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Environmental Equity and Community Participation in the Evaluation and Selection of Superfund Remediation Alternatives

Stephanie Garcia

Environmental equity has emerged as an important topic of research since the 1970s. Despite the massive number of quantitative studies that evaluate disproportionate distribution of Superfund sites, there is a lack of studies that evaluate equity during the processes of Superfund designation or evaluation and selection of remediation alternatives. A multiple regression analysis offers a way to evaluate community participation based on racial and socioeconomic aspects of communities (at the census tract level) as well as characteristics of the Superfund sites. Community participation was influenced most by high percentages of residents receiving public assistance, representing non-white communities with many children and with lower median incomes. The results suggest that minority and disadvantaged communities participate more frequently during the process of evaluating and choosing remediation alternatives; however, concluding that the process is equitable is premature. *Key Words: environmental equity, environmental hazards, community participation.*

The United States Environmental Protection Agency (USEPA) is currently confronted with the issue of environmental justice in the Superfund program. Carol M. Browner, the USEPA Administrator, has stated that "All Americans deserve clean air, pure water, land that is safe to live on, and food that is safe to eat." Despite recent progress, she says, " . . . some communities continue to bear a disproportionate burden of pollution . . ." (USEPA 1997a). This unfair share

Stephanie Garcia is a doctoral student in the Department of Geography at Southwest Texas State University, San Marcos, TX 78666-4616.

of exposure to pollution exemplifies what many contemporary discrimination theorists describe as indirect discrimination. Theorists postulate that indirect discrimination stems from historical institutional overt discriminatory practices, or from current attempts by the majority group to protect their own status (Davos 1986). Impacts of this type of discrimination are easy to see, but the mechanisms often elude observation (Feagin and Feagin 1978). Following designation of a Superfund site, has indirect discrimination occurred during evaluation and selection of alternatives for site cleanup? This research was designed to illuminate symptoms of discrimination manifested in community participation in order to justify case studies seeking to uncover the causes. The research seeks to answer the question: What are the socio-economic characteristics of communities that participate during the evaluation and selection of remediation alternatives? In other words, what community characteristics influence participation? Five hypotheses are tested:

- More affluent communities participate more frequently;
- White communities participate more frequently;
- Communities with Superfund sites that have higher Hazard Ranking System (HRS) scores participate more frequently;
- Communities with Superfund sites with longer time periods between proposal to the Superfund list and the signing of the Record of Decision (ROD) participate more frequently;
- Communities with Superfund sites where proposed remedies are perceived to be less desirable participate more frequently.

Results of the analysis are compared to published environmental justice research and research on the Not-In-My-Backyard (or NIMBY) syndrome.

Why Research Environmental Justice in the Context of Superfund?

Current environmental justice research is guided by the perception that poor and minority communities are more likely to live near, and be exposed to, hazardous wastes (Anderton, Oakes, and Egan 1997). The companion perception is that people in these communities receive different treatment or behave differently during the siting of unwanted facilities or during the regulatory processes involving existing waste facilities (Anderton, Oakes, and Egan 1997). As early as 1971, the geographer Harold Rose called on geographers to examine social variables associated with minority communities in relation to place and to spatial layout (Rose 1971). Geographers and other social scientists are among those who recently have conducted quantitative research designed to evaluate environmental equity in the United States. Most of the recent research related to the Superfund program shows that Superfund sites are not disproportionately located in minority neighborhoods, but this research has not evaluated equal treatment during the evaluation and selection of treatment options.

Following designation of a facility as a Superfund site, the USEPA initiates programs designed to foster public participation during the decision-making phase where treatment options are evaluated and selected. USEPA personnel appointed to the positions of community involvement coordinators oversee the outreach efforts. If the results of this study show that the frequency of community participation is skewed for any of the socioeconomic characteristics entering the analysis, case studies are warranted. These studies should investigate the nature and consistency of the outreach activities in addition to exploring the nature and history of the community.

