

Attitudes and Household Characteristics Influencing Solid Waste Generation: A Household Garbage Analysis

Donald J. Epp and Paul C. Mauger

A survey of household decision-makers and an analysis of their garbage was used to suggest factors affecting the weight of household contributions to municipal solid waste. Iterative regression was used to build a model from the data that is hypothesized to explain garbage weight. Food expenditure, environmental attitude, consumption of soft drinks in plastic bottles, and cats in the household were significant for all households. Self-sufficiency and energy-conscious behavioral scales also affected the subgroup with female householders having an educational level of high school graduation or less.

Increasing attention is focused on the municipal solid waste disposal problem. The odyssey of the garbage barge wandering the eastern seaboard of the United States in 1987 looking for a place to unload and being rejected at every port except, finally, in the state from which it started gave national attention to the frequently unnoticed public policy problem. As society requires greater care in developing waste disposal facilities and as communities increasingly reject proposed landfills, even for their own wastes, the market price of waste disposal increases rapidly. One response is to examine ways of reducing the amount of waste needing disposal through recycling or reduction in the amount of waste generated by modern living.

The purpose of this study was to determine household characteristics that are related to the amount of solid waste generated and to suggest policies that would reduce the pressures on increasingly scarce landfill space. The attitudes, behaviors, and characteristics of a sample of households were related to the amount of their household solid waste. The relationships discovered indicate hypotheses which, if substantiated by further testing, can suggest public policies to reduce this component of municipal solid waste.

The Study

This paper reports results from a portion of a larger study of the volume and energy intensity of household wastes. Data was collected by mailed questionnaire from a random sample of multi-person households in single-family dwellings in the State College, PA, area. A sub-sample of the respondents to the questionnaire had a detailed analysis of the content of materials they placed at the curb for garbage pick-up. The garbage analysis phase was conducted during November, January, and February of 1985–86. Selection of this time period eliminated yard wastes as a significant portion of the solid waste. There is substantial difference among the households in the study area with respect to lot size (thus, amount of yard waste produced) and requirements to place yard waste for separate collection from household waste. Since the focus of this study was on the household portion of the waste stream, the time period chosen avoided collecting large amounts of extraneous waste. Details on sample selection and data collection methods are given in Mauger.

The weight of garbage per household placed for collection weekly was chosen as the dependent variable since weight is the basis for tipping fees at most landfills and thus, the factor determining the cost of waste disposal. Ordinary least squares regression was employed to determine the relationships between the weight of garbage and various independent variables described below.

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Defining Independent Variables

Two types of independent variables were examined in this study: (1) personal and household characteristics, and (2) attitudes, values, and behaviors of the household food buyer. Personal and household characteristics considered were household income, weekly household food expenditure, age of the household food buyer, educational level of the household food buyer, number of adults working outside the home, household size, number of children in the household, and the presence of pet cats and/or dogs. Variables that measured attitudes, values, or behaviors were whether the household recycled materials, whether the household composted waste material, the number of fruits and vegetables produced at home, the presence and level of use of various household appliances, the reported use of certain beverage containers, and the frequency of eating meals outside the home. Three additional independent variables were constructed from factor analysis of responses to a set of questions about attitudes and beliefs. These variables were an index of environmental attitudes of the household food buyer, an index of the nutritional awareness of the household food buyer, and an index indicating reduced consumption of meat.

Data for these variables were obtained from the mailed questionnaire. Regression equations were run iteratively to fit a model explaining the weight

of a household's weekly garbage pick-up. The variables selected using this procedure to estimate the models reported here are described below. Descriptions of the remaining candidate variables may be found in Epp and Mauger.

Results

Readers are cautioned that this is exploratory research and the use of iterative selection procedures to build a model lead to probabilities of "statistically significant" results that are different from the alpha levels stated (see Freund and Debertin). While further testing and development of the model is needed, it is instructive to examine the six factors that demonstrated a statistically significant relationship with total garbage weight—the amount of money spent on groceries each week, the environmental attitude factor scale, two scales on alternative lifestyles, the reported use of plastic soda bottles, and the presence of cats in the household (Table 1).

