



The geography of environmental injustice



Eric Vaz*, Adam Anthony, Meghan McHenry

Ryerson University, Department of Geography and Environmental Studies, Toronto, ON, Canada

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ABSTRACT

Policy and planning have since the last couple of years significantly relied on digital data repositories for decision support. Spatially-enabled data, has become on the vanguard of more complete and coherent decisions at a finer regional gradient. A seldom addressed issue however, that such data combined with Geographic Information Systems may address has been Environmental Injustice.

Environmental Injustice pertains a systemic and institutionalized vision that is inherently exclusive to the health and prosperity of low-income and racialized communities. These communities are subjected to a disproportionate amount of environmental vulnerabilities due to their residential location, such as low air quality and close proximity to pollutant emitting facilities. Conversely, EI also serves to reward majority populations through various forms of urban landscape preferentialism, whereby socio-economic privileged groups, exempt and protected from these undesirable conditions. This research serves to assess three broad narratives of environmental injustice: (i) concentration of minority populations, (ii) major pollution sources, and (iii) socio-economic deprivation. The discussion composes an integrative vision of environmental injustice forwarding the neighborhood boundaries and establishing a novel framework for policies for urban areas. Toronto, as one of the fastest growing cities in North America, deserves special attention for such a study. Comprising its economic growth, the challenge of addressing pollution levels, socio-economic disparities within a growing population, account for an equitable vision for a sustainable socio-economic future. To achieve this, a combinatory approach through hexagon metrics and spatial analysis are used as to integrate the complexity of environmental injustices at regional and neighborhood level in Toronto.

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1. Introduction

Environmental Injustice (EI) corresponds to a structural social issue with serious impacts on vulnerable communities. It negatively affects the health as well as prosperity of low-income and minority communities that are subordinated to a disproportionate amount of negative environmental and social pressures within their residential location. Conversely, EI oftentimes rewards majority populations through various forms of urban landscape preferentialism, and becomes a complex issue to address at local level, given the unavailability of data and difficulty of understanding impact at regional level. The concept of EI incorporates a variety of social ideals, such as economic externalities, inequality in political power relations, and the unequal influence of certain groups over land use decisions that work to benefit only a few restricted groups of society. EI influences the geographic location of pollutant

emitting facilities (PEF) within racialized and socio-economically deprived areas of a city (Fong, 1994), and is strongly spatially-explicit.

Facility siting is often at the centre of EI. Exploring the location of PEF within a city highlights the correlation between these environmentally problematic facilities, the spatial distribution of minority populations, and the location of socio-economically deprived communities. For regional decision making purposes, this adopts a clearly spatial approach where the cohesiveness of place, that is, the integration of social and economic aspects within a geographical scale, should be assessed from a regional intelligence perspective (Vaz, 2016).

The spatial patterns of inequity that have developed over time, trigger complex structural processes and procedures difficult to cope and understand fully from a policy perspective. Several studies have shown that an individual's elevated socio-economic status works to shield from the impacts of facility siting. EI and facility siting is inherently a spatial matter, therefore the use of spatial analysis and mapping should be employed to visualize and interpret patterns of inequality throughout urban regions.

* Corresponding author.

E-mail address: evaz@ryerson.ca (E. Vaz).

Furthermore, the increasingly ubiquitous nature of spatial data allows for a combinatory approach to address such concerns at regional level. This strengthens the framework for decision support and may lead to the integration of initiatives at city level, such as the Wellbeing Toronto interface.¹ A web application that combines and integrates various indicators for Toronto, allowing public awareness for several indicators at neighborhood level while establishing composite indices. In the case of Toronto, these represent important contributions for social awareness of asymmetries and concerns within the city. From a planning and policy perspective, these also suggest the potential of integration of GIS and data sources to address complex concerns such as EI. This paper explores a combinatory approach to assess the complexity of EI from a spatial perspective. By means of the last available Canadian Census (2011), data is extracted and geocoded as well as combined Toronto Public Health's ChemTRAC database. The paper proceeds to identify neighborhoods that are exposed to the highest and lowest rates of EI, constructing a composite spatial index for EI by means of integration four major composite indices that contribute to this phenomenon using Geographic Information Systems: (i) health status of populations through the exploration of social and economic deprivation, (ii) the major pollution sources status of an area based on its proximity to industrial facilities and major transportation routes, and (iii) significant clusters of minority populations. Finally, these three components identified as main contributors to EI are weighted into a spatially-explicit Environmental Injustice framework, using hexagonal geometry, allowing a multifactorial assessment of vulnerable neighborhoods. The final composite will demonstrate a spatial pattern of inequity in which minority and economically depressed populations are exposed to the highest levels of injustice in the City of Toronto from a policy implementation perspective.