The combination of proposed remediation activities and the socioeconomic characteristics of the affected communities is expected to influence community participation. Decisions to treat contaminated land or water at the site, to leave the contamination in place, or to remove the

affected media are not simple. Science can answer some of the decision-makers' questions, but political consequences often enter the equation. People often want the contaminant removed even if it is safer to leave it in place (Harris and Wrenn 1988). On the other hand, if the waste is left in place, the threat of release remains. Both scenarios may precipitate heightened community involvement.

Overview of Study Design

This research assesses the frequency of community participation during the evaluation and selection of remediation alternatives based on socioeconomic characteristics (including race, economic status, and location), the measured or perceived magnitude of the hazard (the Superfund Hazard Ranking System score and the chosen remedy), and the duration of the hazard (the length of time between the listing of the site and the issuance of an ROD). Community participation is the dependent variable and is measured by the percentage of residents who requested inclusion on the USEPA's mailing list for the Superfund site located in their community (defined as the census tract in which the Superfund site is located). The analysis includes the Superfund communities in USEPA's Region 6 (New Mexico, Texas, Oklahoma, Louisiana, and Arkansas) and includes sixty-five Superfund sites and their related census tracts. Region 6 is particularly important within the environmental justice movement because it includes several southern states with large minority populations and is a region with a reputation for racism (Bullard 1990). The scale of analysis used is the census tract in order to include community or neighborhood characteristics sometimes hidden in county and zip code aggregates and averages (Napton and Day 1992; Cutter, Holm and Clark 1996). Dummy variables for each state in the region were used in the analysis to explore state regulatory environments and to avoid pitfalls common to aggregate statistics that fail to represent local situations (Smith 1973).

Previous Research

The complexity of the environmental justice issue demands a broad and comprehensive review of previous scholarship including work focused on five subjects and/or approaches. These include: discrimination and segregation theories and how they have influenced the location of minority communities and the location of hazardous wastes (Swan 1972; Davis and Donaldson 1975; Feagin and Feagin 1978; Bullard 1990; Hird 1990; Mealy 1990; and Godsil 1991); the environmental justice movement (Bullard 1990); the USEPA's regulations and programs governing the designation of Superfund sites and the process of evaluation and selection of remediation alternatives (Hird 1990); community response theory from the environmental hazards perspective, especially highlighting the uniqueness of minority communities (Rich 1980); and quantitative studies evaluating the relationship between the presence of hazardous waste and community socioeconomic characteristics (Burke 1993; Hird 1993; Anderton, Anderson, Oakes, and Fraser 1994; Perlin *et al.* 1994; Bowen *et al.* 1995; Nieves and Wernette 1996; Baden and Coursey 1997; Garcia 1997).

In the last two decades, scholars have evaluated the hypothesis that minorities were more likely to live near hazardous waste sites. The investigators evaluated selected groups of Resource Conservation Recovery Act sites, Comprehensive Environmental Response, Compensation, and Liability Act Information System (CERCLIS) sites, and Superfund sites at the ZIP code, state, county, and census tract levels and published widely varied results.

Several studies, including the 1987 United Church of Christ report "Toxic Waste and Race in the United States" and its follow-up study conducted in 1993 (USEPA 1997c), the National Law Journal's 1990 Expose (Lavelle, Coyle and MacLachlan 1992), and scholarly articles published by Zimmerman (1994) and Boer *et al.* (1997), conclude that race was a significant factor in the location of Superfund and/or CERCLIS

facilities. These studies examined national trends using univariate techniques, with ZIP codes as the smallest units of analysis. Although the studies concluded that race was a significant factor in the location of Superfund and CERCLIS sites, the unit of analysis and the techniques used may have influenced the results. Community characteristics are often misrepresented in scales even as small as the ZIP code. Additionally, univariate techniques may not be appropriate when examining community characteristics because other influential characteristics are not accounted for in the analysis.

