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PROMOTIONAL STRATEGIES FOR THE PREVENTION AND PROPER DISPOSAL OF HOUSEHOLD HAZARDOUS WASTES

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ABSTRACT

In an attempt to develop new approaches for the prevention and proper disposal of household hazardous wastes, a behavioral research project was conducted in Broome County, New York. Questionnaires were mailed to 595 households randomly selected in three communities. The questions addressed several issues including the characteristics of wastes generated by residents, their awareness of the hazardousness of these products, and their current and preferred disposal practices. Twenty-six percent of the targeted households completed the surveys. In analyzing the data, a logistic regression model was developed to investigate the extent to which residents were willing to take part in a series of source reduction and collection events. The research findings provide the basis for developing alternative approaches to ensure the safe storage and proper disposal of these products.

INTRODUCTION

Household Hazardous Wastes (HHW) are wastes that are produced by households that would otherwise be regulated as hazardous materials if they were generated by businesses or organizations [1]. These wastes originate from the use of certain consumer products such as household cleaning agents, paints, solvents, batteries, automobile fluids and maintenance items, pesticides, and several hobby chemicals. In the absence of any standardized federal regulations over the handling and disposal of these materials, they are likely to pose health and environmental risks if stored or discarded improperly. These concerns have

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forced public officials and regulatory agencies at state and local levels to implement household waste collection programs.

In a continuing effort to develop and strengthen the effectiveness of these programs this study examined the underlying factors influencing public involvement in scheduled collection events held in various municipalities. As once argued by Ebreo and Vining, this type of research which explores the linkages between the underlying beliefs and actions of individuals and consumers is crucial for the development of effective environmental programs [2]. The research objectives were fourfold: 1) to assess the amount and variety of hazardous materials that are generated and stored by households; 2) to determine the levels of awareness and perception of hazardousness of these materials and the collection programs that are currently in place to ensure their safe disposal; 3) to evaluate the effectiveness of current collection efforts; and 4) to measure the degree of public support for permanent collection activities.

The article begins with a discussion of the trends in the implementation of HHW programs and the major factors that influence the effectiveness of these programs in the United States. The research hypotheses are then presented followed by analysis using survey data from Broome County, New York. The results are based on a detailed examination of the perception and involvement of residents in the collection events. The article ends with a summary of the major findings and some suggestions on improving the quality of existing or proposed programs.

TRENDS IN THE DEVELOPMENT OF HHW COLLECTION PROGRAMS

Household hazardous waste (HHW) collection programs have become increasingly popular over the last decade. Many communities have sponsored one- or two-day collection events each year by inviting residents to drop off their products at specific locations for safe disposal. Few have set up mobile or permanent collection sites where residents can drop off their material at their own convenience. In New York State, the first HHW collection program was established by Broome County in 1982. Thereafter, many towns and counties in the state initiated their own collection day events with a peak of seventy-three collection days held in 1990. Similar trends in waste collection efforts have been noted nationwide with an establishment of more than 4600 one day collection events by 1992 [3].

Statistics from the New York State Department of Environmental Conservation [1] on all HHW collection events held in the state over a five-year period (1990-1994) were reviewed for this study. The variables consisted of the types and volume of HHW materials collected, the sponsors of the events, the collection sites, total costs, and participation rates. The total operational costs were computed from the disposal costs and other expenses incurred during the

collection events. The disposal costs included the costs of collection, handling, and disposal of the materials by contractors hired by these localities. The other costs were based on the expenses incurred from publicity campaigns and personnel hired to manage these events. The average participation rates was based on the percentage of local residents that participated in the events held in each community.

The trends over the five-year period showed that participation levels in the programs were low relative to the high costs of operating them. For example, in 1994, about sixty collection day events were held in various municipalities with an average participation rate of .28 percent. Yet, the costs for these single day events ranged from $10,000 to over $300,000 per collection day. Overall, participation levels were erratic, changing from year to year, with the highest rate observed in 1992. On the other hand, the operational costs increased consistently over the years.

