

Introduction

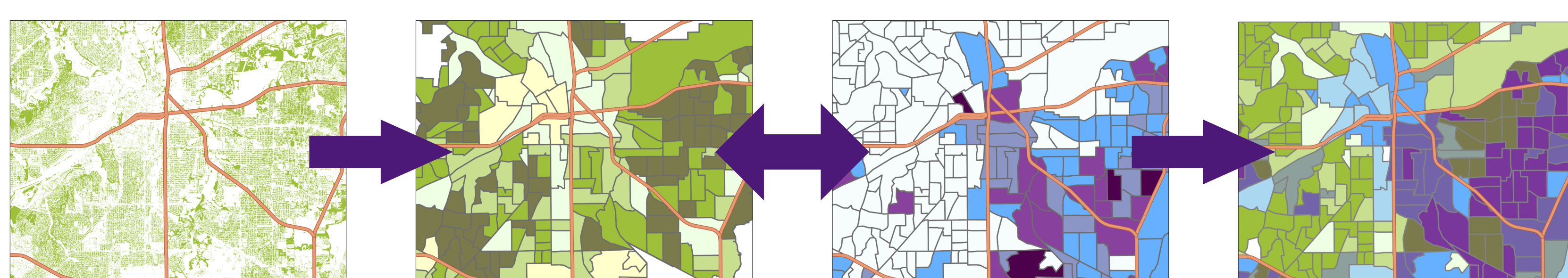
Urban trees provide numerous benefits to communities such as removing air pollution, reducing the urban heat island effect, and providing recreational opportunities. Urbanization processes, however, claim an estimated 175,000 acres of tree canopy each year in the United States or approximately 36 million trees a year (Nowak and Greenfield, 2018). Several major US cities, such as New York City, Atlanta, and Los Angeles, have implemented large-scale tree planting programs to increase canopy cover. In Texas, municipalities enact tree preservation ordinances to regulate tree removals and ensure local communities accrue urban forest benefits (Lavy and Hagelman, 2019). To protect its urban forest, the City of Fort Worth (2009) has a tree preservation ordinance and a 30% canopy cover goal to promote a healthy, multiage forest. Despite these efforts, canopy cover is distributed inequitably in many US cities. A recent study found a strong relationship between resident income and urban canopy cover across seven US cities, with higher income areas having greater tree canopy cover (Schwarz et al., 2015). Similarly, analysis of tree canopy cover in 37 historically segregated or redlined cities demonstrated that white Americans had nearly twice as much tree canopy as those belonging to other racial and ethnic groups (Locke et al., 2021). Understanding the relationship between local community characteristics and tree canopy is important to promote environmental equity across neighborhoods. City officials may use this information to increase canopy cover for disadvantaged groups. The purpose of this research is to examine the distribution of tree canopy cover in relation to socioeconomic and demographic characteristics in Tarrant County, Texas.

Research Question

Is urban tree canopy cover distributed equally across socioeconomic and demographic characteristics in Tarrant County, Texas, at the US Census block level?

Methods

Our study area was Tarrant County, a heavily urbanized part of North Central Texas, mostly containing the cities of Fort Worth and Arlington. As of 2020, Tarrant County had a population of roughly 2.1 million, ranking the 15th most populous county in the United States (US Census Bureau, 2020). We created a geographic information system to analyze canopy cover equity (ESRI ArcGIS Pro, version 3.0). First, we obtained canopy cover data from Halff Associates and socioeconomic and demographic data and legal boundaries from the US Census Bureau, using the TidyCensus R package (Table 1; Walker and Herman, 2023). We calculated the proportion of each variable to the total population of each block group, except for median household income and median age of structure. We then subtracted parks and lakes to calculate percent canopy cover for each census block group. We combined all variables in ArcGIS using the join tool to create a comprehensive layer. Finally, we exported the dataset for further analysis (IBM SPSS, version 29). To determine if inequities exist between the census variables and tree canopy cover, we conducted a Spearman's rank-order correlation analysis. We also conducted a Mann-Whitney U test to determine if any differences occur in block groups above and below the City of Fort Worth's 30% canopy cover goal.