Other studies (Hird 1990; Hird 1993; Anderton *et al.* 1994; Zimmerman 1994, Anderton *et al.* 1997; Garcia 1997) suggest that there is no statistical evidence that minorities are more likely to live near hazardous waste facilities. Others had mixed results (USGAO 1995). These studies examined trends both nationally and in specific geographic areas using multivariate techniques and found no significant correlation between race and the location of Superfund and/or CERCLIS facilities. One of the latest and most broad-based of these studies analyzed CERCLIS and Superfund sites at the census-tract level for the entire nation including considerations for rural and urban settings (Anderton, Oakes, and Egan 1997). They found that CERCLIS neighborhoods are typically working-class communities with few minorities, are less densely populated, and have more industrial employment than average. Similarly, they conclude that Superfund neighborhoods are less impoverished, better educated, and have higher housing values. The authors suggest that either minority communities lack empowerment to get the abandoned sites into the Superfund program or that CERCLIS and Superfund sites are not disproportionately found in minority communities. Previous studies support these conclusions (Hird 1990; Hird 1993; Zimmerman 1994; Garcia 1997). This study differs from previous research in that it evaluates disproportionate participation of geographically segregated communities rather than disproportionate loca-

tion of facilities within those communities.

As evidenced by the number of USEPA-sponsored studies and the establishment of an Environmental Equity Workgroup, the agency was active in studying the problem of environmental injustice (USEPA 1997c). Following USEPA's involvement, President Clinton issued an executive order mandating that all federal agencies address the problem (USEPA 1997c). Shortly after, the USEPA established the Office of Environmental Justice to address issues within USEPA programs. In addition, the USEPA has established a literature repository, grants, and hotlines, and has pledged to work with other government entities and affected communities (USEPA 1997b).

Varied results and conclusions in the literature regarding environmental equity within the Superfund program suggest that the existence of environmental injustice may not be easily explained. Although the most recent and most thorough quantitative analyses seem to concur that Superfund sites are not disproportionately located in minority neighborhoods, the analyses do not address equal treatment during the evaluation and selection of remediation alternatives. This research was designed to evaluate this aspect of environmental justice.

Methodology

Multiple regression analysis is used to evaluate the influence of socioeconomic variables on the percentage of a census tract's population that requested inclusion on the mailing list for the Superfund site within their census tract (herein referred to as community participation). Census tracts are the most suitable unit of analysis because they more adequately characterize communities, whereas county and ZIP code aggregates dilute neighborhood characteristics in larger spatial units (Napton and Day 1992; Cutter, Holm and Clark 1996). Census tract-level data were compiled from *LandView II: Mapping of Selected EPA-*

Regulated Sites (with TIGER/Line files) (USEPA *et al.* 1992) and the *1990 Census of Population and Housing* (US Bureau of the Census 1992). To control for differences between USEPA's regional offices and state regulatory environments, this study limited comparisons to sites within one region (Region 6). The USEPA Region 6 World Wide Web site contains current information regarding each Superfund site (USEPA 1998). Federal Superfund sites and sites for which an ROD had not been signed were identified from web page information, and these facilities were excluded from the analysis. Sixty-five Superfund sites and characteristics of the census tracts in which they are located composed the data set used in the analysis.

Community participation, the dependent variable, is expressed as a percentage of the census tract's population (to account for population differences between tracts). According to Peter Redmond, Community Involvement Coordinator for USEPA's national office, individuals must request that their name be placed on the mailing list for a particular Superfund site (Redmond 1997), indicating at least minimal participation or interest in the Superfund site. Although use of the number of residents on the mailing list is not a perfect measure of actual participation and involvement, Redmond agreed that it is a good relative indicator of the participatory nature of the community.

The independent variables were derived from findings of studies based in community response theory and hazards theory (Savitch 1975; Burton, Kates and White 1978; Cook 1983; Edelstein 1987; Weiss 1988; Anderton, Oakes, and Egan 1997; Ringquist 1997) and were divided into three categories: socioeconomic factors, Superfund characteristics, and location (state) (Table 1). Population characteristics that were expected to positively correlate with community participation include income, length of residence, and value of residence (Savitch 1975; Cook 1983; Edelstein 1987; Weiss 1988). These variables indicate a personal stake in the community. Race and the presence of children

