An Analysis of Factors Associated with Composting Behavior at the Household Level

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Most states have recently enacted municipal solid waste management legislation requiring communities to achieve a certain recycling rate or to reduce the amount of waste reaching landfills or incinerators by a certain percentage relative to a base year. Tennessee's 1991 Solid Waste Management Act required solid waste regions (one or more counties) to reduce the amount of waste disposal per capita by 25% by 1996. About half of the 63 regions in the state failed to achieve the goal by that date, and have been granted a five-year extension. Many of these regions proposed in their original plans to divert yard waste or other organic material through programs designed to encourage "backyard" composting (BYC) at the household level. However, very little progress in this regard can be documented at this point in time. A number of articles in waste industry magazines have described community programs designed to encourage BYC and reported estimates of the percentage of households that practice BYC [Riggle, 1996a; Riggle, 1996b; Sherman, 1996a; Sherman, 1996b; Vossen and Rilla, 1997]. However, there has been no systematic analysis of how household characteristics as well as social, economic, and institutional factors influence this type of resource conservation behavior.

This paper reports findings from a logit regression analysis designed to identify factors associated with BYC of three components of yard waste (grass, leaves, and shrub and tree trimmings) as well as food wastes. The sample data were obtained through a September 1997 telephone survey of 865 households residing in single-family dwellings in Knox County, Tennessee. Knox County represented a particularly instructive case study area for two reasons. First, it encompasses households that dispose of their solid waste in three different

manners. Approximately half of Knox County households (about 75,000) reside within the City of Knoxville, which funds curbside collection of household waste and unbagged yard wastes with property tax revenues. The other half of county households either subscribe to private haulers for pickup of household waste and bagged or bundled yard wastes, or deliver those materials to one of seven county convenience centers, which are funded with property tax revenues. In addition, the county has for several years sponsored a number of programs to encourage BYC.

Conceptual Framework

At the most basic level, a household was assumed to make the decision to compost or not based on the perceived costs and benefits accruing to its members. Perceived costs may include the amount of time and effort required to compost, the amount of space required, or the potential negative feelings of neighbors or peers. Perceived benefits might include the value of the end product as a soil amendment for gardening or landscaping purposes, the feeling of personal satisfaction in doing one's part in reducing the amount of waste that reaches landfills or conserving natural resources, or the potential positive feelings of neighbors or peers. If a unit pricing system of solid waste funding were in place, another household level benefit would be reduced solid waste disposal costs.

In building a conceptual framework, past research focusing upon explanations for why individuals or households engage in resource conservation or environmental behaviors was reviewed [DeYoung, 1996; Jakus, Tiller, and Park, 1997; Oskamp, et al., 1991; Vining and Ebreo, 1990; Vining, Linn, and Burdge, 1992]. Drawing heavily on this past research, as well as basic economic theory, broadly defined factors were identified which could be expected to influence households' perceptions of benefits and costs of composting, and thus

composting behavior. Survey questions were then developed to obtain data on specific variables representing these factors. The general factors that were hypothesized in this research to either directly or indirectly influence BYC included the following: behavioral attitudes, peer influence, knowledge, institutional arrangements, and socioeconomic characteristics.

Logit Analysis

Due to the binary nature of the dependent variable, whether households practiced BYC or not, a logit regression procedure was employed. Such an approach allowed identification of independent variables that were statistically related to BYC behavior. The coefficients of significant independent variables were used to estimate the impact of a unit change in an independent variable on the probability that a household participated in BYC.

Dependent Variables

Five separate models were estimated, each with a binary dependent variable indicating whether the household actively composted grass, leaves, shrub and tree trimmings, food, or any of the four materials. Of the 865 survey respondents, the following percentages indicated that they practiced BYC: grass, 19.2%; leaves, 20.2%; shrub and tree trimmings, 10.8%; food, 9.5%; any of the four materials, 27.9%. A significant number of additional respondents indicated that they "piled up yard waste at the back of their lot" (grass 6.4%, leaves 9.8%, shrub and tree trimmings 15.8%). While this activity might well be considered "passive" BYC, these responses were not considered BYC for the regression analyses.

