Evaluating the Potential for Environmental Quality Improvement in a Community Distressed by Manmade Hazards

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As part of the process of understanding manmade environmental hazards and their impact on affected communities, this study explored the conditions at a waste disposal site in Staten Island, New York. Questionnaires were administered by mail to assess: (a) the range of socio-economic groups affected and their residential characteristics; (b) their awareness and perception of the conditions at the waste site; and (c) their willingness to pay to resolve the problems. The results showed high levels of environmental awareness among the residents. Specifically, air pollution and waste disposal were cited as the most significant problems affecting their community. In the search for alternatives, roughly half of the residents indicated their willingness to financially support programs aimed at improving the quality of their environment.

Keywords: manmade hazards, waste management, landfills, contingent valuation methods.

1. Introduction

Hazard research and adjustment patterns have long been of theoretical and empirical interest to social scientists. For at least three decades, considerable progress has been made in documenting the characteristics of various hazards and the range of public responses resulting from them. Two major types of hazards have been studied: (a) those that result from natural causes such as earthquakes, hurricanes, tornadoes and floods; and (b) those which are manmade or technologically generated such as oil spills, air pollution episodes, nuclear power accidents and leaking toxic waste facilities. Although natural hazards repeatedly pose threats to communities, it is increasingly becoming evident from the literature that the risks, frequency and impact of manmade hazards may be higher and therefore demand more attention (Horowitz and Stefanko, 1989; Green *et al.*, 1990; Baum *et al.*, 1992). Some of these studies portray the victims in such environments as helpless, with high levels of stress, anger, depression and other psychological problems that persist long after the event has occurred. However, aside from the cognitive and physiological impacts on the victims, more has to be known

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about the behavioural responses and the different options that are available to alleviate the effects of these hazards. Specifically, what can be done to minimize or eliminate the consequences of these hazards? Are the communities willing to fund or participate in activities that will influence the regulatory agencies responsible for dealing with these problems? As part of the ongoing research efforts designed to address these questions, this study examines the problems at a waste disposal facility in Staten Island, New York. It evaluates the degree of awareness of the hazards at the facility, the perception of risks among the residents and their willingness to pay to improve the environmental conditions in their community.

2. Theoretical background

Several studies have been conducted over the last decade on the impacts of manmade hazards and the types of adjustment strategies various communities have adopted to cope with them. Some of what has been written has focused on solid and hazardous waste facilities and their impact on the host communities. These studies can be grouped into two areas. First, there are those which have looked at the psychosocial and cognitive adjustments involving the perception, knowledge and feelings of the residents towards the risks posed by the facilities. Many of these studies have reported findings that attribute physiological and psychological problems among residents to the waste facilities (Edelstein, 1982; Levine, 1982; Horowitz and Stefanko, 1989). A study by Taylor *et al.* (1990) examined the impacts associated with living close to proposed and existing waste facilities in Southern Ontario, Canada. The results identified adjustment patterns at three social scales, including the individual level where different emotional and somatic effects were observed among the residents.

Another study by Baum *et al.* (1992) compared flood victims in one locality to residents living near a toxic waste dump in another. The researchers concluded that the effects of manmade hazards were more intense than those resulting from natural hazards. Specifically, subjects living near the waste facility reported more feelings of helplessness, anxiety and depression and were less able to perform challenging tasks.

In contrast to the studies documenting psychosocial impacts, a second group of research efforts have examined the behavioural adjustment patterns adopted by host communities. These range from personal actions (such as moving out of the community to avoid the risks) to group activities involving letter writing campaigns and protests aimed at averting the threat. Among the factors that influence these kinds of adjustment patterns, some studies have suggested household characteristics such as the demographic composition of the residents, their awareness and perception of the hazard, their attachment to the community, length of stay in the community exposed to a range of environmental hazards including air, water and noise pollution. The results indicated a strong, positive relationship between perceived severity of the hazards and the years of residence. The report concluded, however, that many residents remained in the area despite high levels of awareness because of the closely knit community structure and low costs of housing.

Another study by Bachrach and Zautra (1985) examined the coping responses among residents in a rural community in Arizona. Faced with the threat of a proposed hazardous waste facility, many residents responded by writing letters, circulating petitions and attending group meetings designed to protect their environment. The study concluded that two personality variables specifically led to greater involvement

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in these activities. One was the sense of community or the feeling of attachment to the community. The other was self efficacy or the residents' appraisal of what they were capable of doing in that situation. Those who scored highly on both characteristics were more likely to engage in activities directed at altering the threat.

From the review of the literature, there appears to have been two sets of research on adjustment patterns. First, there are studies that have explored the cognitive responses among the residents living near the facilities. The second group of studies have focused on behavioural adjustments at individual and collective levels. Despite the different areas of emphasis, the underlying theme in both research areas is the existing relationship between the perception of the hazards and the subsequent patterns of adjustments.