Table 1: Independent Variables

Variable Name	Operational Variable	Expected/ Actual Correlation
Socio-economic Variables		
HISPAN	% of the population that is Hispanic	-/excluded
KIDS	% of households with children under 18 years of age	-/excluded
MEDINC	Median household income	+/excluded
MEDHOUS	Median house value	+/+
NONWHTE	% of the population that is non-white	-/excluded
POPDEN	Persons per square mile	+/excluded
ASSIST	% of the population that is receiving public assistance	-/+
STAB	% of housing units where residents have lived there 10 years or more	+/-
WELL	% of housing units using well water	+/excluded
Characteristics of the Superfund Site		
CAP	ROD decision to cover (cap) waste in place	+/excluded
DUR	Number of months between proposal to the NPL and signing of the ROD	+/excluded
HRS	HRS score	+/excluded
INCIN	ROD to incinerate at the site	+/+
TREAT	ROD to treat groundwater	+/excluded
State Variables		
ARKAN	Site located in Arkansas	+/-
LOUIS	Site located in Louisiana	+/excluded
NEWMEX	Site located in New Mexico	-/-
OKLA	Site located in Oklahoma	-/excluded

were expected to not correlate positively with participation (Cook 1983). Higher HRS scores, longer time periods between proposal to the NPL and the signing of the ROD, ROD remedies for incineration, water treatment, capping of wastes at the sites, and higher percentages of housing units using well water were expected to positively correlate with community participation (Burton, Kates and White 1978; Edelstein 1987; and Ringquist 1997). These variables are directly related to Superfund site hazardousness. The influence of population density represented differences between sparsely populated rural areas and densely populated urban areas and the location (state) variables served to represent possible differences among state regulatory environments (Anderton, Oakes, and Egan 1997). Expectations of the influence of state differences were based on review of Region 6 sites. The sixty-five sites are concentrated in Texas and Louisiana and only a few sites are located in Arkansas, New Mexico, and Oklahoma (Figure 1). In Arkansas participation was expected to be higher, based on the involvement of the National Association for the Advancement of Colored People at every site in the state (USEPA 1998). Expectations for participation levels in the remaining states were based

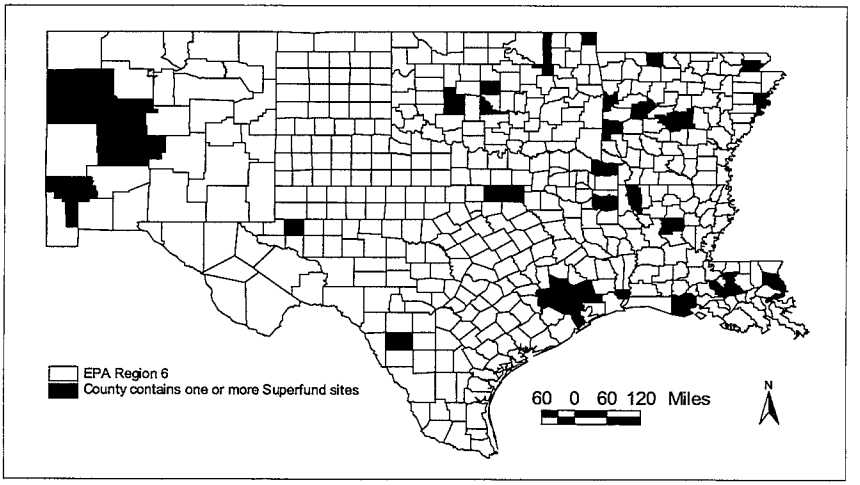

Figure 1. Distribution of Counties Containing one or more Superfund Sites.

on the number of sites per state, with participation expected to rise with frequency.

Multicollinearity between variables was addressed using the Pearson's Correlation Coefficients (Table 2). Correlations near or greater than 0.7 were taken to indicate multicollinearity. Positive significant high correlations exist between the percentage of the population receiving public assistance and the percentage of households with children under 18 years of age and between those receiving public assistance and the percentage of the population that is non-white. A third strong (negative) correlation exists between those receiving public assistance and median household income. Three variables (percent of households with children under 18 years of age, percent of the population that is non-white and median household income) are also moderately correlated with each other. Based on these relationships, public assistance was therefore used to indicate the percentage of non-white households with more children and lower incomes. The public assistance variable and the remaining variables were regressed using the stepwise method in the Statistical Package for Social Sciences (SPSS).