A review of previous studies conducted on HHW programs in other communities also revealed similar trends related specifically to: 1) the lack of knowledge among residents about household hazardous wastes in general or the programs implemented in their communities; 2) the degree of participation; and 3) the costs of operations. A study in Albuquerque, New Mexico showed low levels of awareness accompanied by poor participation rates; only about 28 percent of the residents could name one hazardous product and 12 percent could not name any [4].

A more comprehensive study that was based on all nationwide programs instituted prior to 1986 also concluded that few programs were attracting up to 1 percent of their households [5]. The average participation rate in these programs was, overall, less than .2 percent. Moreover, the study showed that the unit costs of these operations were high. Well publicized programs with high participation rates cost more than $2.00 per pound of HHW collected while those with limited publicity and low participation cost approximately $9.00 per pound ($18,000 a ton).

Another study by Scudder and Blehm in Larimer County, Colorado found that many residents could not identify toxic products in their homes [6]. The level of awareness of proper disposal methods for these products was limited as well as knowledge of the potential effects of these materials if discarded improperly. The study also found that motivation to dispose of these products correctly was not high. Similar findings noted by McEnvoy and Rossingnol in Benton County, Oregon showed that incorrect disposal methods were being used by the majority of the respondents for almost all of the HHW products included in the survey [7].

The effectiveness of HHW programs has also been influenced by additional factors such as those associated with recycling, anti-littering campaigns, energy conservation, and pro-environmental activities in general. For example, the type of collection method adopted by the regulatory agencies may impact on public involvement. One day HHW collection events are popular among local officials but tend to attract a small percentage (less than 3%) of households. On the other

hand, permanent and mobile programs have drawn higher rates of 2 to 10 percent depending on the kinds of materials that are accepted. The highest rates (over 50%) have been achieved in programs using point-of-purchase collection methods for products such as car batteries and used oil [8].

Some researchers have also reported that distance or proximity of the collection program influences the quantity of materials that are delivered [9]. Also, the willingness to travel to these collection sites may also depend on the degree of urbanization of the area. In a study by Tuthill et al. [10], residents were asked how far they were willing to travel to dispose of their hazardous wastes. The results showed that about 70 percent of the rural residents were willing to travel up to five miles compared to only 46 percent of the urban residents.

Another study by Shorten et al. suggested the relevance of perception of the harmfulness of HHW products in explaining public involvement in these collection efforts [3]. By focusing on automotive products the study revealed that respondents who felt that these products posed significant health and environmental risks were more likely to dispose of these products in an environmentally responsible manner.

RESEARCH HYPOTHESES

The consensus from several of the studies conducted so far suggest that planning for household hazardous waste collection programs may not be as easy as once thought by local and state officials. Successful HHW collection programs require extensive planning and coordination of activities among all of the parties involved. Simply scheduling a one- or two-day collection event and publicizing it through the mass media for a week prior to the event may not be enough to motivate residents. Several additional factors need to be taken into consideration such as the knowledge and perception of the hazardousness of the products generated by the residents, the types of collection programs preferred by the residents, the location and accessibility of these collection sites, and the demographic and attitudinal characteristics of the residents. This study was devised to address the relative importance of these factors in planning for new programs, particularly, permanent HHW facilities which are gaining popularity in communities nationwide. The research hypotheses were formulated as follows:

1. The perception of the hazardousness of the products by residents influences the storage and disposal patterns. Specifically, residents who believe that these products are dangerous are less likely to store them in their homes, and more likely to dispose of them properly.
2. Residents have specific preferences in the choice of collection methods for HHW.
3. Public support for a permanent HHW facility is a function of locational, demographic, attitudinal and economic factors.