2. Study area

Toronto is one of the largest metropolitan regions in Canada. Located on the northern banks of Lake Ontario. Toronto is largely characterized by its ethnic diversity, with 49% of the population identifying as a visible minority (Statistics Canada, 2011). Within the past decade, the City of Toronto has experienced rapid population growth. As to support the prevailing population dynamics, the commercial, industrial and infrastructural sectors are expanding, which may jeopardize the environmental, social, and human wellbeing of the city. Toronto's urbanization is a concern that must be carefully managed, and calls for an integration of spatially-explicit methods to understand the changes in its urban form, as well as integration of land use and health (Vaz, Zhao, & Cusimano, 2016). Particularly with it expected continuous increase, as the census metropolitan area (CMA) holds a total population of 6,129,000 inhabitants in 2015,² and is expected to show a continuous growth of 87,070 persons per annum (Fig. 1).

The census metropolitan area holds a total of 7124.5 km², and with a very high population density in its core and decreasing significantly along its periphery. The existing infrastructure is marked by two major public transportation systems which cater the Toronto region: The GO Transit and the Toronto Transit Commission. Commutes from the surrounding municipalities to downtown Toronto are frequent, as the metropolitan capital is the current cradle of services and industry. The economic importance of Toronto has shaped the patterns of immigration and location of

anthropogenic activity, leading to a rapidly changing retail and urban environments. The fluctuations in the economy and demography have further boosted the rapid urbanization Toronto's CMA faces (Fig. 2).

The metropolitan core has thus become, a highly diversified region, with great economic potential for future growth. Toronto has been marked by a successful recovery from the 2009 economic climate felt in North America (Hernandez & Jones, 2005). The investors and stakeholders interest thanks to this rapid recovery, have led in the recent year to a growing interest in investing in the region (Buliung, Hernandez, & Mitchell, 2008). Presently, the metropolitan area of the Toronto region to be the fourth largest economic centre in North America, and recently classified as one of the top 10 according to the Global Financial Centres Index (GFICI).

3. Data

A combination of different data sources was used to generate a spatially-explicit investigation on the nature of environmental injustice in Toronto. The availability of data, and the expanding urban dynamics of the city and its land use, make this metropolis of particular interest for understanding the imbalances and deprivation of clusters of minority communities leading to environmental injustices. A normative approach was nested into the GIS, as to allow an assessment of (i) social determinants of health, (ii) major pollution sources, (iii) distribution of visible minorities. The combination of these three components created a spatially-explicit framework that considers two embedded subsystems: the social subsystem and economic subsystem, which were combined with census data at CMA level, generating three distinct categories: a) major pollution sources, b) socio-economic deprivation and, c) minority communities. In this sense, one of the key advantages of GIS resides in the potential of integrating different spatial data sources, allowing for complex spatially-explicit visualizations to form.

3.1. Social determinants of health

A deprivation index was calibrated at the census tract level in order to measure deprivation within the City of Toronto. The index was developed using a series of indicators and decision criteria recognized by the Public Health Agency of Canada (PHAC) (Public Health Agency of Canada, 2015). In this sense, the PHAC has identified a person's income and social status as the two most important determinants of health. Thus, education and income, as well as housing and employment rates, were the variables selected to formulate the socio-economic determinants of health index. These variables were obtained from the Canadian Census Analyser (CCA). The CCA provides categorical data based upon the National Household Survey (NHS) for 2011 at the census tract level (Canadian Census Analyser, 2016). The proportion of individuals residing in rented dwellings and the proportion of the population that is unemployed are robust indicators of wealth, purchasing power, and social status (Bell, Schuurman, Oliver, & Hayes, 2007), and were consequently used within this analysis. Average household income is a value that may also dictate the potential affluence of an individual or community and is suggestive of lifestyle choices and social privileges. Education was found to contribute significantly to the attribution of an individual's social class and corresponding wealth (Evans & Kantrowitz, 2002). Further, the American Cancer Society's investigation on air pollution and mortality rates, acknowledging educational attainment as a marker of socio-economic status, discovered that the "risk of mortality associated with fine particles declining with increasing educational attainment" (Krewski et al., 2000, p. 20).

¹ map.toronto.ca/wellbeing/.

² <http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/demo05a-eng.htm>.

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