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DEMOGRAPHICS OF DUMPING II: A NATIONAL ENVIRONMENTAL EQUITY SURVEY AND THE DISTRIBUTION OF HAZARDOUS MATERIALS HANDLERS*

PAMELA DAVIDSON AND DOUGLAS L. ANDERTON

Using a national survey of facilities governed by the Resource Conservation and Recovery Act (RCRA), we examine the socio-spatial distribution of a much larger group of hazardous materials handlers than did previous environmental equity studies. Overall we find that RCRA-governed facilities are more likely to be sited in working-class neighborhoods with lower percentages of minority residents. We do not find evidence of stark environmental inequities. RCRA facilities, however, are close to neighborhoods with a higher percentage of minority residents. And in nonmetropolitan areas, they are slightly more likely to be located in neighborhoods with a higher percentage of black residents.

In a previous article in *Demography*, Anderton et al. (1994) presented evidence challenging the claim that facilities for the treatment, storage, and disposal of hazardous waste (TSDFs) are sited disproportionately in minority areas. We revisit this issue and extend the national analysis of environmental equity to a much broader range of hazardous materials handlers governed by the Resource Conservation and Recovery Act (RCRA). As in Anderton et al., we find little evidence supporting broad patterns of “environmental racism” in the location of these facilities.¹

Despite more than two decades of research, environmental justice studies generally have been limited to a small number of potentially sensitive, active TSDFs or abandoned industrial “Superfund” candidate (CERCLA/NPL) sites (for a review, see Hamilton and Viscusi 1999). Further, much of this research is based on case studies and has produced

mixed results (for a review see Krieg 1998; Szasz and Meuser 1997). Because of their focus on problematic cases and their limited generalizability (Pebbley 1998), case studies have been unable to answer distributional questions about broad patterns of equity. Regional and national studies on environmental equity provide a context for such case studies.

The first national studies of hazardous waste sites (GAO 1983; UCC 1987) found evidence of inequity. These results, however, were challenged by subsequent research that controlled for confounding urban-rural differences in minority residence and used more refined geographic areas (Anderton 1996; Anderton, Oakes, and Egan 1997; Cutter, Holm, and Clark 1996). Other studies that later revisited the issue produced mixed findings (GAO 1995a, 1995b; Goldman and Fitton 1994).

Studies of environmental equity also have focused on highly visible commercial handlers of hazardous waste and often notorious “Superfund” sites. Although this focus is understandable, it has obvious limitations. The commercial TSDFs studied handle less than 5% of all hazardous waste generated in the United States, and prescriptive policy options regarding abandoned CERCLA/NPL sites, whose hazards are the product of past industrial activities, are clearly limited. While emphasizing these sites, environmental justice researchers generally have neglected the much larger group of facilities that generate and handle the bulk of federally regulated hazardous materials. This larger group of industries (e.g., chemical plants, pulp mills, military facilities, hospitals, and recycling centers) is governed by RCRA (for a review of the regulatory history of RCRA, see Davis 1993).

Using data from the first national environmental equity survey of RCRA-governed facilities linked to 1990 census tract data, we provide an analysis of the distribution of RCRA sites across socioeconomic segments of the population.² The present analysis does not address health risks, potentially discriminatory motivations by decision makers, longitudinal processes of community change, or volume of site activity. Instead we specifically address the national evidence for equity in the current demographic distribution of RCRA facilities.

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1. Following the EPA’s Office of Environmental Justice, *environmental justice* refers to “fair treatment,” where “no group of people, including racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations” (EPA 1998).

2. The RCRA list has been used in the environmental justice literature (e.g., Bowman and Crews-Meyer 1997), but the distribution of RCRA facilities across the United States population has not been examined, nor has an environmental justice survey of RCRA facilities been analyzed.

DATA, METHODS, AND VARIABLES

RCRA facilities include all of those that handle solid wastes that may “cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; ...[or] pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, or transported, or disposed of, or otherwise managed” (RCRA Section 1004[5]). Some specific hazardous materials are excluded because they receive regulatory coverage elsewhere (e.g., the Toxic Substances Control Act, the Clean Air Act, and the Federal Insecticide, Fungicide, and Rodenticide Act) or by statute (e.g., wastes that can be recycled as a fuel source).