What is missing from the literature, however, is a discussion of economic options or estimates of external costs that provide some insight into mitigation strategies designed to improve the conditions in these hazard-prone communities. In other words, what can be done to improve the conditions at these sites? If given the choice, will residents in these host communities be willing to pay to protect their environment?

Research on economic adjustments can be done through the application of the contingent valuation method (CVM). This is an expressed preference survey method that involves asking individuals, in a structured way, whether they are willing to pay for an environmental gain or improvement (Turner et al., 1992; Opaluch et al., 1993). So far, few studies have looked at this approach as an option available to communities living with waste facilities. A recent attempt by Roberts et al. (1991) employed the technique to determine the willingness to pay to keep a proposed landfill out of a rural community in Knoxville, Tennessee. The researchers found that several household characteristics influenced the residents' decision to pay. These included variables such as the distance from the proposed landfill, the length of stay in the community, the household income and size, and the respondent's education, sex and perception of health risks associated with the potential landfill. A shortcoming of the study, however, is that it focuses on a proposed landfill site in lieu of existing waste facilities. These are two different circumstances that are likely to produce distinct responses from residents. Specifically, it can be argued that, for proposed facilities, one may not be able to accurately assess the impact and adjustment patterns of the hazard if it has not occurred. Residents may simply base their responses on their fears and perceptions of the potential risks involved rather than their personal experiences. As Just et al. (1982) aptly put it,

"when individuals have not experienced the situations posed by a survey, questions of information bias must be raised. That is, an individual is likely to spend less effort and in fact not have sufficient information to respond to hypothetical alternatives; such responses are more likely to be incorrect as an indication of real world behavior as well as an indication of actual underlying preferences" (pp. 292).

Thus, adjustment patterns, particularly those that require responses to economic options, can be better explained in circumstances where residents have fully experienced conditions at an existing site and are willing to take steps to control the problem.

In the present study, therefore, a theoretical model will be developed to evaluate the economic option available to residents living with an existing waste facility. Using the CVM approach, this option is expressed in terms of their willingness to pay (WTP) to improve the environmental conditions in their community. The WTP variable is predicted to be a function of a number of household characteristics, particularly, those that have been consistently important to understanding individual adjustment patterns in the research literature. They include: the demographic characteristics of the residents



Figure 1. Location of the Fresh Kills landfill

such as age, sex, ethnicity, income and education levels; their residential characteristics such as home ownership patterns, length of stay of residence, attachment to the community and proximity to the waste facility; and their awareness and appraisal of the environmental characteristics of the community.

3. Research design

3.1. SITE SELECTION

The data for this study were drawn from the residential community of Staten Island, New York. Extending along the midwestern shore of the island is the Fresh Kills Landfill which is reportedly the world's largest (Goldstein and Izeman, 1990; Suffita *et al.*, 1992). Opened in 1948, it is also one of the oldest landfills in the United States and the only operating landfill in New York City (See Figure 1). The landfill currently receives 14 000 tons of garbage per day, or roughly 75% of the residential and commercial waste generated in the city. It spans an area of 2900 acres with a height of roughly 150 feet.

The Staten Island community is a good locale for testing the research hypotheses for a number of reasons. First, the landfill was opened at a time when there were few governmental regulations imposed on municipal solid waste facilities. Requirements such as: (a) the selection of site based on hydrogeological assessments; (b) the use of

specific cover material and synthetic liners; (c) groundwater monitoring; (d) control of disease vectors, air quality and explosive gases; and (e) construction of leachate collection and monitoring systems were never considered at the time the landfill was built. It is no surprise, therefore, that this site now poses several risks to the residents in the community. For example, estimates show that the landfill is presently leaking close to two million gallons of leachate a day, with adverse consequences on the adjacent waterways (Goldstein and Izeman, 1990). Other problems associated with it include the noxious odours, particularly during the summer months, the noise from bulldozing operations, trucks and cranes, litter, and gaseous emissions such as methane and carbon dioxide laced with other compounds. The garbage also provides a breeding ground for flies, mosquitoes, rodents and other vectors that transmit diseases.

In recent years, many residents have called for the closure of the landfill (Polan, 1991). This, however, is not likely to happen in the near future because, according to government sources, the landfill has a remaining capacity of approximately 85 to 90 million tons. It is therefore expected to operate well into the next century (NYC-Department of Sanitation, 1992).

One option available to residents in this community is to search for ways in which the conditions at the landfill site can be improved by phasing in some of the basic requirements of proper management into the current operations, and by taking steps to minimize the health hazards imposed on the community. The CVM approach utilized in this study therefore provides a unique means of finding out whether the residents are willing to pay to achieve these improvements.

