Toxic Waste and Race in Twenty-First Century America

Neighborhood Poverty and Racial Composition in the Siting of Hazardous Waste Facilities

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■ **ABSTRACT:** In 1987, the United Church of Christ Commission for Racial Justice released its groundbreaking study, *Toxic Waste and Race in the United States*. The report found race to be the most significant predictor of where hazardous waste facilities were located in the United States. We review this and other studies of environmental racism in an effort to explain the relationship between race and the proximity to hazardous waste facilities. More recent research provides some evidence that the effect is causal, where polluting industries follow the path of least resistance. To date, the published work using Census data ends in 2000, which neglects the period when economic and political changes may have worsened the relationship between race and toxic exposure. Thus, we replicate findings using data from 2010 to show that racial disparities remain persistent in 2010. We conclude with a call for further research on how race and siting have changed during the 2010s.

■ **KEYWORDS:** environmental justice, race, racial and socioeconomic disparities, toxic waste

Environmental justice studies investigate the role of race, class, and other social attributes in the uneven distribution of environmental hazards. A major line of inquiry has been about the placement of toxic waste facilities and the demographic and socioeconomic composition of the surrounding areas (Been and Gupta 1997; Bullard et al. 2007; Mohai and Saha 2006, 2007, 2015a, 2015b; Oakes et al. 1996). These studies point to a range of effects of race on proximity, which vary based on the methods and data used. This has made it difficult to assess to what extent racial and socioeconomic disparities in the location of environmental hazards have changed over time and how race and class intersect in the context of siting (Downey and Hawkins 2008; Pulido 1996, 2000). This article reviews this accumulated literature that aims to clarify the relationships between the racial and class composition of areas where environmental hazards are located. We highlight the methodological challenges that emerge in these studies, giving particular focus to the issue of how to conceptualize and measure the appropriate geographical scale (e.g., zip code, tract, or block), and how to document changes over time in the relationship between race, class, and environmental hazards. Additionally, we consider questions of causal order, namely, are poor communities of color targeted for the siting of toxic waste facilities or do poor people of color concentrate near facilities because they have few other options?¹ Because prior research has only relied upon data up to 2000, we also include a descriptive study of the period between

2000 and 2010 in order to bring the research into the twenty-first century. Race continues to be associated with the location of hazardous waste sites in the United States. We also find that while poverty worsened nationally during the decade, host areas' increase in the percentage of people living below the poverty line was roughly parallel to the larger national trend. The story is somewhat different for other measures of economic change. Namely, income growth was much less in the host areas than in non-host areas of the country, and housing values in host areas decreased while elsewhere in the country experienced modest increases. These patterns, while largely consistent with prior research that uses a similar methodology, are both theoretically and politically significant because they highlight the intersectionality in which race and class oppression are manifested in the siting of hazardous waste facilities in the United States. We want to be clear that this research highlights one of the many environments of injustice that communities of color face in this country, namely, proximity to toxic waste facilities. We close with a consideration of possible next steps for research.

Origins and Early Studies

Although the precise origin of the environmental justice movement is difficult to pin down, a major protest staged in Warren County, North Carolina, in 1982 was certainly an important moment. The protest erupted over the dumping of 120 million pounds of soil contaminated with polychlorinated biphenyls (PCBs) in a landfill in a majority African American town. Several hundred protesters (many of them high-profile civil rights activists) were arrested, and the issue of environmental justice was thrust into the national spotlight and onto the political agenda. In the year following the Warren County protest, the US General Accounting Office (GAO) conducted a study in several Southern states of the Environmental Protection Agency's (EPA) Region 4.² In the first study of its kind, the GAO identified four licensed commercial hazardous waste facilities: Chemical Waste Management, Sumter County, Alabama; Industrial Chemical Company, Chester County, South Carolina; SCA Services, Sumter County, South Carolina; and the Warren County PCB landfill, North Carolina. Using 1980 census data, the GAO computed the Black percentage of the population, mean family income (all races and Black), and percentage of the population below the poverty line (all races and Black). These statistics were computed at several different geographic scales, including census areas within four miles of the site, city, county, and state. The GAO (1983) found that all four facilities were located in areas with high percentages of Black residents (ranging from 38% to 90%), and it also found high percentages of Black residents living below the poverty level in these areas (ranging from 90% to 100%). The study also found that the areas within which the sites were located possessed greater percentages of Blacks and Blacks living below the poverty level than the county that hosted the site, neighboring counties, and the state as a whole.

The GAO study focused on an individual region, and, while its findings were alarming, questions were raised about whether the patterns discovered in three Southern states were applicable to the nation as a whole. In 1987, the first national study, *Toxic Wastes and Race in the United States*, was published by the United Church of Christ (UCC) Commission for Racial Justice. The UCC research expanded the focus to the entire United States, relying on data compiled by the EPA under its Hazardous Waste Data Management System and verified by commercial hazardous waste directories. Through these methods, they identified 415 offsite commercial hazardous waste facilities as of May 1986. These are businesses that receive, treat, store, or dispose of toxic material and represent only a subset of the universe of sites containing hazardous waste. The census data that UCC relied upon in the study included a broad array of racial and

ethnic groups (not just African Americans) and a greater number of economic measures. The study also sharpened the geographic methods used in the GAO study, relying on census data aggregated at the zip-code level to make comparisons between zip codes with and without a commercial hazardous waste facility.