Independent Variables

Information regarding the specific variables employed is summarized in Table 1. Specific variables reflecting behavior included RECTOT, MEMBER, and GARDEN. The

RECTOT variable was binary, indicating whether the household recycled four or more types of materials. Such complementary behavior was expected to increase the likelihood of BYC. Included with similar reasoning was the binary variable MEMBER, indicating whether the household held membership in any organizations dedicated to the protection of the environment. The binary variable GARDEN indicated whether the household had a flower or vegetable garden. This behavior was expected to increase the perceived benefits of composting in providing a valued soil amendment and perhaps offsetting out-of-pocket expenses.

The next factor group included variables associated with attitudes. The first was YARDREG, a binary variable indicating whether the respondent would support a ban on disposal of yard wastes in landfills, which was expected to have a positive sign. The binary variable EFFCOMP indicated whether or not the respondent thought that composting requires too much effort to be worthwhile, while another binary variable YARDSPAC indicated whether the respondent believed that composting requires too much yard space to be worthwhile. Having either of these attitudes was expected to reduce the likelihood of BYC.

Peer influence was represented by two variables. The binary variable COMPOST indicated whether the household had friends or family members who composted. The binary variable KIDINT indicated whether the household included school-aged children who had expressed an interest in recycling or composting behavior. Both variables were expected to exhibit a positive relationship with BYC.

A number of variables were included to reflect the respondent's knowledge concerning landfills, state law, and local programs. The binary variable DECOMPOS indicated whether the respondent believed that most materials decompose quickly in landfills, which is not the

case. If the respondent believed this to be true, they would seem less likely to compost themselves. The binary variable LAWS indicated whether the respondent was aware that the 1991 TN Solid Waste Management Act requires counties to reduce the amount of waste per capita going into Class I landfills by 25 percent. If the respondent was aware of this law, the hypothesis was that the household would be more likely to BYC and thereby assist in reaching the goal. The last two knowledge variables were MASTER and BINS. These variables indicated if the household was aware of the Master Composter and Recycler Program and the subsidized sale of backyard composting bins, both active programs within Knox County. Awareness was expected to be positively related to BYC.

Institutional arrangements were reflected in only one variable. This binary variable RESIDENT indicated whether the household was located within the city limits of Knoxville. Households within the city have access to "free" pick up of yard wastes at the curb and thus would seem less likely to BYC. City residents may also be less likely to compost than non-city residents because lot sizes are generally smaller in the city.

Four standard socioeconomic variables were also included. The binary variable OWNHOME indicated whether the household owned their place of residence and was hypothesized to be positively related to BYC. The continuous variable RESPAGE represented the respondent's age in years. The hypothesized relationship of this variable to BYC was considered indeterminate, given that influence in either direction could be reasonably argued. The binary variable EDUC indicated whether the respondent was a college graduate or not, a factor expected to increase the likelihood of BYC. The class variable RESPINCM represented income level. As with age, the hypothesized relationship between income and BYC was considered indeterminate.

Results from Regression Models

The results from the estimation of the regression models are summarized in Table 2. Four to seven independent variables in each model proved to be statistically significant at the 10% level. The variable YARDREG had a sign contrary to what was expected but it was significant only in the food model. Three independent variables were significant in all five models: GARDEN, representing complementary behavior; EFFCOMP, reflecting attitude toward the amount of effort required; and COMPOST, reflecting influence of family or friends.

In addition, composting of grass was more likely in households that were aware of the 25% waste reduction requirement in the state law, that owned their own home, and that were younger in age. Composting of leaves was more likely in households that saw yard space as less of a limitation, that owned their own home, that had children who had expressed interest in recycling or composting, and who had lower incomes. Composting of shrub and tree trimmings was more likely in households that were aware of the subsidized bin sale program. Composting of food was more likely in households that recycled four or more materials, that were aware of the 25% waste reduction requirement and the subsidized bin sales, and in which the respondent had completed a college education. Besides the three variables significant in all five models, the following variables were significant in the "ANY" model: RECTOT, BINS, OWNHOME, and EDUC.

With respect to overall goodness of fit, each of the models had a highly significant log likelihood score. Another indication of a logit model's goodness of fit is its ability to correctly predict the dependent variable. All five of the models had strong predictive characteristics, with each correctly predicting household BYC behavior in 75 to 81% of the

observations.