RESEARCH DESIGN

A survey was conducted in Broome County, New York, which as indicated earlier, has been at the forefront of HHW collection efforts in the state. At least one or two collection events are held each year costing an average of $100,000. Each event attracts approximately .8 percent of the total population and more than 200 drums of used paints, solvents, pesticides, batteries, used motor oil, antifreeze, and other miscellaneous items are collected. Given the relative success of these single-day events, county officials recently decided to find a long-term solution to the HHW problem by building a permanent facility that will provide year-round collection services.

The survey instrument consisted of a three-page questionnaire designed to cover all of the major objectives of the study as outlined earlier including: 1) storage of various materials classified as HHW by the New York State Department of Environmental Conservation; 2) perceptions of the hazardousness of these items; 3) current disposal practices and preferences; 4) willingness to support the proposed permanent facility in the County; and 5) the attitudinal and demographic attributes of the residents. Several of the questions were based on standardized formats developed by researchers in previous studies [6, 10, 11].

To ensure adequate representation of all geographic units in the county, the research sample was drawn from three communities: 1) Binghamton, an old urban community with approximately 53,000 residents; 2) Vestal, an evolving suburban community with 26,733 residents; and 3) Chenango, a rural locality with about 12,310 persons. Using the local telephone book as the sampling frame, a total of 595 residents was randomly selected. The sample was stratified into three groups with the size of each group made proportional to the degree of urbanization in each of the three localities. About 70 percent of sample was drawn from the Binghamton and Vestal and the remaining 30 percent came from Chenango.

The final questionnaire was administered by mail to the residents in July 1995 following a pretest and some minor modifications. The decision to use a mail survey was based on several factors. Of primary importance, however, was the need to ensure that residents would have ample time to go through their basements, garages and other storage areas to systematically document all of the HHW products. The original response rate was low, a problem that is not unusual for mail surveys. After the first three weeks, follow-up letters were issued once to nonrespondents with some success. A total of 137 usable questionnaires were returned. Another twelve of the questionnaires returned were incomplete and unusable. Also, sixty additional questionnaires were sent back due to wrong addresses. These households were considered to be noncontact households. Using the ratio between the number of usable questionnaires received and the number of households contacted, the effective response rate for this survey was 26 percent.

SURVEY RESULTS AND DISCUSSION

The basic demographic characteristics of the sample are provided in Table 1. There were no significant differences by age, gender, ethnicity, income and education among the urban, suburban and rural residents. Slightly over 70 percent of those interviewed were between thirty to sixty-four years of age. The ethnic composition was predominantly white and about two-thirds of these subjects were males. Educational and income levels were widely distributed even though at least 35 percent of the subjects were college graduates and about 30 percent earned over $60,000 a year. There were significant differences in home ownership patterns among residents in the three municipalities. About 92 percent of the renters were from the urban area and the remaining 8 percent were from the rural Chenango. Overall, respondents were primarily homeowners many of whom had lived in the community for a relatively long period of time. Even though homeowners were not specifically targeted in the study, the fact that there were so many of them in the sample was beneficial for two reasons. First, homeowners are more likely than renters to engage in home improvement activities, gardening, and other projects around the home that will generate hazardous wastes. Second, homeowners are more likely to store larger quantities of HHW since they have greater access to garages, basements, and other storage areas than renters.

Generation and Storage of Household Hazardous Wastes

Estimates provided by the Broome County Environmental Council showed that approximately 1,000 tons of HHW were generated annually by residents in the county [12]. Another 2,000 to 4,000 (about 50 pounds per household) were believed to be stored in the homes of residents. To evaluate the nature and characteristics of these materials, respondents were asked to go through their storage areas and document the different types of materials found in their homes.

As expected, the most common materials stored by residents were primarily home cleaning agents such as bleaches, abrasive powders, disinfectants, drain cleaners, rug and upholstery cleaners, and furniture polish. Nearly three-quarters of all households interviewed indicated that they kept these materials at home (Figure 1). It was surprising to learn, however, that besides home cleaners, about 90 percent of the households had paint and other related products in storage. These consisted of many varieties such as enamel, water-based and oil-based paints, thinners, turpentine, and paint/varnish removers.