The UCC study found that race was the most significant factor in determining where commercial hazardous waste treatment, storage, and disposal facilities (TSDFs) were located in the United States. Specifically, the study found that zip codes with no TSDFs had 12.3% minority population, while zip codes with one TSDF had about 23.7%, and zip codes with more than one TSDF or with one of the five largest landfills in the United States had the highest proportion of people of color at 37.6% (Commission for Racial Justice 1987).

The study also examined the locations of “uncontrolled toxic waste sites” that included “a wide range of closed and abandoned sites which pose a present and potential threat to human health and the environment” (Commission for Racial Justice 1987: 3). Uncontrolled toxic waste sites included dumps, accidental spills, illegal discharges, or abandoned factories or warehouses where toxic materials remained. The findings showed that more than half of all Americans live in zip codes containing at least one uncontrolled toxic waste site, but that three out of five African Americans and Hispanic Americans lived in zip codes with at least one such site (1987: 13).

The UCC report exposed the systemic disregard for people of color in the United States regarding the persistent siting of toxic wastes in their neighborhoods. The report concluded that race was the primary predictor of where hazardous waste sites would be located in the United States, more powerful than household income, the value of homes, and the estimated amount of hazardous waste generated by industry (Commission for Racial Justice 1987).

In 1990, sociologist Robert Bullard published his now-classic book *Dumping in Dixie: Race, Class, and Environmental Quality*, which linked hazardous-facility-siting with historical patterns of segregation in the South. Bullard’s study also explored the social and psychological impacts of environmental racism on local populations and analyzed the response from local communities against environmental threats. Scholars have pointed to the GAO study, the UCC report, and Bullard’s book as the beginning of the modern environmental justice movement in the United States (Brulle and Pellow 2006; Szasz and Meuser 1997). As such, they established a link between research evidence and the emerging social movement to address institutionalized environmental racism (Brulle and Pellow 2006; Szasz and Meuser 1997).

Changing Scholarly and Policy Contexts in the 1990s and 2000s

In addition to the growing body of research, conferences such as the Urban Environment Conference in New Orleans in 1983 and the University of Michigan Conference on Race and the Incidence of Environmental Hazards in 1990 brought together researchers from around the nation who were studying racial and socioeconomic disparities in the distribution of environmental contaminants. These conferences were attended by several leading “activist-scholars” who, while working closely with community activists, came together to present and debate their findings and implications (Brulle and Pellow 2006; Mascarenhas 2015; Mohai and Bryant 1992). The proceedings of the conference were forwarded to the EPA, and at the request of its administrator, William Reilly, the agency established the Environmental Equity Workgroup to review this growing body of evidence. In 1992, the EPA published the findings and recommendations of the Environmental Equity Workgroup in a report entitled *Environmental Equity: Reducing Risks for All Communities*. The 130-page report concluded that racial minority and low-income

populations were disproportionately exposed to lead, selected air pollutants, hazardous waste facilities, contaminated fish tissue, and agricultural pesticides (EPA 1992).

The EPA's report lent considerable legitimacy to environmental justice activists' claims, and corroborated the evidence of the earlier reports by the General Accounting Office and the United Church of Christ. The report also signaled a major commitment by a branch of the federal government, which put forth a comprehensive set of policy proposals to address these issues identified in the report. It led to the creation of an Office of Environmental Justice in the EPA in 1992 as well as the National Environmental Justice Advisory Council (NEJAC). The date 30 September 2013 marked the twentieth anniversary of the NEJAC, which, through its 27-member committee,³ has continued to provide advice and recommendations in consultation, with relevant stakeholders and communities, about issues and policy related to environmental justice. This commitment also inspired legislation in the United States that identified hazardous waste sites—commonly known as “Superfund sites”—and established a protocol for remediation.

In February 1994, in an attempt to remedy environmental inequality and injustice nationally, President Bill Clinton established Executive Order 12898. The order required that each federal agency make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.

The order charged all federal agencies with integrating environmental justice concerns into their operations in a concerted effort to reverse the historical trends that have disproportionately affected minority and low-income populations (EPA 1995). Although the order gave legitimacy and visibility to environmental justice claims, its central prescriptions about the necessity of assessing and addressing the adverse environmental and health impacts of programs and policies on minority communities were not required by law. As a result, adoption of environmental justice practices in federal agencies has been fairly weak and subject to political cooption and industry capture (Faber 2008; Harrison 2016; Holifield 2015; Pellow 2018; Pulido 2017).

Two decades have passed since the executive order, yet its effect on environmental justice programs such as Superfund is still rather ambiguous (Arquette et al. 2002; Holifield 2004; Murphy-Greene and Leip 2002; O'Neil 2007; Sicotte 2009; Tesh 2001). The Superfund program was originally financed by a tax levied on the petroleum and chemical industries. However, this “polluter-pays” tax was allowed to expire in 1995, and the fund officially reached a zero balance by the end of 2003 (O'Neil 2007). Since its depletion, the Superfund program has relied on taxpayer dollars, in the form of annual appropriations, and the monies recovered by the EPA from successful liability settlements (Faber 2008).

Many policy, research, and advocacy groups also attribute the lack of further environmental justice milestones and reforms to the eight years of President George W. Bush's administration. For example, Bush's budget for the fiscal year 2002 slashed overall spending for environmental and natural resources agencies by \$2.3 billion, or 7.2%. This amounted to nearly a \$500 million reduction in the budget of the EPA (NRDC 2015).⁴ The US environmental justice movement was largely stalled for the eight years of President George W. Bush's administration. Moreover, a Supreme Court ruling (*Alexander v. Sandoval*)⁵ in 2001 reversed earlier court interpretations of Title VI of the Civil Rights Act of 1964, which had previously allowed private parties to use the federal courts to enforce violations of federal agency regulations that had a disparate impact on people of color, regardless of intent. The *Sandoval* decision implied that those disproportionately impacted by federal agency regulations now had to prove intent, effectively ending the EPA's ability to rely on Title VI for environmental justice (Core 2002).