3.2. SURVEY DESIGN

Using a stratified random sample method, 450 households were initially selected for study. The households were stratified into two groups based on the proximity to the landfill site. The first group consisted of 230 households that lived within a four mile radius of the landfill site, and the second group involved 220 households living beyond the four mile radius. In October 1992, a questionnaire was mailed to these households accompanied by a stamped return envelope and a letter explaining the purpose of the study. The 57-item questionnaire covered five major areas:

- 1. The residents' awareness and knowledge of the environmental characteristics of the community;
- 2. Their attachment to the community;
- 3. Their perception and appraisal of the conditions at the landfill;
- 4. Their means of coping with those conditions; and
- 5. Their willingness to pay to mitigate these conditions.

The survey also secured the demographic characteristics of these households. All of the questions were written or modified specifically for the study based on procedures and findings of previous studies. Questions about willingness to pay were based on the approach employed by Roberts *et al.* (1991). Specifically, respondents were asked to imagine a hypothetical situation in which they could pay higher local taxes into a fund that would ensure the improvement of the conditions at the waste site. They were then asked to indicate, on a predetermined scale, the maximum amount of money they would be willing to pay for such an undertaking.

Characteristic	Distribution (%)
Age	
18-29 years	7.3
30–44 years	35.3
45–64 years	37.3
65 + years	19.1
Gender	
Male	69 ·1
Female	28.2
thnicity	
White	87.3
Other	12.7
ducation	
Grade school	1.8
High school	20.9
Some college degree	36.4
Advanced degree	40.0
ousehold income	
Under \$19,000	5.5
\$20-\$29,000	8.2
\$30-\$39,000	10.9
\$40-\$59,000	29.1
60,000 +	42.7
umber of persons in the household	
1	13.1
2	28.0
3	20.6
4+	38.3
ome ownership	
Renters	15.1
Owners	84.9
ngth of stay in community	
Under 10 years	37.7
11-20 years	23.6
21-30 years	19.8
over 30 years	18.9
oximity to landfill	
Within four miles	53.6
Beyond four miles	46.4

TABLE 1. Selected characteristics of the respondents

4. Results

4.1. PRELIMINARY ANALYSES

The overall response rate was 24%, which was not unusual for a survey of this type. A set of 110 usable questionnaires was retained for the analysis. Table 1 summarizes some of the background characteristics of the residents. Of the 110 respondents interviewed, 85% owned their homes. Many (63%) had lived in the community for more than ten years. Roughly half (54%) of the homes were found within four miles

of the landfill and the other 46% lived beyond four miles (these percentages reflected the initial sampling plan that called for approximately equal numbers of households within and beyond four miles of the landfill). Among the factors that influenced the residents' decision to move into this community, 70% of the respondents suggested the lower crime levels relative to the rest of New York City. The second most important factor was the presence of family members in the community. The demographic profile of the sample reflected a large proportion of white (87%), male (69%) respondents between the ages of 30 to 64 years (72%). The respondents were also well educated with relatively high household incomes. About 76% of them had some training beyond high school and 72% earned over \$40 000 a year.

The level of awareness of the environmental conditions in the community was significantly high. Ninety-four percent of the respondents were well aware of the landfill and its associated environmental problems. This result was predictable given the age and size of the waste facility. For a problem that had persisted for over forty years, it was no surprise that many residents had a clear understanding of the situation in their community. The proximity to the landfill had no significant effect on awareness levels. Residents beyond the four-mile radius were just as knowledgeable about the existing conditions as those who were closer to the site. Among the primary sources of environmental information were newspapers, neighbourhood communication and television broadcasts.

In appraising the conditions in their community, roughly 89% reported air pollution and waste disposal as the principal environmental problems. The fact that so many residents cited air pollution was no surprise. This was a problem that originated not only from the landfill but also from industrial emissions in the adjacent communities of New Jersey. Approximately 68% of the respondents rated these conditions as severe.

For questions relating directly to the landfill, 60% claimed that they did not feel safe having a waste facility in their community. Among the problems associated with the facility some respondents (55%) documented the unsightly conditions, including the presence of trash and litter at the site, 35% mentioned the noise, and 65% cited the noxious odours. Some (33%) also reported psychological stress and health related problems among members of their households.

Finally, for questions regarding potential environmental improvements, roughly 53% of the residents were willing to pay some amount in the form of higher taxes to improve the conditions in the community. The average amount offered was \$125 per year. Among those not willing to pay, 20% said they cannot afford to pay anything, while another 40% said they objected in principle to the whole process. Others expressed resentment at this question, particularly because the bulk of the garbage originated from the other boroughs in New York City and not from their community.

4.2. ANALYSIS OF VARIANCE RESULTS

Further statistical analysis included ANOVA (analysis of variance) to identify the different sources of variation in the data (see Table 2). The results indicated that there were significant variations in the willingness to pay for environmental improvement (F=4.88; P<0.05). Overall, the fit of the model was good (\mathbb{R}^2 =0.55) meaning that 55% of the variance in the model had been explained. The sources of variations can be identified in three areas.