The coefficients of the independent variables found to be statistically significant at the 10% level were used to estimate the impact of a one unit change on the probability of BYC assuming all other variables to be at their mean or modal level. These values are summarized in Table 3. Having a garden increased the probability of BYC for particular materials by 2 to 8%, and for any material by 13%. The comparable impacts from having friends or family who compost were 5 to 13% and 20%, respectively. Home ownership, having a college education, and knowledge of the subsidized bin sale program increased the likelihood of BYC at least one material by 12%, 10%, and 8%, respectively. Having the attitude that composting requires too much effort to be worthwhile reduced the likelihood of BYC by 13%. Also of particular interest is that knowledge of the 25% waste reduction requirement appears to have a greater positive impact on the likelihood of grass composting (9%) than food composting (2%).

Conclusions and Policy Implications

The findings from the survey responses and regression analyses were highly consistent with expectations. For communities who, like Knox County, desire to increase the percentage of households practicing BYC, the findings appear to have policy implications along the following lines. Programs might well be targeted to audiences that appear more inclined to

practice BYC; households who are “serious” recyclers, gardeners, homeowners, and more highly educated. Strategies that effectively increase the visibility of composting among friends and neighbors may well have a major impact. Expansion of the subsidized bin sale program would represent one specific way of attempting to achieve this. A continued investment in K-

12 education programs would appear to be warranted, as would efforts to increasing awareness of the state's 25% waste reduction requirement. Finally, to counter the attitude that BYC requires too much effort to be worthwhile, communities may want to consider a unit pricing or "pay-as-you-throw" system for financing solid waste management which would give an explicit economic incentive for households to practice BYC. A potentially fruitful line of research would be to analyze how community characteristics, including the type of financing system, affect the percentage of households practicing BYC across communities.

Table 1. Independent Variables

Factor group	Variable name and definition	Hypothesized impact on BYC	Mean or percentage
Behavior	RECTOT: 1 if household recycled ≥ 4 items, 0 otherwise	(+)	46.4%
	MEMBER: 1 if household held membership in an organization dedicated to the protection of the environment, 0 otherwise	(+)	12.9%
	GARDEN: 1 if household had a vegetable or flower garden, 0 otherwise	(+)	68.4%
Attitude	YARDREG: 1 if household supported ban on yard wastes in landfills, 0 otherwise	(+)	50.6%
	EFFCOMP: 1 if respondent agreed or strongly agreed that composting requires too much effort to be worthwhile, 0 otherwise	(-)	21.6%
	YARDSPAC: 1 if respondent believed that composting requires too much space to be worthwhile, 0 otherwise	(-)	16.9%
Peer Influence	COMPOST: 1 if household had friends or family that compost, 0 otherwise	(+)	43.0%
	KIDINT: 1 if household had at least one child in grades K-12 that had shown an interest in recycling or composting, 0 otherwise	(+)	19.7%
Knowledge	DECOMPOS: 1 if household believed that most materials break down quickly in landfills, 0 otherwise	(-)	40.4%
	LAWS: 1 if household knew that TN law requires amount of materials being sent to landfills be reduced by 25%, 0 otherwise	(+)	16.7%
	MASTER: 1 if household was familiar or very familiar with the Master Recycler and Composter Program offered by Knox County, 0 otherwise	(+)	9.4%
	BINS: 1 if household was familiar or very familiar with the annual sale of composting bins coordinated by the City of Knoxville, 0 otherwise	(+)	26.6%

Institutional	RESIDENT: 1 if household was located inside the city limits, 0 otherwise	(-)	46.2%
Socioeconomic	OWNHOME: 1 if household owned their dwelling place, 0 otherwise	(+)	88.5%
	RESPAGE: actual age of respondent	(+/-)	
	EDUC: 1 if respondent was a college graduate, 0 otherwise	(+)	42.1%
	RESPINCM: Household taxable income 1 ≤ $12,500 2 = $12,500-$25,000 3 = $25,000-$35,000 4 = $35,000-$50,000 5 ≥ $50,000	(+/-)	1 = 9.8% 2 = 14.3% 3 = 18.0% 4 = 19.5% 5 = 38.4%