Results

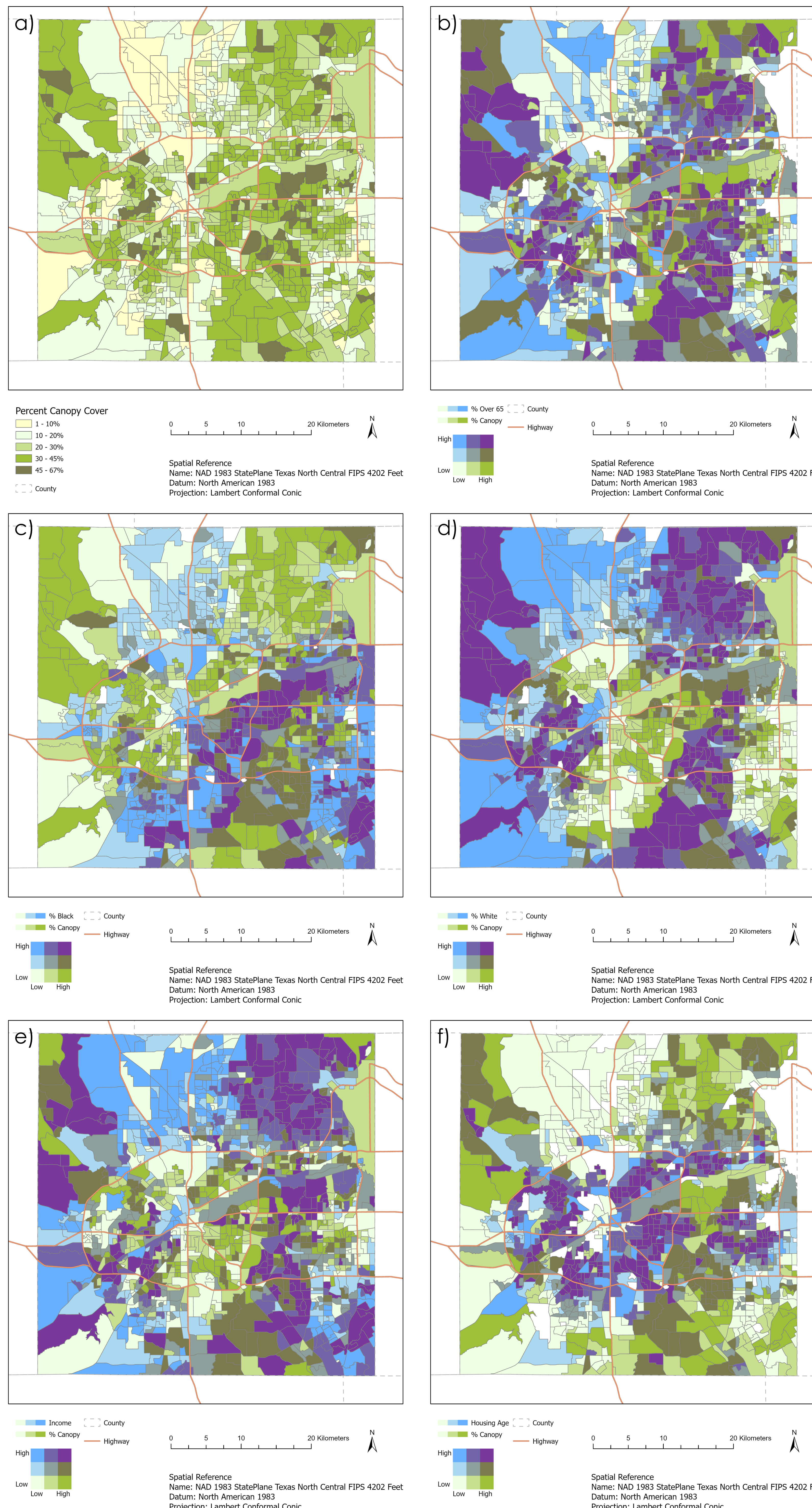


Figure 1. a) Percent canopy cover at the block group level in Tarrant County, Texas. Bivariate color correlations for percent canopy cover at the block group level are displayed against b) percent older than 65, c) percent Black, d) percent White, e) median household income, and f) median housing age.

Table 1. Statistical tests for tree equity in Tarrant County (n=1164-1246)

Variable	Mean Rank <30% CC	Mean Rank >30% CC	U	Asymp. Sig.	Spearman's Rho	Asymp. Sig.
Race and Ethnicity						
% White	559.58	707.97	130989.5	<.001	0.215	<.001
% Black	683.71	487.3	117438.5	<.001	-0.311	<.001
% Asian	671.39	509.19	127092.5	<.001	-0.241	<.001
% Hispanic	637.18	570.01	153913.5	0.001	-0.096	<.001
Age						
% Under 18	618.76	587.76	161739	0.138	-0.074	0.010
% Over 65	543.78	719.19	121190	<.001	0.334	<.001
Educational Attainment						
% No diploma over 25	612.31	599.06	166725	0.508	-0.017	0.548
Tenure						
% Vacant	601.55	615.15	166190.5	0.509	0.03	0.301
Housing Characteristics						
Median age of structure	502.89	718.89	99144.5	<.001	0.414	<.001
Income						
Median household income	586.25	691.26	147734	<.001	0.148	<.001

Significance value is 0.05.

Discussion and Conclusions

Approximately 25% of Tarrant County is covered by tree canopy, and our results suggest that tree canopy is significantly related to race and ethnicity, age, income, and housing characteristics. Results show that block groups with less canopy cover are associated with increasing proportions of Black, Asian, Hispanic, and under 18 populations. Results also indicated that block groups with more canopy cover are associated with increasing proportions of White and over 65 populations as well as with older structures and households with greater median incomes. Results of the Mann-Whitney U test show similar patterns with Black, Asian, and Hispanic populations more likely to live in an area with less than 30% canopy. Whereas majority White and over 65 populations as well as places with older homes and higher incomes were more likely to be in areas with more than 30% canopy. Results also indicate that educational attainment and housing tenure were not significantly associated with canopy cover. Taken together, our study shows that the urban forest in Tarrant County is distributed unequally amongst residents. Black, Asian, and Hispanic populations live in neighborhoods with significantly less canopy than White, wealthier, and older areas. As a result, the benefits provided by the urban forest accrue to some populations more than others. These results are most likely connected to a history of redlining practices that resulted in continued disinvestment in communities of color. Additionally, some of the canopy distribution may be attributed to the county's position within two ecoregions: 1) the Cross Timbers and 2) the Blackland Prairies. Finally, to reach a canopy goal of 30% in Fort Worth, Arlington, and Tarrant County, city officials and urban forestry professionals should prioritize tree plantings in disadvantaged communities with low canopy cover.

References

