Data Visualization

Hurricane Flooding and Environmental Inequality: Do Disadvantaged Neighborhoods Have Lower Elevations?

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Abstract

Most research on environmental inequality studies whether poor and minority neighborhoods are more exposed to environmental hazards in the form of pollution and waste. However, natural disasters, such as hurricanes, and their aftermaths are also important forms of environmental hazards and may disproportionately affect disadvantaged neighborhoods. Using data from Google Maps API and the American Community Survey, this study shows that poor neighborhoods in the Houston area tend to have lower elevations and thus may be more vulnerable to flooding. Further analyses show that this association persists even after controlling for latitude, longitude, and population density. Additionally, other types of neighborhood disadvantage, such as poverty and high concentration of racial-ethnic minorities and noncitizens, are also associated with lower elevations. Moreover, these patterns are common among most of the 20 largest metropolitan areas in the United States. These findings reveal a new dimension of environmental inequality and the consequences of spatially concentrated disadvantages.

Keywords

evironmental inequality, neighborhood disadvantage, natural disasters, elevation, Google Maps API

Most research on environmental inequality studies whether and why poor and minority neighborhoods are more exposed to environmental hazards in the form of industrial pollution and waste (Crowder and Downey 2010; Pais, Crowder, and Downey 2014). However, as we have been reminded during this past hurricane season, natural disasters and their aftereffects are important forms of environmental hazards as well. Disasters like hurricanes may hit everyone on their paths, but everyone is often not equally exposed to the resulting hazards and consequences (Donner and Rodriguez 2008). This study will use visualizations and additional analyses to show how disadvantaged neighborhoods in Houston and many other large metropolitan areas in general have lower elevations and thus may have higher risks of flooding after extreme rainfalls.

Figure 1 shows the relationship between neighborhood elevation and median household income in the Houston metropolitan area. In general, the scatterplots and their corresponding nonparametric LOESS curves indicate a positive association between elevation and income, suggesting that poor neighborhoods tend to have lower elevations while more wealthy neighborhoods are more likely to be on local high grounds. The relationship between elevation and median income does vary by the neighborhood’s population density.

While the relationship is positive and fairly consistent in less densely populated regions, such as suburbs and rural or semirural areas, the relationship is less clear in the most densely populated regions, such as the downtown areas, where most neighborhoods have similarly low elevations regardless of median income.

Further analyses (see the supplemental document) using spatial lag regression models that control for latitude, longitude, and population density show a robust positive relationship between elevation and median income. Regression analyses also find similar associations between elevation and other types of neighborhood disadvantage, such as poverty and high concentration of racial and ethnic minorities and noncitizens. Moreover, such patterns are not unique to the Houston area but are common among the 20 largest metropolitan areas in the United States despite their vastly different geographical characteristics and urban layout.

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Everything else equal, the lower elevations of disadvantaged neighborhoods are likely associated with higher risks and increased intensity of flooding, slower retreat of floodwater, accumulation of flood-related environmental and health hazards, and slower rebuilding and recovery. Everything else is likely not equal, however, as those in disadvantaged neighborhoods may also be less likely to have private safety nets, such as flood insurance, savings, or second homes, to buffer the losses. Therefore, studying neighborhood elevation and related flooding risks reveals another dimension of environmental inequality and contributes to a more complete understanding of the status quo and consequences of spatially concentrated disadvantages.

In addition, the prevalence and consistency of these patterns in different geographies point to structural factors and social, economic, and political processes that have led or forced disadvantaged groups to concentrate in neighborhoods of low elevation. Future research will need to explore the roles that residential segregation, affordability of housing, practices and regulations of the real estate industry, and other factors play in stratifying neighborhoods by elevation or other characteristics associated with disaster vulnerability. Identifying and understanding these environmental risks that disproportionally affect disadvantaged neighborhoods may have implications for improving urban planning and disaster preparation and relief to make sure that the
most vulnerable and marginalized groups in the society are no longer left behind when natural disasters hit.

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Author Biography
Yuqi Lu is currently a sociology PhD candidate at Cornell University with a minor in demography. He is affiliated with the Center for the Study of Inequality and the Cornell Population Center. His research interests include (1) spatially concentrated poverty and disadvantages and neighborhood access to resources, amenities, and public services; (2) households’ response and adaptation to economic insecurity and the role of labor market, family, and welfare state; and (3) how family demographic patterns and processes are related to social stratification and mobility over the life course.