Despite particular empirical and political challenges, the environmental justice movement has had a significant impact on the direction of environmental policy, research, and activism in

the United States and around the world. In particular, the emergence of a network of scholars, the tireless efforts of grassroots activists, and the formation of federal and state government agencies have provided a means by which research findings and environmental justice concepts were carried into policymaking. History has also taught us that those early gains, and progress in embedding environmental justice concepts into policy, more generally, has been slow. The enduring racialized environmental disparities have prompted many scholars in the field to claim that we need to rethink environmental justice (Checker 2005; Pellow 2016; Pulido 2000, 2017; Wilson Gilmore 2008). For example, Laura Pulido (2000, 2016) argues that we need to move past the notion of a few bad actors with an emphasis on events or cases. She argues that we should instead focus on the institutions and systems that structure environmental racism. Ruth Wilson Gilmore has echoed this observation, writing that siting of hazardous materials and destructive materials are “planned concentrations or sinks . . . whether state-sanctioned or extralegal . . . regardless of the intent of the harms produced” (2008: 35–36). In response, David Pellow and others have developed a critical environmental justice framework to further contextualize the problem of environmental racism (Mascarenhas 2020; Pellow 2016, 2020). Researchers and activists alike have responded accordingly, asking to what extent government (in)action has contributed to ongoing toxic exposure for communities of color in the following decade and century. This concern about whether disparities improved, worsened, or stayed the same engendered the next generation of environmental justice studies, which asked deeper methodological and political questions about the persistent toxic inequality between White and non-White communities.

Measurement and Methodological Debate

During the 1990s, documenting the existence of the “disproportionate impact” on people of color and poor populations of environmental hazards became hotly contested. The key debate revolved around this central question: “What is the best geographic method of analysis to determine who is most at risk from hazardous sites”? The groundbreaking studies by the United Church of Christ and the General Accounting Office both used the “unit-hazard coincidence”⁶ method in determining that race was the most significant factor in determining where licensed commercial hazardous waste facilities and uncontrolled toxic waste sites were located in the United States. Using census areas and zip codes, these studies compared the racial and socioeconomic characteristics of people living in “host” tracts with those of non-host census tracts. However, the use of the unit-hazard-coincidence method for conducting environmental justice analyses has been the subject of much debate and criticism.

Douglas Anderton and colleagues (1994a, 1994b) led a series of studies arguing that the findings of the UCC and GAO studies were an artifact of geographic scale and not environmental racism. Instead of using zip codes, which the authors deemed too large to identify local inequities, Anderton and colleagues (1994a) compared census tracts with TSDFs to tracts without, and concluded that the “evidence of racial and ethnic inequity in location of hazardous waste facilities is almost nonexistent” (1994a: 242). Given that the smaller census tract “found no nationally consistent and statistically significant evidence of racial or ethnic bias” (Oakes et al. 1996: 128) in the location of commercial TSDFs, Anderson and colleagues (1994a) concluded that previous studies using zip codes areas overaggregated their cross-sectional findings.⁷ Contrary to previous research, Anderton and colleagues (1994a, 1994b) concluded that the most significant and consistent difference regarding the distribution of facilities across social groups amounted to labor force indicators.⁸ Specifically, they found that both the mean and the median

percentages of the population employed in precision manufacturing occupations were substantially greater in tracts containing TSDFs than in other tracts. In effect, they asserted that class, specifically income and occupation, and not race, was the most consequential predictive variable of where a TSDF would be located for both the nation as a whole and in 9 of the 10 EPA regions (Anderton et al. 1994a).

Questions of appropriate scale or geographic unit, exemplified in the work of Anderton and colleagues (1994a, 1994b), have produced conflicting findings and prolonged the uncertainty to which the existence and extent of environmental disparity can be assessed to be a function of race, class, or both.⁹ The work of Anderton and colleagues has come under much criticism by environmental justice scholars. For example, the former did not consider rural areas in their analyses, but the UCC study did. Moreover, Anderton and colleagues (1994a, 1994b) excluded metropolitan areas not already containing a TSDF, whereas the UCC study included all metropolitan areas in their study (Been 1995; Mohai 1995). In a subsequent empirical analysis, Paul Mohai (2008) found that Anderton and colleagues's principal indicator of industrial activity, percentage of people employed in manufacturing, was found to be statistically insignificant between metropolitan areas containing a hazardous waste facility and those areas that did not. Previous national and regional studies did not account for the exact geographic location of hazardous waste facilities but rather compared the demographic characteristics of host geographic units, such as census tracts (the 1983 GAO and the 1987 UCC Reports) or zip codes (Anderton et al. 1994a, 1994b), with the characteristics of non-host units. This method was termed the "unit-hazard coincidence" method because the geographic unit used was coincident with where the facility was located (Bullard et al. 2007; Mohai and Saha 2015a, 2015b).