For a study of RCRA facilities, we compiled data from three sources. First, we obtained basic data on RCRA facilities that the EPA makes publicly available in the RCRA National Notifier list.³ Our analysis draws on the EPA National RCRA Notifier list dated July 16, 1992, which included 3,857 facilities located in the continental United States, Hawaii, and Alaska.

Second, we conducted a telephone survey of RCRA facilities to validate EPA data and to obtain more detailed information including specific types of processes on the site (e.g., incineration or recycling), the year when the facility began operations, whether the facility was ever a landfill, ownership type (e.g., public facility, college), and the proportion of hazardous waste generated off-site. We conducted the survey in March 1996. Of the 3,857 listed facilities, we found evidence of continuing activity at 2,693; 85.4% (2,299) of these responded to the survey.

Finally, to characterize community demographics, we used 1990 tract-level census data. We extracted this database from STF (Summary Standard Tape File) 3A; it includes more than 200 social and demographic variables for 61,258 tracts. Through geocoded site location we linked RCRA facility data to the 1990 census tract-level database for an analysis of community demographics near RCRA facilities.⁴

To examine minority community composition, our analysis uses the percentages of blacks, Hispanics, and foreign-born persons in census tracts with and without RCRA facilities. The percentage of families below the poverty line, the percentage of males in the labor force, and median household income provide measures of neighborhoods' economic or class characteristics. In line with previous environmental equity research, the percentage of persons age 18 and older

without a high school diploma (or equivalent) and the percentage of persons with at least one year of college education are included as proxies for community political empowerment. The percentage of the population employed in manufacturing and industrial enterprises is an indicator for the industrial nature of tracts. Also, we included the average value of owner-occupied housing as a proxy for land values relevant to the decision-making process (e.g., by influencing costs) in siting a new facility.⁵

In our initial analysis of environmental equity in the distribution of RCRA-governed hazardous waste facilities, we compare tracts containing at least one RCRA facility to tracts without an RCRA facility. Also, to provide some control for spurious effects of urban-rural residential differences in minority residence (Anderton et al. 1994, 1997), we compare tracts with RCRA facilities to tracts that have no such facilities but that are in the same MSA or nonmetropolitan county as any RCRA facility (“control” tracts). Then we use multivariate models to assess competing sociodemographic correlates of facility location.

ANALYSIS

Our aggregate comparison of the population composition of tracts with and without RCRA facilities (shown in Table 1) does not support the general claim that such facilities are more likely to be located in minority communities. In fact, the percentage of black residents is significantly lower in tracts with an RCRA facility (12.30%) than in *control* tracts (14.69%) or in *all* tracts without RCRA facilities (13.44%). When comparisons are restricted to metropolitan tracts, the results are similar: The percentage of blacks in metropolitan tracts with an RCRA facility (13.51%) is significantly lower than in control tracts (15.52%) or in all tracts (15.36%). This pattern is reversed, however, in nonmetropolitan tracts, where the mean percentage of blacks in tracts with an RCRA facility is significantly higher (9.14%) than in control nonmetropolitan tracts (7.49%). The average percentages of both Hispanics and of persons born abroad are consistently lower in tracts with an RCRA facility than in tracts without, and these differences are most often significant.

Table 1 provides mixed initial evidence for the inequitable distribution of RCRA facilities in poorer neighborhoods. The mean percentage of families below the poverty line is significantly higher in tracts with an RCRA facility (15.52%) than in control tracts (14.41%). Similarly, the median household annual income is significantly lower in tracts with a facility (\$28,880) than in control tracts (\$31,870). These patterns, however, are not evident in metropolitan or nonmetropolitan areas considered separately; thus we suspect that they arise from the general concentration of both poverty and industry in metropolitan areas.

3. RCRA data suffer from several limitations. In particular, the scope of RCRA coverage has changed over time as the list of regulated materials and facilities has been expanded. The Toxicity Characteristic Rule of 1990, for example, added 25 new hazardous materials codes (accounting for as much as 135 million tons) to RCRA-governed materials. In addition, adequacy of coverage of RCRA data varies from state to federal databases, and the positional accuracy of all EPA databases can be problematic (Scott et al. 1997).

4. Fifteen RCRA facilities could not be geocoded. As a result, some tracts may contain facilities but may be coded as tracts without facilities.