Perception of the Hazardousness of Waste Materials

Survey respondents were asked to indicate the extent to which they perceived the different HHW products to be harmful to their health and the environment.

Table 1. Selected Demographic Characteristics of the Sample

Variable	Categories	Distribution (%)
Age	18 to 29 years	2.2
	30 to 44	29.4
	45 to 64	43.4
	Over 64	25.0
Educational Level	Grade school	2.2
	High school	21.9
	Some college	15.3
	College	33.6
	Advanced	25.5
Ethnicity	Blacks/Hispanics	1.4
	Native Americans	3.4
	Whites	92.6
	Other	3.7
Home Ownership	Renters	11.8*
	Owners	88.2
Household Income	Under $20,000	14.5
	$20,000 to $29,000	12.9
	$30,000 to $39,000	16.9
	$40,000 to $49,000	13.7
	$50,000 to $59,000	11.3
	Above $60,000	30.6
Length of Stay	1 to 10 years	15.4
	11 to 20	13.2
	21 to 30	19.1
	Over 30	52.2
Location	Binghamton (Urban)	46.6
	Vestal (Suburban)	24.8
	Chenango (Rural)	28.5

*Significant difference across communities ($p < 0.05$).

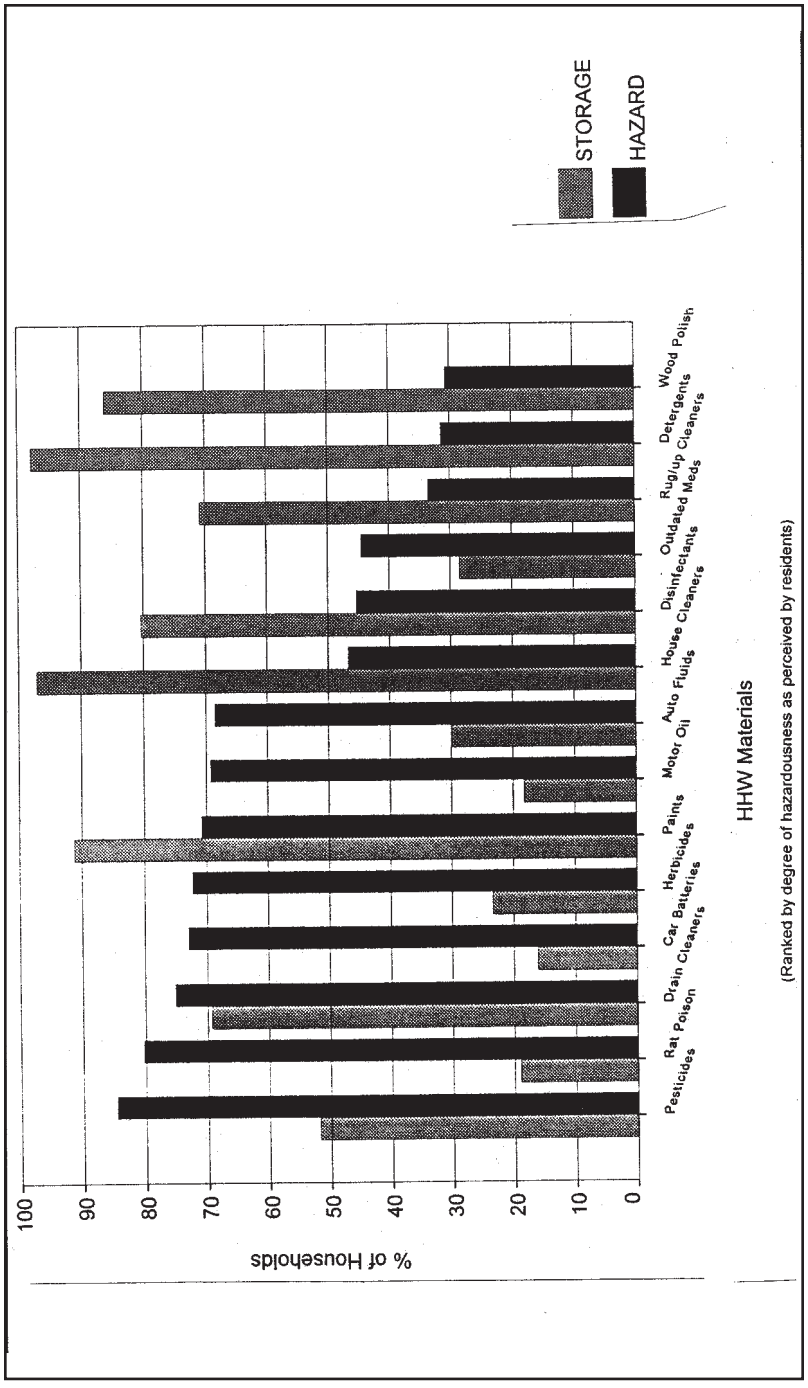

Figure 1. Storage and perception of hazardousness of HHW.

Overall, many of the materials were considered to be harmful products. The most dangerous products cited by residents were pesticides and rat poisoning (Figure 1). These were closely followed in descending order by drain cleaners, car batteries, herbicides, and paints. At least 70 percent of the households rated these products as hazardous materials.

The relationship between the perceived harmfulness of the household products and storage of these materials was examined. As indicated earlier, one should expect a strong negative correlation between the perceived hazardousness of these products and storage in homes. An analysis of the association between the two sets of variables using Chi-square tests showed that the relationships were insignificant (at $p < 0.05$); implying that residents were likely to store these materials regardless of their perception of how hazardous they were. This was particularly apparent for paint products, drain cleaners, and pesticides for which more than half of the respondents stored these products, yet over 70 percent of them regarded them as hazardous.

There are two potential explanations for the observed findings. First, it is possible that the decision to purchase and/or store these products is primarily influenced by the usefulness of these materials in accomplishing household chores/projects rather than the environmental or health risks that they pose. Second, residents may have had no direct harmful experiences with these products, so that, even though they are considered hazardous they continue to buy them anyway. Residents may be convinced that the chances of an accidental ingestion or spill are so remote that it is perfectly acceptable to purchase and store unused portions of these chemicals. Unfortunately the harmful effects of several of these products may not always be as dramatic as chemical leaks or spills. For the most part they tend to go unnoticed. Toxic fumes, for example, may be released slowly over time and will be eventually inhaled by household members resulting in health problems.

Current and Preferred Disposal Options

The disposal practices of survey respondents was difficult to quantify and probably overestimated because we relied primarily on self-report measures. With the exception of outdated medications, very few respondents (less than 15%) indicated that they disposed of HHW materials in the garbage. About 80 percent of those interviewed reported that they were most likely to use up all of the cleaning products including drain cleaners, rug and upholstery cleaners, furniture polish, disinfectants, and other home cleaners. Car batteries and other automobile products were most likely to be recycled or taken to collection events. About half of the residents also indicated that they were likely to take paint products to collection events (Table 2).