In an effort to match exposure and hazardous locations more precisely, Paul Mohai and Robin Saha (2006, 2007) turned to the distance-based method. Zip codes and census tracts, they argued, were simply too crude a measure to analyze exposure and hazardous locations. First, the unit-hazard-coincidence method only included people living within the host unit. However, given a facility's location, people living in adjacent areas may be equally impacted but not counted with this method. This was particularly true for clustered and single facilities that were located at or near the boundary of a host unit. For example, Mohai and Saha (2006, 2007) in their distance-based studies found that 49% of the nation's hazardous waste TSDFs were located within .25 miles of the boundary of their host census tracts, while 71% were located within half a mile of their census tract boundary. Moreover, the opposite may be true where people were counted in a given host unit but lived a far distance from the facility and were therefore not impacted by its location. This scenario may be particularly relevant in the case where facilities were located in larger census tracts. In effect, in the former example the unit-hazard-coincidence method undercounts people impacted by a hazardous waste facility, and in the latter example it exaggerates facility impact.

Instead of determining whether a particular geographic unit and hazardous waste site were coincident, Mohai and Saha (2006) identified the exact locations of hazardous waste facilities and then classified all geographic units—not just the host unit—within a specified distance from the hazardous facility as a *host neighborhood*. Racial and socioeconomic characteristics of people living in host neighborhoods were then compared to non-host census tracts. A host neighborhood was identified as having one or more facilities within a three-kilometer radius. This radius, approximately 1.8 miles, is a particularly noteworthy boundary marker, as it corresponds to the distance within which empirical studies have noted adverse health, property value, and quality-of-life impacts associated with living next to a hazardous waste site or waste facility (Baibergenova et al. 2003; Bullard et al. 2007; Dolk et al. 1998; Fielder et al. 2000; Vrijheid 2000).

Figure 1

In their national-level reassessment, Mohai and Saha (2006, 2007) applied a 50% areal containment method to examine the racial and socioeconomic disparities in the distribution of the nation's hazardous waste. Any census tract in which at least 50% of its area was within three kilometers of the facility was considered to be part of the host neighborhood. The result produced circular buffers around each facility. Figure 1 provides two illustrations of neighborhoods around a hazardous waste facility that are at one, three, and five kilometers away from the facility. Mohai and Saha (2006, 2007) used the 1990 digitized census areas (tracts and block groups) and zip code areas to analyze the demographic characteristics around the nation's TSDFs. They found that the distance-based method was a more accurate representation of where people and environmental hazardous sites are located. In particular, using distance-based measures Mohai and Saha (2007) found that, although non-Whites comprised about 25% of the US population, the percentage of non-Whites living within one mile of a hazardous facility was 40% in 1990. Moreover, the difference between the proportion of non-Whites in host and non-host areas was over 20

percentage points when the distance-based method was applied, compared to the modest 1 to 3 percentage-point differences found when the unit-hazard-coincidence method was applied.

This more accurate method effectively indicated that racial disparities around hazardous waste sites were even greater than previously reported in the 1983 GAO and 1987 UCC studies. And it intimated the degree to which a lack of understanding regarding the unequal distribution of environmental burdens by academic researchers and government agencies alike had prejudiced the first two decades of the environmental justice movement in the United States.

In 2007, Robert Bullard and colleagues (2007) published *Toxic Wastes and Race at Twenty 1987–2007* to mark the twentieth anniversary of the environmental justice movement in the United States. In an effort to provide some longitudinal data to these long-standing debates, the 2007 report used updated information on hazardous waste facility locations, the 50% areal apportionment method, and demographic data from the 2000 census to perform a national-level reassessment of where facilities and people were located. This research was the first national-level environmental justice study to conduct longitudinal analyses using the distance-based method. Again, this report found that the poor and people of color were more heavily concentrated around the nation's TSDFs than what previous studies had identified, including the 1983 GAO and 1987 UCC reports. In fact, the 2007 report found that in 2000 people of color made up the majority (56%) of those living within three kilometers of where hazardous waste facilities were located, despite being only 30% of the national population. And where two or more facilities were clustered together, people of color made up 69% of those living in host neighborhoods (Bullard et al. 2007). The report concluded that “significant racial and socioeconomic dispari-

ties *persist* in the distribution of the nation's commercial hazardous waste facilities" (2007: xi). Another key finding of their report was that "race continues to be an independent predictor of where hazardous wastes are located," stronger "than income, education, and other socioeconomic indicators" (2007: xi).

In addition to the race versus class debate, the question of who came first, poor communities and communities of color or toxic industry, has been the cause of much misunderstanding in environmental justice communities surrounding the root causes of the issue. In 2015, Mohai and Saha put this debate to rest. Using a national database of commercial hazardous waste facilities sited from 1966 to 1996, they conducted a longitudinal analysis using the distance-based method and concluded that "neighborhood transition serves to attract noxious facilities rather than the facilities themselves attracting people of color and low income populations" (2015b: 1). In other words, "contrary to the post-siting demographic change hypothesis . . . the demographic changes appear to 'attract' the facilities rather than the facilities attract minorities" (2015b: 7). In other words, industry has targeted poor communities and communities of color when choosing where to locate its toxic waste sites (Mohai and Saha 2015a, 2015b; Pastor et al. 2001).

Bringing the Discussion into the Twenty-First Century

Given the availability of 2010 census data, we can now provide an assessment of how trends and patterns observed in prior research look after the first decade of the twenty-first century. To do so, we repeat the distance-based methodology of Bullard and colleagues (2007) and Mohai and Saha (2007, 2016a, 2015b) using the 2011 National Biennial RCRA Hazardous Waste Report (EPA 2012). The EPA biennially collects information regarding the generation, management, and final disposition of hazardous wastes regulated under the Resource Conservation and Recovery Act (RCRA) of 1976. RCRA hazardous waste management information is obtained from the data reported by facilities that treat, store, or dispose of RCRA hazardous waste.¹⁰ Only facilities in operation for the purpose of making a profit from waste management are included in the list. Hazardous waste that is stored, bulked, and/or transferred offsite with no prior treatment/recovery, fuel blending, or disposal at the site are excluded from the management quantities reported (EPA 2012). Both the 2001 and 2011 National Biennial Reports include management and receipt data from both permitted treatment, storage, and disposal facilities and generators that are not required to be permitted (e.g., those that recycle solvent hazardous waste generated onsite) (EPA 2003).