F value	Р
7 60	
7 60	
7.09	0.0006*
7.50	0.0023*
10.17	0.0001*
9.53	0.0001*
2.13	0.1000
1.90	0.1236
1.79	0.1911
1.00	0.3256
1.96	0.1418
7.48	0.0104*
3.77	0.0208*
3.71	0.0221*
6.71	0.0001*
4.46	0.0201*
1.52	0.2202
4.21	0.0080*
1.03	0.4072
10.85	0.0001*
1.68	0.1818
5.11	0.0029*
	$\begin{array}{c} 7.69\\ 7.50\\ 10.17\\ 9.53\\ 2.13\\ 1.90\\ \end{array}$ $\begin{array}{c} 1.79\\ 1.00\\ 1.96\\ 7.48\\ 3.77\\ 3.71\\ 6.71\\ \end{array}$ $\begin{array}{c} 4.46\\ 1.52\\ 4.21\\ 1.03\\ 10.85\\ 1.68\\ 5.11\\ \end{array}$

TABLE 2. Results from the Analysis of Variance Procedure Dependent Variable: Willingness to pay

*Significant at 0.05 level.

4.2.1. Demographic variables

These variables included the age, sex, ethnicity, income and education of the respondents and the number of persons in their households. The results showed that most of the demographic variables were significant except for ethnicity and the number of persons in the households. A test of mean differences among the groups provided details of the variations. For example, on average, respondents between ages 45 to 64 were willing to pay more than any of the other age groups. Male respondents were willing to pay twice as much as their female counterparts. The level of education showed that those with advanced degrees offered to pay higher average amounts than any of the other respondents. Similarly, households with higher incomes (over \$60,000) were more generous than lower income households.

4.2.2. Residential characteristics

The variables included here were home ownership patterns (renters/owners), location or proximity to the landfill, length of stay in the community and the level of attachment to friends and family in the community. None of the main effects of these variables were significant except for the interactions between them (see Table 2). For example, the interaction between home ownership and length of stay was highly significant in explaining variations in willingness to pay. Homeowners who had lived in the community

the longest (over 30 years) were willing to pay the most to improve the conditions in the community. Similarly, the interaction between home ownership and proximity to the landfill yielded significant results. As expected, owners within the four mile radius offered to pay significantly more for the upkeep of the environment than renters within or beyond the four mile radius.

In assessing the level of attachment to the community, the results showed that those who had moved into the community primarily to be with friends and family were more likely to pay for environmental improvements than those who moved in for other reasons.

4.2.3. Awareness and appraisal of the landfill conditions

Two sets of variables were included here: the level of awareness of environmental problems in the community; and appraisal of the conditions of the landfill. The latter included concerns about health and safety of the environment, the noise, odours, the potential decline in property values and the severity of these problems. Overall, four out of seven of these variables were significant (see Table 2). These included awareness, concerns about odours, health and loss of property values. Those who expressed concerns about the declining value of their property offered more than those who did not. Similarly, higher levels of awareness and concerns about health and noxious odours promoted greater willingness to pay for environmental improvement.

5. Summary and research implications

This study has sought to identify the existing problems at a waste disposal facility and evaluate the degree of awareness and perception of risks among the residents in the host community. Using the contingent valuation method, respondents were asked to state their willingness to pay for improved environmental quality. The importance of different demographic, cognitive and residential characteristics of the respondents were then employed to assess the residents' decision.

Results of the study were largely encouraging. Nearly half of the residents interviewed were willing to pay some amount to bring about changes in their environment. Estimates showed that, on average, the households interviewed offered as much as \$125.00 a year to pay for improved environmental quality. Consistent with previous studies, significant differences were found among the respondents based on household income, age, education, and gender. Highly educated residents with large household incomes were willing to pay significantly more than others resident in the community.

The main effects of variables measuring the residential characteristics such as proximity to the landfill, length of stay in the residence and home ownership were not significant. However, the interactions between the variables proved to be good predictors of the residents' decision to participate in the clean-up efforts. For instance, homeowners who had lived in the locality for over thirty years with vested interests in their property, were more likely to offer larger amounts than renters.

The results of the study also suggested that variables such as awareness, and concerns about noxious odours, health and safety had significant effects on the decision to pay. It was not surprising that these variables were significant. Residents in this community had a clear understanding of their problem and consequently based their decisions on their personal experiences.

From a planning perspective, this study represents a new and important direction in

the research area because it transcends the discussion of cognitive and behavioural adjustments to more practical responses designed to improve the conditions in impact areas. Victims in hazard-prone communities provide a unique source for studying not only the types of adjustment and coping patterns, but also answers to the kinds of options that can be taken to alleviate the effects of the hazards.

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