In evaluating the disposal methods favored by residents, they were asked to select one of four collection options: 1) a temporary collection site; 2) a

Table 2. HHW Disposal Patterns among Residents (% Distribution)

Materials	Garbage	Recycle	Collection Program	Use it All
Drain cleaners	0.8	1.5	13.1	81.1
Rug/up cleaners	8.5	1.5	5.4	84.5
Wood polishes/waxes	11.5	0.8	4.6	83.2
Disinfectants	7.6	2.3	6.8	83.3
Household cleaners	5.2	2.2	4.4	88.1
Paint products	0.0	9.9	55.7	32.8
Pesticides	0.0	5.7	41.1	53.3
Rat poison	0.0	10.2	40.7	49.2
Herbicides	5.2	0.9	44.8	49.1
Car batteries	0.8	40.8	57.5	0.8
Used motor oil	0.0	45.8	53.3	0.8
Auto fluids	0.8	29.7	52.5	16.9
Outdated medications	69.0	1.7	19.8	8.6

permanent facility; 3) a special curbside pickup; and 4) taking the unused portions to the point-of-purchase. Slightly over half of the respondents (54%) opted for a special curbside pickup for the household hazardous wastes compared to almost 20 percent each for temporary collection programs and permanent facilities. This finding contradicts the previous study by Tuthill et al. in Massachusetts which showed that there were no particular preferences among residents [10]. The strong preference for curbside pickup in this study, however, can be explained by the fact that residents are generally familiar with curbside operations given the success of the current recycling program in the county. However, it does suggest also that many residents are unaware of the dangers inherent in an HHW curbside program. Sanitation workers, for example, may be injured if a toxic container accidentally opens during the collection process. Also, materials will have to be picked up promptly to avoid accidental ingestion by children playing outside, or spills along the curbside.

Public Support for a Permanent Collection Facility

As indicated earlier, county officials voted in 1994 to establish a permanent collection facility that will supplement the current collection efforts. One of the stated objectives of this study was to evaluate the extent to which residents would support the establishment of this facility. Several questions were asked regarding participation in these efforts, travelling distance to the site and willingness to pay for the containers taken to the facility.

Nearly 89 percent of those interviewed showed support for the permanent collection facility. A one-way analysis of variance was performed to test the effect of urbanization on how far residents were willing to travel to deposit their HHW materials at the permanent facility (Figure 2). The average distance was ten miles with subtle differences among residents in urban and those in the suburban and rural communities. The overall F statistic ($p > 0.1$) showed that the observed differences among residents in various communities were statistically insignificant.