In all, 563 sites were identified in the 2001 RCRA report and 456 facilities were identified in the 2011 RCRA Report. These sites represented all the commercial hazardous waste facilities operating in the United States in 2000 and 2010, respectively, with the exception of Puerto Rico and Guam.¹¹ We mapped facility locations using their latitude and longitude data. The census tract geographies¹² (2000 and 2010 sets) came from the US Census website.¹³ Both the site and tract geographic data were loaded into a PostgreSQL database with the PostGIS extension. They were analyzed and processed using a GeoDjango application. Google Maps was used only for visualization purposes.¹⁴

Combining the 2000 and 2010 census data with the 2001 and 2011 Biennial RCRA reports makes it possible to determine the racial and socioeconomic characteristics for host and non-host areas at the same time the facilities were known to be in operation. For the year 2000, the 2000 long-form census data was used. However, for the year 2010 the census abandoned

the long form and created the American Community Survey. For this, we used the 2010 American Community Survey's five-year estimate. The total population; the number of respondents identifying as non-Hispanic or Latino White only; and the number of respondents identifying as Black or African American, American Indian or Alaskan Native, Asian, or Native Hawaiian or Pacific Islander were calculated for each individual census tract and then summed across each geographical unit first and then divided by the appropriate summed denominator. For example, for the percentage of people of color, the numbers of non-Whites were summed across every tract in a given state and then that sum was divided by the sum of the populations for every tract in that state. The numbers in Table 1 are the averages for the four categories analyzed made up of the two years (2000, 2010) and the host versus non-host neighborhoods.

Table 1 provides a detailed breakdown of the demographics of host versus non-host census tracts across different years. The 2000 and 2010 statistics reflect our original data collection

Table 1. Racial and Socioeconomic Disparities between Host Neighborhoods and Non-Host Areas (2000 and 2010 census data does not include Alaska, Washington DC, Idaho, Montana, and Wyoming).

	2000				2010			
	Host	Non-Host	Diff.	Ratio	Host	Non-Host	Diff.	Ratio
Population								
Total Population (1000s)	10,792	266,741	-255,949	0.04	8,101	291,542	-283,441	0.03
Population Density	1,287	43	1,244	30	1,287	43	1,244	30
Race/Ethnicity								
% People of Color	41.00%	24.00%	17.00%	1.71	44.90%	28.30%	16.60%	1.59
% African American	21.10%	10.32%	10.78%	2.04	21.00%	10.83%	10.17%	1.94
% Hispanic or Latino	13.02%	7.78%	5.24%	1.67	15.99%	10.27%	5.72%	1.56
% Asian	3.72%	2.98%	0.74%	1.25	4.92%	3.74%	1.18%	1.32
% Pacific Islander	0.33%	0.28%	0.05%	1.18	0.29%	0.31%	-0.02%	0.94
% Native American	0.91%	1.28%	-0.37%	0.71	0.92%	1.23%	-0.31%	0.75
Socioeconomics								
Poverty Rate	17.80%	11.80%	6.00%	1.51	20.10%	13.30%	6.80%	1.51
Mean Household Income ¹	\$37,031	\$42,628	(\$5,597)	0.87	\$56,238	\$68,564	(\$12,326)	0.82
Mean Housing Value	\$10,2825	\$115,503	(\$12,678)	0.89	\$95,578	\$13,3586	(\$38,008)	0.72
% of 25+ Year Olds with 4-Yr College Degree	28.60%	30.30%	-1.70%	0.94	32.20%	35.10%	-2.90%	0.92

Data taken from Bullard et al. (2007)

Bullard and colleagues report combined % Asian and % Pacific Islander in one category (% Asian/Pac. Is.).

¹The home value is estimated by the respondent. It appears that the value is not inflation-adjusted in its aggregate form, which is what we used. We calculated the mean by summing the aggregate values and dividing by the sums of the count of respondents/homeowners for that question. Additional information about data definition for the 2010 American Community Survey we used can be found here: https://www2.census.gov/programs-surveys/acs/tech_docs/subject_definitions/2010_ACSSubjectDefinitions.pdf#value.

and analysis. Host tracts are consistently home to double-digit higher percentages of people of color, especially higher percentages of African Americans and Latinos. Host tracts also have consistently higher percentages of people living under the poverty line and with lower mean household income and a lower mean home value.

More than 8 million people (8,101,414) lived in census tracts that had at least 50% of their area fall within at least three kilometers (1.8 miles) of the nation's 456 commercial hazardous waste facilities in 2010. In 2000, there were 563 sites and 10 million people who lived in tracts falling within a three-kilometer radius. In 2010, 44.9% of the host area population was made up of people of color as compared to the non-host area population, 28.3% of which was made up of people of color. These figures are slightly higher than those of 2000, when 41% of the host area population was made up of people of color and 24% of the non-host area population was made up of people of color. Although the percentage of people of color in host areas increased by four percentage points, the percentage of people of color in non-host areas also increased by four percentage points, which suggests that the change was due to a common trend affecting the American population more generally. The increases in the percentage of people of color in both host and non-host areas appear mostly due to growth in the Latinx population occurring between 2000 and 2010. Latinx people were 13% of the host areas in 2000 and 16% in 2010. The percentage of Asians in the host areas was 3.7 in 2000 and 4.9 in 2010. However, both of these groups also experienced growth in non-host areas between the two years. African Americans remain the largest share of the percent people of color living in host areas, but that has remained stable across both years.