Information gathered by personal contact with participants while selecting the subsample for garbage analysis led to the inference that most food buying in this sample is done by women and thus the education of the household female was used, although the education of both male and female householders was tested. More educated food buy-

Table 1. Factors Affecting Total Weight of Garbage Pick-Up, State College Area, 1985, by Educational Level of Female Householder

Variable	Parameter Estimates		
	High School Graduate or Lower (n = 29)	At Least Some College (n = 47)	Total Sample (n = 76)
Intercept	41.7 (2.6, .02)*	46.7 (2.8, .01)	41.7 (3.5, .001)
Weekly Food Expenditure	0.2 (3.7, .001)	0.03 (insignif)	0.1 (1.6, .11)
Use Plastic Soda Bottles	8.2 (2.4, .02)	8.3 (2.4, .02)	7.9 (3.1, .003)
Cats in Household	4.5 (1.9, .07)	2.3 (insignif)	3.1 (1.8, .08)
Environmental Attitude	-1.7 (-2.0, .05)	-2.3 (-2.1, .04)	-1.7 (-2.5, .01)
Self-Sufficiency (grow fruits and veg., compost, eat less meat)	0.9 (1.9, .07)	0.09 (insignif)	0.4 (insignif)
Energy-Consciousness (own and use fewer appliances, recycling, eat less meat)	-0.5 (-2.0, .06)	0.04 (insignif)	0.2 (insignif)
R ² , adjusted for d. f.	.49	.17	.27

*Numbers in parentheses are t-statistic and significance level.

ers may be more informed and aware about the implications of their own behavior concerning solid waste, leading to a negative relationship between education and the dependent variable. Educational level was tabulated as an index from one to six corresponding to survey response categories from "eight years or less" to "some graduate study" (which included those with graduate degrees). While specific types of learning such as that obtained by participation in environmental groups or health organizations might also influence purchasing behavior, too few members of the sample participated in any particular group to make meaningful comparisons of subgroups.

Education of the food buyer (female householder) was found to interact with many of the other independent variables. These effects can be shown most clearly in this analysis by treating education as a binary variable to divide the sample into two groups to compare the results of identical models run on each group. Those with no more than high school graduation were separated from those with post high school education, although both higher and lower cut-off points were tested. The relationships found were most significant for the portion of the sample that had female householders whose formal education was high school graduation or less. Table 1 shows explanatory factors for the two subgroups, and for the whole sample.

The significance level chosen to separate the coefficients considered significant from those considered insignificant was .11, since no *t* scores had a probability level between .11 and .19. Thus this cut-off provides a distinct difference between significant and insignificant variables. The sub-sample with lower educational level had an adjusted R^2 of 0.49, while for the other group and the total sample, less of the variation was explained.

Intercept

The intercept is 41.7 pounds, meaning that a large pick-up would be obtained given zero values of the influential variables. Since the average pick-up weighed 28.1 pounds, the sum of the effects of the explanatory variables on the average was negative. The weights of weekly garbage pick-up ranged from 8.0 pounds to 72.6 pounds.

Weekly Food Expenditure

The parameter estimate for weekly food expenditure was 0.2 for the subgroup with high school or less education, meaning that for every additional dollar spent on food, 0.2 pounds of additional garbage was generated. That group spent an average

of \$64.93 each week for food. For the total sample, where the average weekly food expenditure was \$69.42, the parameter estimate was 0.1, also significantly different from zero. The diagnosis for multicollinearity revealed, however, that household income for 1985 and household size are each closely related to weekly food expenditure. Further examination of the three variables failed to uncover a method for explicitly incorporating the multiple effects. Therefore the best solution possible is to realize that the food expenditure coefficient represents a combination of the effects of all three variables.

Food expenditure had no significant effect in the group where female householders have education beyond high school and spend an average of \$72.19 per week on food. Solid waste production seems to be independent of food expenditure and the related variables in this group.

Consumption of Soft Drinks in Plastic Bottles

The use of specified types of containers was hypothesized to contribute to the weight of household waste. For instance families consuming significant amounts of soft drinks in nonreturnable glass bottles may have more packaging waste than those who use other soft drink containers or who drink none at all. Use of each container type for milk, soda, or beer was reported on the questionnaire and was entered as a binary value for each variable, given a value of one if used and zero if not.

One of the more intriguing results of the study was a statistically significant relationship between reported use of plastic soda bottles and garbage pick-up weight. Even when the weight of soda bottles was subtracted from the total garbage weight, the relationship remained strong. On the average, households who reported buying soft drinks in plastic bottles threw away 8.2 pounds (7.9 pounds in the total sample) more garbage than those who either bought soda in other containers or who bought none at all.

To determine whether this phenomenon was related to plastic bottle consumers only or to persons buying soft drinks in any containers, a variable indicating consumption of soda in any kind of container was used to replace the plastic bottle variable. Its coefficient was of similar magnitude and the remaining variable coefficients were near the values given in Table 1, except for environmental attitude. The environmental coefficient had changed from -1.7 to -1.1 and had dropped out of statistical significance ($p = .22$). This was found to be the result of a multicollinearity problem masking the effect of environmental attitude on garbage

weight. The variable for soda in all containers correlated negatively with environmental attitude ($p = .05$). The plastic soda bottle variable was not related to environmental attitudes, which explains why no collinearity problem existed before, but implies interesting conclusions that attitudes about the environment affect the decision to consume soda but have no impact on whether or not a consumer chooses plastic bottles for soda purchases.

