Applied Geography 90 (2018) 257–271

Contents lists available at ScienceDirect

Applied Geography

journal homepage: www.elsevier.com/locate/apgeog

Environmental justice and U.S. Forest Service hazardous fuels reduction: A spatial method for impact assessment of federal resource management actions

Mark D.O. Adams*, Susan Charnley

United States Forest Service, Pacific Northwest Research Station, USA

ARTICLE INFO

Keywords:
Environmental justice
Rural populations
U.S. Census
Natural resource management
U.S. Forest Service
Hazardous fuels reduction

ABSTRACT

Natural resource managers of federal lands in the USA are often tasked with various forms of social and economic impact analysis. Federal agencies in the USA also have a mandate to analyze the potential environmental justice consequences of their activities. Relatively little is known about the environmental justice impacts of natural resource management in rural areas. Quantitative environmental justice analyses have so far heavily favored urban populations, in part owing to the difficulty of quantitative analysis of rural U.S. Census data. We developed a spatial method for integrating rural U.S. Census data with natural resource management data to address this gap. The method learns from methodological advances in overcoming the spatial limitations of Census data, but prioritizes a simple, efficient technique that is applicable not only for identifying potential environmental justice problems, but also to a potentially broad spectrum of natural resource management activities and spatial scales. We pilot test the method by analyzing the hazardous fuels reduction activities of two national forests in central Oregon, USA. We find no evidence of systematic environmental justice issues on either forest, but identify local areas that warrant additional investigation.

1. Introduction

Natural resource managers in the USA are often tasked with projecting, monitoring, or retrospectively evaluating the economic and social impacts of their management activities. All U.S. federal agencies must also implement federal Executive Order 12898 on Environmental Justice (EJ), promulgated by President Clinton in 1994. The executive order directs agencies to undertake thee analytical tasks: 1) identify EJ communities potentially impacted by the implementation of agency programs and policies; 2) determine which programs and policies may impose disproportionate adverse impacts on such communities; and 3) develop and execute a plan for mitigating any disproportionate impacts (59 FR 7629, 1994).

Multiple challenges confront these obligatory analyses. Most natural resource management (NRM) activities by federal land management agencies occur in rural areas, making rural populations the focus of impact assessments. U.S. Census data are typically used for these assessments, but because Census data geographies fit poorly with dispersed rural populations, quantitative analysis of EJ in the context of NRM activity is prone to serious selection bias and estimate error. Implementation of NRM policies and programs is not monolithic: considerable discretion is delegated to unit-level administrators (e.g., a national forest), units are not equally funded, and local factors influencing implementation are variable. EJ assessment of NRM actions is needed at the scale where implementation occurs, but due to the small populations that neighbor individual units, only small numbers of Census data observations are likely to be relevant to the assessment, disqualifying many statistical procedures from consideration. The typical agency impact assessment, including for EJ, analyzes Census data but does not analyze NRM activity data in a way that allows for direct comparison with population characteristics. Such assessments could be significantly improved by doing so. However, this task encounters two further sources of potential error: the boundary problem, caused by NRM activity effects that cross Census unit boundaries; and, the modifiable areal unit problem (MAUP), where data observations are correlated with the physical size of the unit in which they are recorded. Social impact assessment, including for EJ, is usually performed by agency staff as part of National Environmental Policy Act (NEPA) analysis or land management plan revision. These staff may not possess advanced skills in spatial analysis and Geographic Information Systems (GIS), or specialized expertise in the limitations of Census estimates. Hence, there is a need for a quantitative analysis procedure that

* Corresponding author. USDA Forest Service Pacific Northwest Research Station, 620 SW Main Street, Suite 400, Portland, OR, 97205 USA.
E-mail address: markdadams@fs.fed.us (M.D.O. Adams).

https://doi.org/10.1016/j.apgeog.2017.12.014
Received 7 January 2017; Received in revised form 14 December 2017; Accepted 14 December 2017
Available online 02 January 2018
0143-6228/ Published by Elsevier Ltd.

produces more insightful impact assessments while working within the limitations of the available data and managing the many causes of spatial and estimate error.

In response to these challenges, we developed a method for integrating NRM activity data and rural U.S. Census data into a GIS, and a series of analytical procedures to screen Census data units for possible EJ concerns. The method represents a compromise: between technically advanced solutions to the mismatches between Census data units and population, and Census data and NRM activity data; and the reality that agency personnel conducting EJ and related social impact analyses may lack the specialized research skills for advanced quantitative analysis. Our approach allows analysts to identify locations where some aspect of managing an entire unit (i.e., national park, national forest) is most likely to create potential EJ impacts. Agency managers can then prioritize locales for further investigation using complementary research methods. We pilot-tested our approach by analyzing the spatial location of wildfire hazard mitigation activities conducted by two national forests in central Oregon, USA, relative to the distribution of nearby low-income and minority populations. Our objective was to evaluate the range of options for data selection and analysis procedures by verifying results in national forests where knowledge of the social context of wildfire hazard reduction activities was current and thorough.

We chose wildfire hazard mitigation for our pilot test because wildfire is an urgent problem facing federal land management agencies in the USA. In the 11 western states, the fire season has lengthened by 78 days, and average wildfire size has doubled, since 1970 (USDAFS, 2015). Lands managed by the United States Forest Service (USFS) accounted for 45% of total burned area in these 11 states in 2015 (NIFC, 2016), above the ten-year average of 37%. Consequently, the USFS plays a lead role in western wildfire management. In 2015, more than half the USFS budget was allocated to fire-related activities, compared to 16% in 1995 (USDAFS, 2015). These trends seriously impair the agency's ability to carry out its many other management obligations, including hazardous fuels reduction.