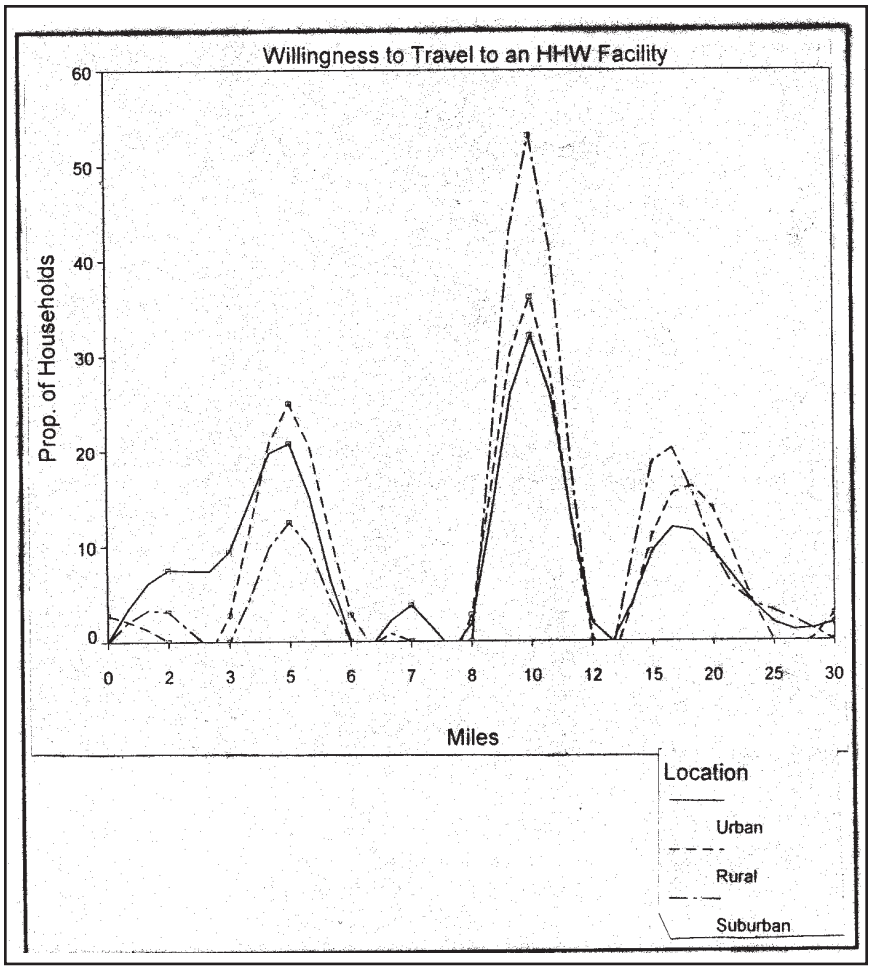

Figure 2. Willingness to travel to an HHW facility.

Another issue that was addressed in the survey had to do with disposal fees. Like landfill and other solid waste disposal options, most permanent HHW facilities require that residents pay tipping fees toward the final disposal of the products delivered at the site. The disposal fee may be based on charges per car load or charges per pound depending on the type of waste delivered at the site. This matter was addressed by a series of survey questions regarding 1) whether residents are willing to pay for the materials taken to the facility, and 2) to indicate the maximum amount that they would agree to pay per 10 pounds container of waste. Preliminary analysis of these variables showed that only 39 percent of the respondents expressed willingness to pay for materials taken to the facility. Among those who were willing to pay, the median price offered was up to $2.00 per ten pounds container.

Finally, a logistic regression was performed to identify the factors that influenced the willingness to pay (WTP) for disposal of the materials at the proposed facility. Four sets of variables were included: 1) demographic factors such as age, income, and education, 2) residential factors such as location of the resident and length of stay in the community; 3) environmental attitudes of the respondents, and 4) their perception of the harmfulness of these materials.

The procedure utilized the backward stepwise approach (Table 3). Three variables were retained in the model as significant predictors of WTP. These consisted of the environmental attitudes of the respondents, their length of stay in the community and income levels. Among the six income categories, however, only households earning between $50,000-$60,000 expressed some willingness to pay for disposal at the permanent facility.

The fit of the model was good with a chi-square value of 17 (df = 7; p = 0.01). Overall, 64 percent of the cases were correctly classified. Among those who indicated that they will not pay for disposal, 76 percent were correctly classified. Among those who indicated that they will pay, only 46 percent were accurately classified. These results suggest the need for uncovering additional factors that will help identify potential participants in permanent waste collection facilities.

CONCLUSIONS

This research has attempted to evaluate the effectiveness of HHW collection programs based on the expenses incurred and the level of community support for the programs. Four major conclusions were drawn from the study. First, the results suggest that there is no consistency between the rising costs of operating HHW programs and the relatively weak participation rates. Second, residents continue to buy and store HHW materials regardless of the perceived harmfulness of these materials to their health or the environment. Third, residents have specific preferences for the type of HHW collection methods. Many residents

Table 3. Summary Table for Logistic Regression
(Backward Stepwise)

Dependent Variable: Willingness to Pay for HHW Disposal

Independent Variables in the Equation:
Location (Rural, Urban, or Suburban)
Length of Residence
Age (Three categories)
Income (Six categories)
Education (Four categories)
Environmental Attitudes
Perception of Hazardousness of Materials