The second problem was to determine if the plastic soda bottle variable was related to any other variable for which it might be acting as a proxy. The use of plastic soda bottles was found to be negatively correlated (significant at the .0002 level) with the response to one nutritional item, "More expensive brands of food are usually more nutritious than cheaper brands." This may mean that reported plastic soda bottle purchases are acting as a proxy for preferences for cheaper foods, a high value on economy of food purchase, or awareness of the difference between nutritional value and price.

Perhaps what appears as a large effect of plastic soda bottle usage on garbage weight may include a small positive effect of nutritional awareness. Indeed some practices suggested by nutritionists lead to precautionary behavior that could produce more refuse. For instance the purchase of milk in paperboard containers is advocated over returnable glass, because light may break down certain vitamins.

Cats in the Household

Pets in the household were expected to affect total garbage weight. If cats are a part of the household, cat litter may be present in the garbage. Feeding any pet would also produce pet food packaging waste. On the other hand pets, especially dogs, might eat table scraps and bones, thus decreasing total garbage weight. The questionnaire contained four possible responses each for cats and dogs indicating "zero," "one," "two," and "more than two" animals present in the household. Each variable was coded with four values from zero to three corresponding to the categories. The variable for each pet was tested as a separate variable, and the sum of both was tested as a third variable.

The presence of cats in the household (but not dogs) had a statistically significant relationship with garbage weight. The estimated coefficient indicates that each additional cat reported in the household contributed 4.5 pounds (3.1 pounds in the total sample) on the average to the total weight of garbage per week. This can be explained by the presence of disposed cat litter. When present in the garbage samples studied, cat litter frequently weighed

from 15 to 20 pounds. Given an average of .37 cats per household, or 25% having one to three cats, and perhaps 30 to 50% of them being indoor cats requiring cat litter which is replaced every few weeks, a reasonable conclusion is that enough cat litter was found, weighed, and recorded to produce such a differential weight for homes with cats.

A portion of the coefficient for cats in the household may be due to a relationship between the number of cats and household size. Regression of household size on the number of cats indicated a significant positive relationship which might mean that the coefficient on number of cats is, in part, a proxy for household size.

Attitude Variables

Some of the variables on the questionnaire were combined into indexes or scales reflecting a particular attitude. For example, the questionnaire included items about environmental and nutritional attitudes, such as, "I think old things should be used up or worn out before new ones are bought," and "Powdered milk is not as nutritious as fluid milk," to which respondents marked a response from a five point scale ranging from "strongly agree" to "strongly disagree." The eight environmental and nine nutritional questions had been developed and tested in a previous study of the correlates of food utilization (Harrison). Responses from the present study were analyzed using item analysis, internal consistency correlations, factor analysis and reliability tests to construct a weighted environmental attitude scale of four items and two weighted scales of nutritional awareness (Mauger). The environmental attitude scale was found to have a statistically significant relationship to the weight of household garbage and is discussed below. Other items on the questionnaire were combined to form a scale indicating a preference for self-sufficient living and a scale reflecting energy-consciousness. Each of these scales was significantly related to the weight of household wastes and is discussed in the following sections.

Environmental Attitude

Environmentally concerned food buyers were hypothesized to be less likely to buy foods with a high level of processing and packaging. This preference would lead to a negative relationship between favorable environmental attitude and the amount of food packaging. Furthermore, environmental awareness may lead to recycling or conservation, which would reduce the solid waste.

Environmental attitude was measured by an index composed of environmental items on the questionnaire, summed according to weights determined by factor analysis. Each item was scored from one to five, the higher score being associated with a more environmentally-oriented response.

The environmental attitude of the householder is negatively related to the weight of a garbage pick-up, as was hypothesized. For the whole sample and each sub-sample a higher score on the environmental scale (more favorable attitude toward the environment and conservation) tended to decrease the solid waste generated by the household.

The coefficient was estimated at -1.7 indicating that an increase of one point on the scale (with a minimum of 2.57 and maximum of 12.85) was associated with a decrease in garbage by 1.7 pounds per week. Environmental attitude could reduce solid waste either by reduced use of products generating waste or by recycling of wastes materials. Since the coefficient remains statistically significant in both educational subdivisions, environmental attitude has a significant effect on the amount of garbage generated regardless of the educational level.