Hazardous fuels reduction (HFR) activities are key to the USFS's effort to counteract these wildfire trends in the dry, high-fire frequency forests of the west. When effective, HFR can reduce the severity and minimize the spread of future fires within a treated area (Calkin, Cohen, Finney, & Thompson, 2014), and facilitate the re-establishment of historic fire regimes (Safford, Stevens, Merriam, Meyer, & Latimer, 2012). HFR may also reduce the cost of future fire suppression, though data do not yet confirm this. Any ecological or fiscal benefits that result from HFR accrue not only to national forest lands, but also to adjacent federal, state, tribal, or private lands. However, HFR activities cannot be applied uniformly to the vast acreage managed by a national forest.

The process of allocating limited HFR resources to a subset of priority treatment areas is influenced by numerous internal and external variables, including: the USFS's community protection, ecological restoration, and silvicultural objectives; land management allocations that may make treatments difficult to implement in some areas; and the social setting surrounding individual national forests (Charnley et al., 2015; Steelman & Burke, 2007; Stephens & Ruth, 2005). These influences may result in a spatial distribution of HFR activity that confers hazard reduction benefits on some populations adjacent to a national forest, but not others. If high proportions of minority or low-income households exist in the population that lacks access to HFR benefits, and populations benefitting from HFR have few such households, the agency may have created a disproportionate burden of wildfire risk for its neighboring EJ population, in violation of the executive order.

2. Literature review

Quantitative EJ research has evolved from its initial focus on locally unwanted land uses and stationary pollution sources (e.g. Saha & Mohai, 2005) to cover a broad range of topics. Recent efforts encompass such diverse topics as: regional flood risk (Grineski, Collins, Chakraborty, & Montgomery, 2015; Maantay & Maroko, 2009); air pollution dispersion modeling (Bravo, Anthopolos, Bell, & Miranda, 2016; Maroko, 2012); brownfield soil pollution (McClintock, 2012); fracking (Ogneva-Himmelberger & Huang, 2015); airport noise pollution (Most, Sengupta, & Burgener, 2004); and the interacting effects of multiple emissions sources (Lewis & Bennett, 2013). Environmental justice researchers have also increasingly measured the converse form of EJ impact: lack of equitable access to benefits such as parks (Boone, Buckley, Grove, & Sister, 2009), public beaches (Montgomery, Chakraborty, Grineski, & Collins, 2015), and safe walking and bicycling opportunities (Cutts, Darby, Boone, & Brewis, 2009); and exclusion from amenities caused by gentrification (Bullard, 2011). Some analysts seek to measure both amenity access and hazard exposure, drawing conclusions in terms of the relative balance of the two contrasting metrics (e.g. Johnson Gaither, 2015; Stewart, Bacon, & Burke, 2014).

Nearly all of these analyses focus on urban or metropolitan populations. Recent, novel methodological innovations such as rasterized population estimates (Seirup & Yetman, 2006), dasymetric mapping (Dmowska & Stepinski, 2014; Maantay & Maroko, 2009; Eicher & Brewer, 2001), and integrating household-level survey data into the traditional hazard event-and-Census-data model (Collins, Grineski, Chakraborty, Montgomery, & Hernandez, 2015), have all been tested in urban settings. Even the EJ literature pertaining to forests is almost exclusively concerned with urban forestry (e.g. Schwarz et al., 2015; Lawrence, 2013; Tooke, Klinkenberg, & Coops, 2010; Landry & Chakraborty, 2009). One research team has argued that Native Americans, a population that rarely exists in measurable concentrations in urban populations, are seriously underrepresented in EJ research (Vickery & Hunter, 2016), perhaps a side effect of the dominance of urban settings.

Quantitative analysis of rural populations using Census data is not scarce, but it tends to not be explicitly focused on EJ. Rather, many studies explore the spatial variability in association between social vulnerability characteristics and risk of environmental hazards, including wildfire (Paveglio, Prato, Edgeley, & Nalle, 2016; Poudyal, Johnson-Gaither, Goodrick, Bowker, & Gan, 2012) and smoke (Johnson-Gaither, Goodrick, Murphy, & Poudyal, 2015). These analyses are usually conducted at spatial scales where both rural and urban or suburban populations are present (e.g. Lewis & Bennett, 2013), or encompass broad multi-state regions (e.g. Ogneva-Himmelberger & Huang, 2015). Political ecology approaches to social inequities in rural landscapes sometimes include a quantitative component and may relate to NRM (e.g. Collins, 2008). However, we failed to identify any quantitative research that directly analyzes the social impact of a specific NRM agency action by a discrete management unit, in the manner envisioned by the executive order on EJ, where the affected population is almost exclusively rural.

Some qualitative research addresses this relationship much more directly. In two related studies, Norgaard analyzes the EJ consequences of fire suppression for the traditional culture of the Native American Karuk, and the differential risk perception of USFS herbicide aplications held by forest managers, Karuk tribal members, and rural whites (Norgaard, 2014, 2007). Roberts (2013) offers a participant-observation critique of a single HFR project by the USFS. Macias (2008) and Pulido (1996) employ ethnographic methods in analyzing the complex relationship between traditional Hispano populations and national forest management. These analyses generate useful insights for the specific management units studied. However, a program of EJ analysis for an NRM agency could not feasibly be based on long-term, closely engaged, qualitative fieldwork such as these studies employ.

We conclude that there is a substantial knowledge gap that encompasses both documentation of the EJ consequences of NRM agency actions, and the appropriate research method for conducting such an analysis. The impacts of these agency actions are most often confined to a scale that matches closely with the individual NRM unit, such as a