Table 1 also reveals significant socioeconomic disparities over time. In 2000, the percentage of people below the poverty line in host tracts was 17.8% and in non-host tracts it was 11.8%. In 2010, the percentage of people below the poverty line in host tracts rose to 20.1% percent, an increase of 2.3 percentage points. However, the percentage of people below the poverty line also increased in non-host tracts, from 11.8% to 13.3%, an increase of 1.5 percentage points. Thus, it appears that there was an increase in the percentage of people below the poverty line in host areas in 2010 and that most of that increase was due to an increase in the poverty rate in both host and non-host areas.

The story is a bit different for the other two measures of poverty: mean household income and mean owner-occupied housing value. Both in 2000 and in 2010, household income and home values were substantially lower in host tracts than in non-host tracts, which may have been due to the differential impacts of the 2008 recession on poor communities. Household income grew in both host and non-host tracts, although the amount of growth was greater in non-host tracts (\$12,326) than it has in host tracts (\$5,597). Mean owner-occupied housing value in non-host tracts increased from \$115,503 to \$133,586, whereas in host areas the housing values actually decreased from \$102,825 to \$95,578 (see Table 1). Thus, unlike the poverty measure, both the income and housing value measures show that the gaps between host areas and non-host areas worsened over the decade.

EPA Regional Disparities

Table 2 shows that racial disparities for people of color as a whole continue to exist in all 10 EPA regions. In 2000, disparities in people of color percentages between host and non-host areas were greatest in Region 5 (45% vs. 19%), Region 9 (76% vs. 49%), Region 6 (66% vs. 42%), and Region 4 (52% vs. 30%) (see Figure 2). In 2010, Region 9 became the EPA Region where the percent-

Table 2. People of Color Percentages for Host Neighborhoods and Non-Host Areas by EPA Region (2000 and 2010 Census)

Regions	2000			2010		
	Host	Non-Host	Ratio	Host	Non-Host	Ratio
Region 1	33%	16%	2.02	26%	21%	1.23
Region 2	50%	36%	1.39	51%	40%	1.28
Region 3	32%	23%	1.39	43%	28%	1.55
Region 4	52%	30%	1.72	53%	35%	1.52
Region 5	45%	19%	2.45	50%	22%	2.32
Region 6	66%	42%	1.58	70%	47%	1.48
Region 7	27%	14%	1.95	32%	17%	1.89
Region 8	26%	19%	1.32	38%	23%	1.67
Region 9	76%	49%	1.55	85%	54%	1.58
Region 10	29%	26%	1.10	42%	30%	1.40

age of people of color between host and non-host areas was most significant (85% vs. 54%). Regions 9, 5, 6, and 4 remained national hotspots, with all regions increasing the percentage people of color between host and non-host areas over the decade: Region 9 (76% vs. 85%), Region 5 (45% vs. 50%), Region 6 (67% vs. 70%), and Region 4 (52% vs. 53%). Moreover, racial disparities in the location of the nation's commercial hazardous waste facilities numerically increased in all EPA regions over the decade. This increase is geographically unequal, with the Mid-West, Southern and Southwestern states disproportionately burdened. California and Nevada (the principal states of Region 9) represent a particularly significant hotspot, where 85 of every 100 US residents living within three kilometers of one or more of the states' 47 (California has 41 and Arizona 6 facilities) commercial hazardous waste facilities are persons of color.

Geographically widespread numerical socioeconomic disparities are evident in 2010 (see Table 3). Regions 5, 9, 6, and 4, the national hotspots, have on average poverty rates between 20% to 23% in host neighborhoods. Differences in poverty rates between host neighborhoods and non-host areas are numerically greatest for Region 8 (23% vs. 12%), Region 5 (23% vs. 13%), Region 3 (19% vs. 11%), Region 7 (20% vs. 13%), and Region 9 (20% vs. 13%). Moreover, disproportionately low mean household incomes and housing values are found in all 10 EPA regions in 2010.

Figure 2

Table 3. Socioeconomic Disparities between Host Neighborhoods and Non-Host Areas by EPA Region in 2010

EPA Region	Poverty Rates			Mean Household Income			Mean Household Value		
	Host	Non-Host	Diff.	Ratio	Host	Non-Host	Diff.	Host	Non-Host
Region 1	15%	10%	4%	1.41	\$61,641	\$83,891	\$22,250	\$15,6645	\$229,508
Region 2	17%	12%	4%	1.33	\$63,041	\$85,099	\$22,058	\$178,963	\$235,887
Region 3	19%	11%	8%	1.75	\$57,206	\$75,612	\$18,405	\$94,145	\$147,846
Region 4	22%	16%	6%	1.39	\$53,888	\$62,347	\$8,459	\$77,686	\$103,861
Region 5	23%	13%	10%	1.80	\$60,080	\$67,526	\$7,446	\$104,912	\$113,236
Region 6	22%	17%	5%	1.29	\$55,084	\$64,877	\$9,793	\$55,313	\$82,064
Region 7	20%	13%	8%	1.59	\$50,524	\$62,651	\$12,126	\$69,259	\$83,889
Region 8	23%	12%	12%	2.00	\$50,497	\$72,226	\$21,729	\$91,906	\$141,734
Region 9	20%	13%	7%	1.50	\$64,002	\$81,089	\$17,087	\$228,759	\$249,193
Region 10	14%	12%	2%	1.14	\$63,685	\$ 72069	\$8,384	\$135,392	\$185,666