Table 2. Results from Logit Regression Models

	Dependent variable				
	Grass	**Leaves**	**Shrub**	**Food**	**Any**
Independent variables[a]	**Parameter estimate (Probability level)[b]**				
INTERCPT	-2.70 (0.00)	-2.81 (0.00)	-3.38 (0.00)	-3.49 (0.00)	-3.13 (0.00)
RECTOT	0.29 (0.24)	0.35 (0.14)	-0.09 (0.74)	0.73 (0.02)	0.38 (0.08)
MEMBER	-0.04 (0.89)	-0.17 (0.55)	0.11 (0.73)	0.56 (0.10)	0.33 (0.23)
GARDEN	1.22 (0.00)	0.87 (0.00)	0.81 (0.06)	1.09 (0.03)	1.03 (0.00)
YARDREG	-0.14 (0.56)	-0.02 (0.90)	-0.10 (0.71)	-0.54 (0.09)	-0.25 (0.27)
EFFCOMP	-1.14 (0.01)	-0.86 (0.04)	-1.08 (0.06)	-1.45 (0.06)	-1.04 (0.00)
YARDSPAC	-0.32 (0.55)	-1.14 (0.08)	-0.35 (0.60)	-1.08 (0.31)	-0.76 (0.12)
COMPOST	0.73 (0.00)	0.80 (0.00)	1.06 (0.00)	1.04 (0.00)	0.94 (0.00)
KIDINT	0.23 (0.39)	0.46 (0.08)	0.24 (0.43)	0.35 (0.30)	0.05 (0.83)
DECOMPOS	-0.05 (0.83)	-0.02 (0.93)	0.18 (0.52)	0.20 (0.54)	-0.14 (0.52)
LAWS	0.66 (0.02)	0.30 (0.30)	0.21 (0.54)	0.65 (0.08)	0.18 (0.50)
MASTER	-0.17 (0.62)	0.18 (0.60)	0.20 (0.60)	-0.29 (0.51)	-0.06 (0.83)
BINS	0.26 (0.30)	0.10 (0.67)	0.56 (0.05)	0.79 (0.01)	0.44 (0.05)
RESIDENT	-0.14 (0.57)	0.03 (0.87)	-0.38 (0.19)	-0.21 (0.51)	-0.02 (0.90)
OWNHOME	1.23 (0.02)	0.98 (0.04)	0.64 (0.28)	0.01 (0.97)	0.96 (0.02)
RESPAGE	-0.01 (0.07)	0.00 (0.95)	-0.01 (0.15)	-0.00 (0.72)	0.00 (0.46)
EDUC	0.41 (0.12)	0.32 (0.21)	0.36 (0.24)	0.61 (0.07)	0.52 (0.02)
RESPINCM	-0.17 (0.13)	-0.19 (0.08)	0.02 (0.87)	-0.23 (0.12)	-0.13 (0.18)
Log likelihood score	62.226 (0.00)	60.618 (0.00)	48.603 (0.00)	56.540 (0.00)	99.563 (0.00)
Prediction Success					
% concordant	75.7	74.8	76.7	80.8	78.0
% discon-cordant	24.0	24.9	22.9	18.8	21.8
% tied	0.3	0.3	0.4	0.4	0.2
# observations	506	469	531	533	533

[a]See Table 1 for variable definitions.

[b]This is the probability that the independent variable is actually unrelated to the dependent variable, based on a standard t-ratio test.

Table 3. Probability Impacts

	Dependent variables				
	Grass	**Leaves**	**Shrub**	**Food**	**Any**
Independent variables[a]	**Change in probability of BYC from unit change in independent variable[b]**				
INTERCPT	0.55	0.59	0.57	0.51	0.64
RECTOT				0.03	0.07
MEMBER					
GARDEN	0.08	0.08	0.02	0.02	0.13
YARDREG				-0.01	
EFFCOMP	-0.07	-0.08	-0.03	-0.02	-0.13
YARDSPAC		-0.09			
COMPOST	0.10	0.13	0.08	0.05	0.20
KIDINT		0.07			
DECOMPOS					
LAWS	0.09			0.02	
MASTER					
BINS			0.03	0.03	0.08
RESIDENT					
OWNHOME	0.08	0.08			0.12
RESPAGE	-0.00				
EDUC				0.02	0.10
RESPINCM		-0.02			

[a]See Table 1 for variable definition.

[b]Changes in probabilities are included only for independent variables significant at the 10% level. The values listed represent the change in probability that a household composts due to a one-unit increase in the independent variable.

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