Variables Retained	b Value	S.E.	Wald Statistic	*Df.*	Partial *r*
Constant	–.89	.653	1.882	1	
Attitudes	.340	.173	*	1	.108
Length	.025	.011	3.86*	1	.134
Income			*	5	.000
Income (1)				1	.000
Income (2)	–.137	.637	4.86*	1	.000
Income (3)	–.923	.668	*	1	.000
Income (4)	.365	.572	8.21*	1	.000
Income (5)	–.649	.634	.05	1	.131
	2.462	1.13	1.91		
			.41		
			1.04		
			4.78*		
			*		

prefer curbside HHW collection programs and are generally unaware of the dangers of such a program. They are, however, willing to support permanent facilities as well. Residents in the urban, suburban and rural areas are willing to drive up to about 10 miles to deposit their materials at these facilities. So, the degree of urbanization has no observable impact on how far residents are willing to travel to deposit these materials. Finally, only about two out of every five residents are willing to pay for the disposal of HHW products. The latter depends on their length of stay in the community, favorable environmental attitudes and income levels.

It is anticipated that these results will be useful particularly for communities that are looking for ways to cut costs and improve the efficiency of their HHW programs. Existing programs must be revised to accommodate the issues

addressed in this study. The public must be encouraged to learn more about the toxicity of the products that they purchase. Educational programs must emphasize the benefits of non-toxic products and substitutes over existing products in order to reduce the amount of potentially hazardous products that are stored in the homes. Collection programs must be well designed to promote higher levels of resident involvement. One viable option to expensive one-day collection events is the establishment of regional permanent facilities that are convenient, easily accessible and open at all times to the public. Residents must be encouraged to visit such facilities regularly and if necessary pay for the disposal services. It is only through these kinds of approaches that one can effectively minimize the dangers of household hazardous products to human health and the environment.

REFERENCES

1. New York State Department of Environmental Conservation, *Household Hazardous Wastes: 1993 Annual Report,* Division of Hazardous Substance Regulation, Albany, New York, 1994.
2. A. Ebreo and J. Vining, Conservation-Wise Consumers: Recycling and Household Shopping As Ecological Behavior, *Journal of Environmental Systems, 23*:2, pp. 109-131, 1993-94.
3. C. V. Shorten, M. L. Glowacki, and M. M. Lynch, Household Hazardous Wastes and Automotive Products: A Pennsylvania Survey, *Journal of Environmental Health, 57*:7, pp. 19-24, 1995.
4. A. Salas, *Residential Hazardous/Toxic Waste Survey,* New Mexico Department of Health and Energy, Albuquerque, New Mexico, 1983.
5. United States Environmental Protection Agency, *A Survey of Household Hazardous Wastes and Related Collection Systems,* Office of Solid Waste and Emergency Response, Washington, D.C.: EPA/530-SW-86-038, 1986.
6. K. Scudder and K. D. Blehm, Household Hazardous Wastes: Assessing Public Attitudes and Awareness, *Journal of Environmental Health, 53*:6, pp. 18-20, 1991.
7. J. W. McEnvoy and A. M. Rossingnol, Household Hazardous Waste Disposal in Benton County, Oregon, *Journal of Environmental Health, 56*:3, pp. 11-15, 1993.
8. D. Duxbury, A Look at Household Hazardous Waste Management Trends, *Waste Age,* pp. 15-19, October 1989.
9. H. E. Jacobs, J. S. Bailey, and J. I. Crews, Development and Analysis of a Community-Based Resource Recovery Program, *Journal of Applied Behavior Analysis, 17,* pp. 27-45, 1984.
10. R. W. Tuthill, E. J. Stanek, C. Willis, and G. S. Moore. Degree of Public Support for Household Hazardous Waste Control Alternatives, *American Journal of Public Health, 77*:3, pp. 304-306, 1984.
11. E. S. Bass, R. L. Calderon, and E. L. Khan, Household Hazardous Wastes. A Review of Public Attitudes and Disposal Problems, *Journal of Environmental Health, 52*:6, pp. 358-361, 1990.

12. C. Stallman and S. V. Thompson, *A Plan for Household Hazardous Waste in Broome County,* Vols. 1 and 2, submitted to the Broome County Legislature, 1991.

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