State Disparities

Table 4 identifies the states with the 10 largest differences in people of color percentages between host neighborhoods and non-host areas in 2010. Illinois and Georgia, while not on the top 10 list, have similar differences between host neighborhoods and non-host areas as Ohio (26%). Similar to the Bullard and colleagues report (2007), the states are shown in order (left to right) by the percentages of people of color living in the host neighborhoods relative to the percentages of people living in non-host areas. For example, in Mississippi 97% of residents of host areas were people of color, as compared with 41% of non-host areas. Other states that had high levels of disparities included Arkansas (74% of host tracts were people of color vs. 25% on non-host tracts), Michigan (64% vs. 22%), Nevada (78% vs. 44%), Kansas (55% vs. 21%), Arizona (70% vs. 41%), Tennessee (53% vs. 24%), California (86% vs. 57%), Virginia (62% vs. 34%), and Ohio (44% vs. 18%). Only the District of Columbia, Idaho, Montana, and Wyoming did not have licensed and operating commercial hazardous waste facilities in 2010.¹⁵ In 21 of the remain-

Table 4. States with the 10 largest Differences in People of Color Percentages between Host Neighborhoods and Non-Host Areas

State	Host	Non-Host	Diff.	Ratio
Mississippi	97%	41%	56%	2.36
California	86%	57%	29%	1.51
Nevada	78%	44%	35%	1.79
Arkansas	74%	25%	49%	2.98
Arizona	70%	41%	29%	1.72
Michigan	64%	22%	42%	2.92
Virginia	62%	34%	28%	1.82
Kansas	55%	21%	34%	2.67
Tennessee	53%	24%	29%	2.23
Ohio	44%	18%	26%	2.48

ing 46 states with commercial hazardous waste facilities, the overwhelming majority (50% or greater) of people living in host neighborhoods were people of color. In the state of Mississippi, the percentage of people of color as a whole is 2.4 times greater in host neighborhoods than in non-host areas. In the Arkansas, Kansas, and Michigan, the percentage of people of color was three times greater in host neighborhoods than in non-host areas. Additionally, numerous other states had numerically large disparities in people of color percentages in 2010 but did not make up the majority of those living less than three kilometers from one or more commercial hazardous waste facilities.

Rethinking Toxic Exposure

It has now been more than three decades since *Toxic Waste and Race* was published in 1987. Since then, advances in research and a sustained and tenacious grassroots organizing and community-based advocacy have impelled the notion that not all communities are treated equally into the public consciousness. This particular conjuncture of research and activism moves beyond the anecdote to provide evidence of the impact of institutionalized racism in the arena of environmental policy. The 2007 follow-up study, *Toxic Waste and Race at Twenty* (using 2000 census data and the distance-based method) found that racial disparities were even greater than previously reported (Bullard et al. 2007, 2008; Mohai and Saha 2007). Recent research has moved beyond mere association to begin to unpack causal relationships between race and siting. This deeper understanding is reflected in recent longitudinal work that seeks to determine whether it is the demographic characteristics of a community that make it “the target” for a hazardous waste site or whether the demographic characteristics change once a facility has been sited. The findings suggest that the former is more often the case than the latter (Mohai and Saha 2015b).

This research moves beyond purely associational approaches and finds that over time polluting industries still follow the path of least resistance, choosing to locate where land, labor, and lives are deemed to be cheaper and expendable (Mohai and Saha 2015a, 2015b; Pellow 2016, 2018; Pulido 2017).

Using the 2010 census data and the distanced-based method, our research builds on previous innovations in environmental justice methodology. We found that although the percentage of people of color and percentage of people in poverty increased in host tracts during the first decade of the twenty-first century, comparable increases also occurred in non-host tracts. This finding is reflective of national demographic and poverty trends during the decade. The implication is that, while the racial disparities did not worsen during the Bush years, they certainly did not improve either. In particular, we found that host tracts lagged behind non-host tracts in economic measures, as both household income and home values in host tracts did not increase at the same rate as non-host tracts. With respect to these measures, it appears that host tracts lost ground to non-host tracts in terms of wealth between 2000 and 2010. Moreover, we found that some states and regions have particularly pronounced racial disparities.

Our findings also elucidate the theoretical and policy limitations of framing hazardous waste sites as a function of racial inequalities or socioeconomic position, a controversy that has come to be known as the “race versus class debate.” Race continues to be an independent predictor of the location of the nation’s hazardous waste sites. This correlation between race and toxic waste, first documented in the 1980s, continues today. This fact is also particularly true for people of color who live in the toxic waste “hotspots” of the Mid-West, Southern, and Southwestern states. Our analysis also illustrates that, while the number of people of color in the United States has increased overall during the decade, the difference in the percentage of people of color that live in host neighborhoods versus non-host areas has remained the same from the 2000 to the 2010 census data. However, of those people of color that live in neighborhoods with one or more hazardous waste facilities, both their mean annual household incomes and owner-occupied housing values have significantly decreased in host neighborhoods versus non-host areas from 2000 to 2010. As a result, people of color living in host neighborhoods are poorer today than they were a decade ago, revealing the fact that this form of injustice disproportionately burdens low-income communities of color.