5. Density effects in these models are complex and require the entry of main effects for land area, population, and their interaction. We also ran all models presented with these terms included in a detailed nominal form; the key results presented were not altered substantially.

TABLE 1. CHARACTERISTICS OF 1990 CENSUS TRACTS IN REGIONS WITH AND WITHOUT AN ACTIVE RCRA FACILITY^a

Tract Characteristics	All Regions			Metro (MSA) Regions			Nonmetro Regions		
	Tracts With Facility	Tracts Without Facility		Tracts With Facility	Tracts Without Facility		Tracts With Facility	Tracts Without Facility	
		Control ^b	All		Control ^b	All		Control ^b	All
% Black	12.30	14.69 ^{c,d}	13.44 ^c	13.51	15.52 ^c	15.36 ^c	9.14	7.49 ^c	7.88
% Hispanics	6.95	8.78 ^{c,d}	7.88 ^{c,d}	8.46	9.39 ^{c,d}	9.31 ^{c,d}	3.03	3.51	3.71 ^c
% Born Abroad	6.16	9.94 ^{c,d}	8.55 ^{c,d}	7.53	10.75 ^{c,d}	10.64 ^{c,d}	2.56	2.95 ^{c,d}	2.49
% Families Below Poverty Line	15.52	14.41 ^c	15.46	14.66	14.06	14.12	17.77	17.44	19.30 ^{c,d}
Median Household Income (\$1,000s)	28.88	31.87 ^{c,d}	30.06 ^c	30.60	32.75 ^{c,d}	32.60 ^{c,d}	24.36	24.24	22.70 ^c
% Men in the Labor Force	92.72	92.61 ^d	92.62	92.57	92.60	92.60	93.09	92.70 ^c	92.68 ^c
% Persons Without a High School Diploma	27.60	25.06 ^c	26.21 ^c	26.99	24.65 ^c	24.72 ^c	29.19	28.62	30.52 ^{c,d}
% Persons With 1+ Years of College	38.84	45.40 ^{c,d}	43.26	40.60	46.49 ^{c,d}	46.35 ^{c,d}	34.25	35.96 ^c	34.31
% Employed in Industrial Jobs	31.28	25.88 ^c	27.37 ^c	29.89	24.96 ^c	25.07 ^c	34.89	33.89 ^c	34.02 ^c
Housing Value (\$1,000s)	85.42	116.16 ^{c,d}	105.39 ^{c,d}	95.38	122.21 ^{c,d}	121.32 ^{c,d}	60.13	64.66 ^{c,d}	60.20
Sample Size ^e	2,596	47,372	58,662	1,880	42,468	43,613	716	4,904	15,048

^aFacilities identified as active in the 1996 Social and Demographic Research Institute (SADRI) survey.

^bTracts without an RCRA facility but in an MSA or county with at least one RCRA facility.

^cMeans differ at $p < .05$.

^dMedians differ at $p < .05$.

^eThe number of cases in the statistical tests varies because of missing values related to the independent variable.

Tracts with RCRA facilities are generally industrial and working-class. Both metropolitan and nonmetropolitan tracts with an RCRA facility contain a significantly higher percentage of males employed in manufacturing and industrial occupations than do control tracts and other tracts without RCRA facilities. Also, in tracts with RCRA facilities, we generally find a higher percentage of persons without a high school diploma and a lower percentage of persons with at least one year of college. Although it has been suggested that political empowerment may be less in communities with lower average levels of education, such levels also may simply reflect the presence of industrially employed residents living near places of employment. The value of housing is also significantly lower in tracts that host an RCRA facility than in control and other tracts, especially in metropolitan regions. Whether or not lower housing values reflect an inducement to site facilities on lower-cost land, they mirror the general working-class quality of these neighborhoods.

Taken together, these findings suggest that tracts with RCRA facilities may be described as working-class neighborhoods with a lower average percentage of Hispanic and

black residents (except in nonmetropolitan regions), higher levels of industrial employment, lower average levels of education, and more modest housing.

We use logistic regression to examine the net association between community characteristics and the likelihood, or odds, that the tract contains an RCRA facility. In these and subsequent analyses, tracts with a facility are compared with control tracts. The odds ratios presented in Table 2 estimate the change in the relative likelihood of an RCRA facility in the tract as a function of a unit change (usually 1%) in selected neighborhood characteristics.

