulfilled two requirements: 1. They had a mean household income that was less than half the average (<$30,385) and 2. Had a normalized greenspace ratio that was less than half the average (<0.000048) (Fig. 5, 7, 8)
  - Greenspace ratio was found to increase as income increased when census tracts were split into four quantiles of increasing income ranges, with a notable jump occurring between the two highest income groups (Fig.6)

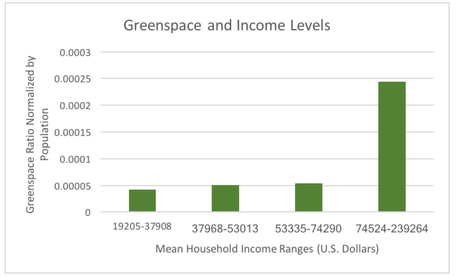

Figure 6

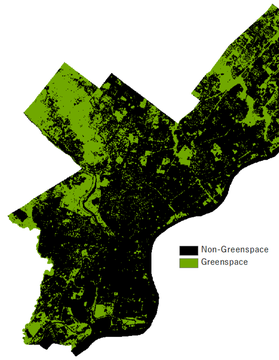

Figure 1. Binary Classification of Land Cover in Philadelphia

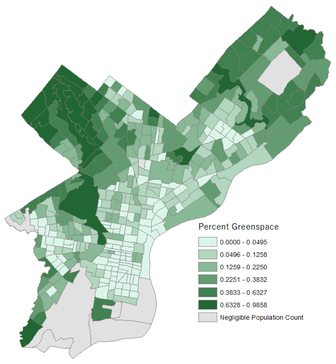

Figure 2. Ratio of Greenspace to Total Land Cover By Census Tract

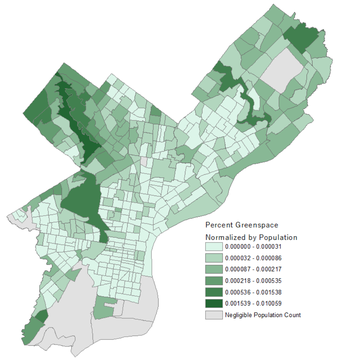

Figure 3. Ratio of Greenspace to Total Land Cover By Census Tract, Normalized by Population Count Per Census Tract

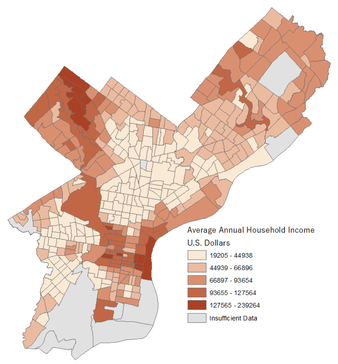

Figure 4. Average Annual Household Income by Census Tract

Figure 5. Focal Mean Raster of Binary Classification, Overlaid with Low-Income Neighborhoods Containing the Least Greenspace

Discussion and Conclusions

- This preliminary analysis of the relationship between urban greenspace and income aligns with the findings in the dominant body of literature on the subject
- In this, it seems that higher income areas tend to have greater access to greenspace than lower income areas in terms of quantity
- Specifically, the ratio of greenspace to non-greenspace was larger in higher income areas
- Further, I identified census tracts in Philadelphia that were both low-income and lacking in greenspace coverage
- The majority of these census tracts are located in areas informally known as Upper and Lower North Philadelphia
- Several of these tracts are also located in Kensington, while the remaining two are located in West Philadelphia
- In order to equitably distribute the benefits of greenspace across the city, these areas may benefit from a partnership with one of the many governmental and nonprofit greening intervention programs in Philadelphia

Figures 7 and 8. Census tracts with less than half the mean annual income and less than half the average greenspace ratio for all tracts