This longitudinal analysis, then, highlights how the intersection between race and class oppression are manifested in the siting of hazardous waste facilities in the United States. In effect, we argue that these structural forms of inequality are not additive or divisible in some sort of comparable way but rather intersecting to constantly reproduce a racial formation that discriminates on the basis of race and class (Omi and Winant 2015). This is both theoretically and politically significant, since both racial and ethnic groups continue to increase at higher rates than the White population, while the wealth gap between rich and poor continues to widen, indicating that the United States will remain a highly segregated and unevenly exposed society. However, Black Lives Matter and the Poor People’s Revival Campaign have given heightened visibility to how governmental institutions reinforce and sometimes worsen class and racial inequality. As a collateral consequence of the efforts of these movements, the environmental justice movement may gain traction in ways that it has not previously.

Environmental racism in the United States, as measured by the proximity of commercial hazardous waste facilities and other environmental pollutants, continues to increase in spite of decades of environmental justice policy by both state and federal agencies, sustained activism, and a growing public awareness of the problem. In effect, this longitudinal analysis impels us to think more critically about governments’ role in the making and remaking of environmental racism in the United States. For example, the deregulation of the financial sector in the United

States and elsewhere, which ultimately led to the sub-prime mortgage crisis in the United States and the recession of 2008, disproportionately impacted urban poor and people of color, many of whom lost their homes and/or savings as a result of the predatory lending schemes of the financial elite. More recently, the tragedy that unfolded in Flint, Michigan, where residents in the majority-Black city were knowingly poisoned by the decisions of state elected officials underscores the extent to which people of color are harmed at the hand of their government. Similarly, the combination of funding cuts to environmental agencies and the rolling back of environmental protections, particularly under the Bush presidency, and again under Trump, harms all people, but particularly BIPOC communities and the poor. On top of this, the Trump administration's failed attempt to add a citizenship question to the 2020 census, combined with the COVID-19 pandemic, have made it less likely that all poor and people of color will be counted in the 2020 census. If this is the case, then data on the demographic characteristics of communities near toxic waste facilities might become less accurate than in prior census years. These governmental decisions have the potential to further erode the linkage between evidence of racial and economic disparities in siting and the activism that serves as an important hallmark of the environmental justice movement.

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■ NOTES

1. This study builds on the work of Tessum and colleagues (2019) that highlights the relationship between consumption and racial-ethnic disparity.
2. The EPA's Region 4 consists of Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee.

3. The membership comprises representation from academia, community groups, industry/business, nongovernmental organizations / environmental organizations, state/local governments, and tribal governments/Indigenous groups, in addition to one Designated Federal Officer (DFO).
4. Specific cuts included nearly \$500 million from the EPA, nearly \$400 million from the Department of Interior, and nearly \$500 million from the US Forest Service. In addition to this \$2.3 billion reduction, the budget would cut about \$450 million from the Department of Energy, concentrating reductions in clean energy programs and environmental cleanup programs (NRDC 2015).
5. 532 U.S. 275 (2001). See also Core (2002).
6. The unit-hazard-coincidence method involves compiling the demographic characteristics of the geographic units (e.g., zip codes, census tracts, counties) that host toxic facilities as compared with units that do not host facilities. The method is premised on the idea that geographic units defined in the census are useful ways of gauging risk for the adverse health effects of toxic facilities.
7. Anderton and colleagues (1994a) focus on private commercial hazardous waste treatment, storage, and disposal facilities identified by Environmental Information, Ltd. (1992).
8. However, the 1994a Anderton et al. study also concluded that “TSDFs are more likely to be found in tracts with Hispanic groups, primarily in regions with the greatest percentage of Hispanics” (1994a: 229).
9. This controversy has come to be known as the “race versus class debate” (see Been 1995; and Mohai 1995, 2008).
10. We should acknowledge that previous research by Bullard and colleagues (2007) and Mohai and Saha (2006, 2007, 2015b) supplement the RCRA National Biennial Reports with data from the RCRIS, Envirofacts, and EDS directories. The Bullard and colleagues study directly contacted facilities to provide further verification. Thus, the sites in our analysis, while identified using a consistent source across 2001 and 2011, are not directly comparable to the previous work.
11. State-by-state data was retrieved from <http://www.epa.gov/enviro/br-search>. “Management Location” was set to “All,” “Waste Origin” was set to “Wastes received from offsite.” Data was downloaded by state, as a national dataset could not be downloaded from the interface.
12. We use tracts to be comparable with prior research using the distance-based method. For future research, it is worth pursuing use of census blocks to derive even more precise measures of host-area composition. However, with 11 million census blocks the creation of the demographic and economic measures becomes significantly more demanding to compute.
13. The US Census Bureau abandoned the long form and created the American Community Survey in 2010.
14. Clustered facilities also presented a methodological challenge. To identify clustered facilities, we started with the three-kilometer cluster previously analyzed in the Bullard and colleagues report (2007). Then, we used the GeoDjango’s *distance lte* filter to determine whether any other points were within twice the radius (six kilometers) of both the original facility and any other facilities found to be nearby. The polygons for each distance level were created for all the points in a cluster. We then created a multi-polygon from the union of the polygons for each distance. Figure 4 shows a cluster of hazardous waste sites in Los Angeles and the one-, three-, and five-kilometer boundary multi-polygons. As explained above, the 50% areal containment method was applied for these joined polygons. This means that, for example, an intersecting census tract that passes through the one-kilometer boundary polygons for two hazardous waste sites and that has at least 50% of its area between the two boundaries would be included in the one-kilometer cohort.
15. Hawai‘i was also not included in this calculation.

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