Results

Stepwise regression included six variables and explained 41.4 percent of the variance (Table 3). Variables with correlation significance levels equal to or greater than 95% were entered in the equation. Beta values (used to standardize the variables and allow for comparisons) were positive for the percentage of the population that is receiving public assistance and for an ROD to incinerate waste at the site, indicating residents in these tracts are more likely to participate. The stability variable, measuring the number of residents living in the same residence for at least 10 years, is negatively correlated with community participation.

Table 2: Pearson's Correlation Matrix

	ARKAN	CAP	DUR	HISPAN	HRS	INCIN	KIDS	LOUIS	MEDHOUS	MEDINC	NEWMEX	NONWHT	OKLA	POPDEN	ASSIST	STAB	TREAT	WELL
ARKAN	1.00																	
CAP	.151	1.00																
DUR	.092	-.005	1.00															
HISPAN	-.244	.054	-.220	1.00														
HRS	-.098	.063	.178	-.094	1.00													
INCIN	.173	-.276*	-.085	-.179	.013	1.00												
KIDS	-.005	-.281*	-.201	.096	-.054	-.039	1.00											
LOUIS	-.213	-.139	-.167	-.272*	-.038	.213	.029	1.00										
MEDHOUS	.087	-.186	.105	-.012	.030	.077	-.140	.082	1.00									
MEDINC	-.50	-.028	.193	-.124	.052	.012	-.273*	-.065	**.728****	1.00								
NEWMEX	-.148	-.165	-.020	.379**	-.037	-.148	.254*	-.174	.020	-.173	1.00							
NONWHT	-.221	-.119	-.027	.108	.015	-.127	.583**	-.090	-.392**	-.378**	.138	1.00						
OKLA	-.182	.151	.160	-.230	.063	-.182	-.131	-.213	-.161	-.001	-.148	.039	1.00					
POPDEN	-.151	.050	-.172	.248*	-.003	-.110	-.002	.037	-.018	-.065	-.162	.300*	-.083	1.00				
ASSIST	-.047	-.116	-.188	.103	.019	-.041	**.683****	.018	-.564**	**-.715***	.202	**.666****	-122	.159	1.00			
STAB	.164	.225	.124	-.170	-.239	-.036	.029	.112	-.120	.023	.019	.061	.168	-.163	-.066	1.00		
TREAT	-.125	-.072	.041	.008	.187	.218	-.097	.015	-.183	-.201	-.012	.162	-.211	-.012	.033	-.116	1.00	
WELL	.000	-.085	.181	-.003	-.072	-.052	-.017	.232	.117	.018	.232	-.328*	-.141	-.393**	-.199	.138	.082	1.00

*p = < .01

**p = < .05

Table 3: Stepwise Regression Coefficients Predicting the Percentage of Residents Requesting Inclusion on the Superfund Mailing List

Independent Variable	Coefficient
% of the population that is receiving public assistance	.588**
ROD to incinerate at the site	.356**
% of housing units where residents lived 10+ years	-.174**
Median house value	.331**
Site located in Arkansas	-.240*
Site located in New Mexico	-.248*
Constant	.905
Adjusted R^2	.414
Number of Observations	65

*p = < .01

**p = < .05

Median household income is positively correlated with participation rates. Arkansas and New Mexico however, were both negatively correlated with requests for inclusion on the Superfund mailing list.

In order to test the significance of inclusion of the dummy state variables, a second stepwise regression was run without these indicators. The explanatory power of the equation was weakened (lower R^2), indicating the importance of the state setting in determination of participation.

Discussion

The most significant correlations in this analysis exist between the percentage of households receiving public assistance and community participation, and between the decision for onsite incineration and community participation. Based on discrimination and segregation com-

munity response theory as well as environmental equity literature, these results are surprising. The public assistance variable (representing both lower income and minority census tracts) should be negatively correlated with community participation (Burton 1972; Savitch 1975; Cook 1983; Weiss 1988; Mealy 1990).