The multivariate results support conclusions based on the bivariate findings. For the United States as a whole, the presence of an RCRA facility is associated with lower percentages of black and Hispanic residents. RCRA sites also are associated with higher percentages of male labor force participation and industrial employment, lower percentages of college-educated residents, and lower housing values. The percentage of families below the poverty line is not a significant effect. Modest evidence supports a greater likelihood of RCRA facilities in nonmetropolitan neighborhoods with a higher percentage of blacks (significant at $p < .10$). Although

TABLE 2. ODDS RATIOS FOR AN RCRA FACILITY AS A FUNCTION OF CENSUS TRACT CHARACTERISTICS, BY METROPOLITAN AND NONMETROPOLITAN REGIONS^{a,b}

Model Effects	Type of Region		
	All Regions	Metro Regions	Nonmetro Regions
% Black	0.994*	0.996*	1.005
% Hispanic	0.990*	0.992*	0.998
% Families Below Poverty Line	1.004	0.998	0.999
% Persons With 1+ Years of College	0.994*	0.996	0.993
% Men in Labor Force	1.019*	1.009	1.025*
% Employed in Industrial Jobs	1.027*	1.032*	0.997
Housing Value (\$1,000s)	0.997*	0.998*	0.997
Pseudo- <i>R</i> ²	0.036	0.029	0.005
Model Chi-Square	706.320	434.229	23.081
<i>p</i> > Chi-Square	0.036	0.002	0.002
Sample Size	47,316	41,895	5,421

^aFacilities identified as active in the 1996 SADRI survey.

^bReference tracts are those without an RCRA facility but in an MSA or county with at least one RCRA facility.

**p* < .05

industrial employment is not associated with the presence of RCRA facilities in nonmetropolitan areas, the percentage of males in the labor force is so associated; this finding suggests that host areas may constitute pockets of higher employment in nonmetropolitan settings.

We are interested largely in the neighborhood distribution of facilities and in *prima facie* evidence of discriminatory site selection. Abutting communities, however, are a matter of interest for other aspects of environmental equity (e.g., exposure, long-term socioeconomic impacts) and are potentially important for making siting decisions through less proximate avenues (e.g., regional political resistance, general land values, and patterns of land use). To draw comparisons with nearby areas, we divided control tracts into two categories based on distance: (1) "nearby" control tracts, within three miles of any facility tract,⁶ and (2) "distant" control tracts, located three miles or more from facilities. Table 3 displays comparisons of tracts with RCRA facilities to those close to and distant from facilities.

Tracts without, but close to, RCRA facilities contain a notably higher percentage of black residents, Hispanics, and

6. We measured distance from the centroid of each RCRA tract to the centroid of the nearest non-RCRA tract. We chose three miles as a cutoff in keeping with other environmental justice research, which uses distances from one to five miles (e.g., Anderton et al. 1994; GAO 1995a, 1995b; Glickman 1994).

low-income families than do those with RCRA facilities. More distant control tracts contain lower percentages of black and Hispanic residents and families below the poverty line than do tracts either with or close to facilities. This pattern clearly characterizes metropolitan but not nonmetropolitan tracts, and is similar to the distribution of metropolitan TSDFs (Anderton et al. 1994).

Caution is warranted, however, in simplified spatial analyses such as these summary results (Sheppard et al. 1999). Areas with a fixed radius, by definition, reflect the prevailing density of different areas and resident socioeconomic groups; they do not necessarily reflect inequitable siting of facilities. Nonetheless, surrounding areas may be more likely to include minority and disadvantaged populations even if tracts in which facilities are sited are less likely to include such groups.

In our analyses thus far, we have considered environmental equity across the entire, diverse group of enterprises governed by RCRA. In a final step, however, because policy interests and options differ for different types of RCRA facilities, we address environmental equity for selected types of RCRA facilities.

Waste-handling activities at RCRA facilities are important to the argument that more burdensome or more noxious types of facilities (e.g., toxic dump sites, incinerators, and landfills) are more likely to be sited in minority neighborhoods. To address such concerns, we collected information on six primary (not mutually exclusive) activities in which RCRA facilities could be involved: hazardous waste incineration, landfill, storage, treatment, transfer, and recycling. These categories represent the range of major activities at RCRA facilities and major subgroups of RCRA facilities that have received specific attention (e.g., incinerators and landfills).