Self-sufficiency Lifestyle

The index of self-sufficiency was developed from three elements on the questionnaire: home production of fruits and vegetables, composting, and eating less meat. This index had a positive relationship with garbage pick-up weight. With a minimum of zero and a maximum of 166.9, each incremental point was associated with an increase of 0.9 pounds of garbage. In terms of the individual elements, a one point increase in the index means one of three things. First it could mean a decrease in meat consumption by about one half meal per week, depending on the kind of meat. The second possibility is an increase in the number of types of fruits and vegetables grown by 1.2, and the third, an affirmative response to the practice of composting. Since composting has the potential to affect the scale by a maximum difference of about one point, the coefficient here most likely represents the effects of the first two variables. Growing food at home could contribute significantly to the amount of food waste during the growing season, but not at the time of the study (November, January, and February). Those who produce their own food may have preferences for fresh foods which carry over into winter, causing them to buy produce and leading to an increase in food scraps in the garbage. Perhaps the more vegetarian consumer tends to buy more produce as well, resulting in a similar increase in food scraps.

Energy Conscious Lifestyle

The relationship between garbage weight and the energy conscious behavioral scale conforms to expectations. A person scoring an additional point on this scale on the average disposes of 0.5 pounds less garbage. In terms of the individual elements of this lifestyle scale (with possible range from zero to 329.9 and actual scores from 122 to 311), an incremental point may result from a small decrease in meat eaten with meals each week, an increase in recycling, or a decrease in the presence and usage of appliances. Although one of the appliances found in many of the homes was a garbage disposal, the use of which would reduce the weight of garbage placed at the curb, the analysis produced the same results when adjustment was made for the presence of a garbage disposal.

Conclusions

Results of this investigation confirm the importance of income, family size and weekly food expenditures (collectively represented in this study by the variable weekly food expenditures) as determinants of waste generation. This association is widely accepted in household consumption theory and is consistent with logic and previous studies (Brooks; Connor et al; Efaw and Lanen; Harrison; Phillips et al; Rathje and Thompson). Likewise, the finding that the presence of cats in the household is an important determinant of the total weight of household waste is logical and conforms to expectations. An interesting part of the consumption behavior revealed in this study that is not reported in previous studies and warrants further analysis concerns the relationships between environmental attitude, purchasing soda in plastic bottles and the weight of household garbage. Both of these independent variables were highly significant regardless of the educational level of the food buyer.

Policy Implications

A number of the findings in this study, if confirmed by subsequent testing, might be useful in developing public policies concerning household waste. The importance of attitudes, especially attitudes about the environment and nutrition, points to the possibility of programs to influence the relevant attitudes. The results of this study do not indicate what action would be most effective in changing attitudes, but they do indicate that changing certain attitudes would reduce the weight of garbage.

For example, a one point increase in score on

the environmental awareness scale was found to reduce weekly garbage collection by 1.7 pounds, or about 6% of the average amount. If the relationship between attitude and weight of garbage remains the same at greater distances from the mean, a few points increase in environmental attitude could cause reductions of 10 to 20% in the weight of the garbage households present for collection. If the average score of the quartile of respondents having the most "unfavorable" answers to the four questions in the environmental attitude scale were changed to the average score of the most "favorable" quartile, the environmental awareness score of the lower group would increase by 6.4 points, meaning a 10.88 pounds per week (about 38%) reduction in weekly average weight of garbage.

Information from the study indicates that designing a program to change attitudes related to the environmental attitude scale may be a complex process. Responses to three questions that relate most directly to waste reduction were eliminated from the environmental attitude scale because the responses exhibited too little variation to help in differentiating attitudes. The items eliminated were, "I think I personally have a responsibility to help clean up the environment; I agree with the old adage, waste not, want not; and I think recycling of newspapers, cans and glass containers is important and more people should do it." The items retained in the scale, while relating to environmental attitude, are less directly connected than those exhibiting less discrimination power. The retained items were, "I think the world is facing a crisis because we won't be able to feed all the people in the world in a few years; It is important for children to learn to clean their plates; I think old things should be used up or worn out before new ones are bought; and I think it's sinful to waste food if you can help it." These results suggest that a program to change attitudes must address a broader range of attitudes than just garbage and solid waste topics.

Another finding of this study also suggests that solutions to the waste disposal problem will be complex and difficult to discover and implement. Several independent variables, most notable the self-sufficiency and energy-consciousness indexes and the purchase of plastic soda bottles, have an impact on the weight of garbage greater than the weight of the items explicitly included in the in-

dependent variable. That is, the estimated impact of incremental changes in these variables is greater than the weight of the food wastes implicit in the self-sufficiency and energy consciousness indexes or the weight of the plastic soda bottles. This finding suggests that the variables examined are proxies for a broader set of consumption decisions. To suggest that regulating the explicitly considered items of consumption would have a substantial impact on the weight of garbage delivered for disposal is probably misleading. For example, a ban on the sale of plastic soda bottles probably would not lead to a reduction in garbage of the magnitude shown by the coefficients in this study. A greater understand of the lifestyle that is characterized by (or that includes) the purchase of soda in plastic bottles is necessary.

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