Poor and minority communities, it is often presented, lack both financial and temporal resources to effectively respond to the hazard. Perhaps these communities are rather experienced in dealing (even battling) with government agencies and demanding government attention and funds. If this is true, participating in the Superfund decision-making process amounts to just one more fight. Others suggest that communities with more public assistance are desensitized to environmental hazards and are not motivated to participate. Perhaps instead of being desensitized, they have heightened awareness or are already well organized.

The strong positive correlation between an ROD to incinerate and community participation was consistent with previous research. It seems that the establishment or use of an incinerator at a Superfund site constitutes a threat from a new source, one that perhaps the community believes it can fight (Cook 1983). On the other hand, excavation and removal of contaminated soils may be perceived as a lower risk to the community.

Weaker, yet significant, correlations exist between median house values and community stability and community participation. Like previous studies, this research suggests that financial investment in a community (median house value) is positively correlated with participation, and that a community's emotional ties (length of residence) are negatively correlated with participation. Perhaps this counter-intuitive result indicates that those people well established in a neighborhood community just want to be left alone. These types of communities may not be able to accept that their neighborhood may be unsafe.

The other variables that others have suggested would influence com-

munity participation, including the duration of the hazard, the magnitude of the hazard, and rural/urban and locational differences, were not significant based on the measures devised for these characteristics of Superfund sites (the hazard). Finally, although the state variables enhanced the overall explanatory power of the regression equation, none of the variables themselves had strong correlations. Although Arkansas and New Mexico were included in the stepwise regression, the beta values were low. These states may have influenced the equation because both have fewer than 10 sites.

Conclusions

This is a first step toward evaluating influences on participation during the Superfund site evaluation process. Multivariate regression was used to test the hypotheses that more affluent, white communities and communities with Superfund sites that have higher HRS scores, longer time periods between proposal to the Superfund list and the signing of the ROD, and communities that perceive the remedies to be less desirable, participate more during evaluation and selection of remediation alternatives. Results of the regression differed significantly from expected results derived from a review of published environmental justice research.

Contrary to expectations, census tracts with higher percentages of residents receiving public assistance were found to have larger percentages of their populations participating during the Superfund decision-making process. Based on multicollinearity analysis, the public assistance variable represented minority and lower-income communities with more children, indicating the census tracts with higher participation levels were more often economically disadvantaged. To conclude that this correlation proves that there is equity in the Superfund program would be premature and perhaps inaccurate. Although these communi-

ties may participate more frequently, the influence of the participation on the decision-making process cannot be evaluated from this data set. It would be easy for the USEPA to project equal treatment and consideration, when meetings may only serve to inform those who participate, but do not involve them in the process.

If one part of the USEPA's Community Involvement Plan is to motivate participation, the agency has been either successful or lucky. It seems that the next step is to ensure that the same consideration is given to poorer and minority communities as that given to more affluent majority communities, a task not easily evaluated with quantitative data. One way to study such a question would be to compare the relationships between remedial options, public input, and the final remedy selected, in the context of socially and economically different Superfund communities.

The strong positive correlation between an ROD to incinerate and community participation was consistent with previous research. The idea of an incinerator within a community motivates participation because incinerators are perceived to be a threat to community health. This should alert the USEPA to step up risk communication and educate communities regarding the costs and benefits of incineration compared with the capping of or removal of wastes. The equity question is less obvious here, but equivalent efforts to educate should be made in all community types.

Although the relationships between participation and median house value (positive correlation) and between participation and the stability variable (negative correlation) were weak, they do support previous research. Knowing how the neighborhood characteristics influence community participation should help the USEPA to plan outreach efforts based on neighborhood tenure and the financial investment within the community.

Future studies should evaluate the influence exerted by participat-

ing communities during the Superfund decision-making process. Certainly, a combination of quantitative and qualitative techniques would be required to evaluate such a question. Although it may seem unfair to spend more tax money on outreach programs to empower poor and minority communities, it may be the only way to formulate equitable outcomes.

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