RCRA facilities also vary in ownership or governance structure; thus they may require different decision-making processes, involve different regulatory authorities, and present different possibilities for policy. Sovereign immunity, for example, distinguishes federally owned facilities from private facilities, and many government-operated facilities are more limited than privately operated facilities as to siting options. (For example, they may be restricted to small political jurisdictions such as county landfills.)

Finally, commercial sites (privately owned facilities generating less than 50% of the waste stream that they manage) and noncommercial facilities⁷ are subject to unique regulations within RCRA. In our survey of RCRA-governed facilities, we collected information on ownership and percentage of on-site waste stream generation, which we use to classify the governance of facilities as public (e.g., military facilities), private commercial (e.g., off-site

7. Our definition of commercial facilities closely follows that used by Weststat, except that we exclude public facilities from the definition (1984:213). Only 176 of the 484 tracts with TSDFs analyzed by Anderton et al. (1994) contain private commercial facilities as identified on the RCRA National Notifier List.

TABLE 3. CHARACTERISTICS OF 1990 CENSUS TRACTS WITH AN RCRA FACILITY AND OF CONTROL TRACTS CLOSE TO OR DISTANT FROM FACILITIES^{a,b}

	Sample Size ^c	% Black	% Hispanic	% Families Below Poverty Line
All Regions				
Facility	2,596	12.30	6.95	15.52
Nearby control	16,146	21.01 ^{c,d}	11.60 ^{c,d}	18.06 ^{c,d}
Distant control	31,226	11.38 ^{c,d}	7.31 ^d	12.52 ^{c,d}
Metro Regions				
Facility	1,880	13.51	8.46	14.66
Nearby control	15,481	21.56 ^{c,d}	11.98 ^c	18.08 ^{c,d}
Distant control	26,987	12.01 ^c	7.89 ^d	11.75 ^{c,d}
Nonmetro Regions				
Facility	716	9.14	3.03	17.77
Nearby control	665	8.03 ^d	2.75 ^d	17.78
Distant control	4,239	7.41 ^{c,d}	3.62	17.39

^aFacilities identified as active in the 1996 SADRI survey.

^bControl tracts include tracts without an RCRA facility but in an MSA or county with at least one RCRA facility. "Nearby" means within three miles of any tract with at least one RCRA facility.

^cMeans differ at $p < .05$.

^dMedians differ at $p < .05$.

^eThe number of cases in the statistical tests varies because of missing values related to the independent variable.

recycling centers), and private noncommercial (e.g., on-site storage facilities).

Multivariate analyses for each type of facility activity and governance type (details not presented) support findings that site location either is not related or is related inversely to the percentages of black or Hispanic residents. An increase in the percentage of families below the poverty line significantly increases the likelihood of RCRA treatment facilities and storage facilities. The largest estimated effect, however, is that of an increasing percentage of industrial employment. Despite suggestions to the contrary in the literature, our results suggest that more burdensome activities are not concentrated in minority or poor neighborhoods, and that the type of governance does not significantly alter the equity of siting.

DISCUSSION

Our analysis of RCRA-governed hazardous materials handlers expands the range of facilities and environmental burdens considered so far in the environmental justice literature. It does not indicate prevalent or severe overall inequities in the distribution of RCRA facilities across neighborhoods of different socioeconomic composition. RCRA facilities are located primarily in working-class neighborhoods. These more industrial RCRA neighborhoods abut residential areas characterized by higher percentages of both minorities and economically disadvantaged populations.

Nonetheless, because of the heterogeneity of industrial activities, local geographies, and unique residential area his-

stories, facilities certainly will be sited in predominantly minority or disadvantaged areas. Our national-level survey of RCRA facilities assesses prevalent national patterns of inequity and provides a backdrop for such local concerns.

Overall our findings suggest that the siting of RCRA facilities does not merit high priority among the potential hazards and burdens to which minorities and the disadvantaged are disproportionately exposed. These findings, however, do not address further concerns, such as whether especially large, more noxious, or more dangerous RCRA facilities are sited specifically in minority or economically disadvantaged areas.

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