Residential Solid Waste Generated in Low-income Areas

A Study of Residential Solid Waste Generated in Low-income Areas

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F O R E W O R D

Variations inherent in the generation of solid wastes make it extremely difficult to predict quantities that can be expected from a dwelling within a residential neighborhood. Some possibly influencing factors are climate, season, socioeconomic level, and dweller density.

The objective of this study was to examine the quantities and critical factors involved in the generation of solid wastes in low-income residential neighborhoods. The results are presented in order that a better understanding of waste quantities and characteristics may be obtained. The quantities reported may be used in conjunction with studies of similar areas to provide improved estimates of solid waste generation rates.

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A Study of Residential Solid Waste Generated in Low-income Areas

This study of solid waste generation characteristics was conducted during a four-week period over three collection routes in a low-income area of Cincinnati, Ohio to determine the quantities and critical factors involved in solid waste generation. It was assumed that there was no significant variation among the routes in the solid waste they generated and that, if combined, they would represent a typical low-income area with respect to waste generation. Testing of this assumption showed that combining the routes was valid.

Five variables that characterize the solid waste generated in this area were studied: pounds and gallons per sample point per week; pounds and gallons per capita per week; and, pounds per cubic yard. (Preliminary analysis indicated that the first two would be of little use in estimating waste generation because the quantities varied too greatly.)

A random sampling of houses was not made. Instead dwellings judged to be representative were studied, and the data collected were treated as if they had been acquired

from a random sampling. Solid waste from 15 residences on each route was collected and separated during the second week to determine its composition.

The following are average values for each dwelling type studied:

	Single family dwelling	Multifamily dwelling	Apartment house
Pounds/capita/week	12.54	9.83	6.91
Gallons/capita/week	14.07	11.00	5.61
Pounds/cubic/yard	179.97	180.50	248.87

Analysis indicates that:

1. The average solid waste contribution per person is constant within each of the dwelling classifications studied (multifamily, single-family, and apartments).

2. A fixed amount of solid waste (junk mail, lawn trimmings, etc.) is generated per dwelling regardless of the number of persons occupying it.

3. The total quantity of solid waste generated from a dwelling depends on the number of occupants, not the dwelling type.

4. Making comparisons of solid waste generation on a per capita basis alone may be misleading.

FIELD METHODOLOGY

Data Collection

After discussions were held with the Cincinnati Community Action Commission, three routes within an area bounded by Vine Street and Forest, Gilbert, and Dorchester Avenues were chosen for study. Statistics furnished by the U.S. Census Bureau indicated that they served a low-income area. An effort was made to use each dwelling on the three routes as a sample point. In all, 96 single family residences, 137 multifamily residences, and 6 apartment houses were studied for three consecutive weeks, and data regarding these dwellings were considered in the analysis.

Each of the routes selected could be observed on a different day of the week. This was convenient since the city provides once-a-week waste collection, and each route could be sampled in its entirety on one day.

Two study groups (each equipped with scales) were used to record data. Because the city trucks follow a strict schedule, the collection of data had to be adjusted so that the sanitation workers were not to be delayed.

After trial data collection runs were made over each route, formal data collection was begun. A 5-man forward crew, a truck driver, a data recorder, and three men who weighed the solid waste preceded the city collection truck

and two men who followed it weighed the empty containers. The forward crew also estimated the volume of the waste; both crews recorded the address of the dwelling whose occupants had generated it.

The cans were weighed to the nearest one-half pound on platform scales. Loose waste was placed in a 50-gallon carry can to be weighed and to have its volume estimated. Bulky items such as furniture, stoves, refrigerators, and washing machines were not considered. Estimates of solid waste volume were reported as full or half-full 10-, 20-, and 30-gallon cans. This sacrifice in accuracy was necessary so that the forward crew could remain ahead of the city truck.

The compositon of the solid waste was determined by manually separating samples collected during the second week of the study. From a table of 200 random numbers, 15 numbers were selected for each route. These numbers were noted by an asterisk on the numbered cards that were placed with groups of full waste containers. (The numbered index cards were used to correlate the weights of the full and empty sets of containers.) As the forward crew encountered a card containing an asterisk, it weighed the full containers, emptied the contents into plastic bags, and put identification tags on them. The bags were put in the rear of the scale truck and were later taken to the city garage where they were manually

separated into nine classes: paper products; food wastes; garden wastes; plastics, rubber, and leather; textiles; wood; metals; glass and ceramics; and ash, rocks, and dirt. All of the bags from each dwelling were treated as a single sample.

A door-to-door survey was carried out during the fourth week of the study to determine how many people lived in each dwelling. This information was used to obtain per capita generation rates.

Route Characteristics

In an attempt to characterize the routes, the Hamilton County Tax Office and Cincinnati Community Action Commission were contacted. Characteristics obtained included information about the occupants and the condition of their dwellings. Only information about single and multifamily dwellings was available (Tables 1 and 2). The data indicate that such dwellings were similar with respect to value and condition on all three routes.

Information was also gathered on the occupants of all dwellings for each route according to education, employment status, and total income (Table 3). The occupants of dwellings on route A had slightly higher levels of income, education, and employment than persons living on the other routes. Data were also gathered during a door-to-door survey (Table 4).

TABLE 1

CHARACTERISTICS OF SINGLE-FAMILY DWELLINGS SAMPLED*

Route	Dwelling value†	Land value†	Dwellings 50 years or older (percent)	Wooden frame construction (percent)	Dwellings with front footage of lot ≤ 40 feet (percent)	Dwellings in dilapidated condition‡† (percent)
A	$1,960	$9,480	68	41	50	15.9
B	2,260	8,020	79	68	59	14.8
C	1,400	5,260	68	65	85	16.9

*Based on 1962 Cincinnati tax assessment.
†Median value based on total number of dwellings for each route.
‡Very bad condition; major repairs needed.

TABLE 2

CHARACTERISTICS OF MULTIFAMILY DWELLINGS SAMPLED*

Route	Dwelling value†	Land value†	Dwellings 50 years or older (percent)	Wooden frame construction (percent)	Dwellings with front footage of lot ≤ 40 feet (percent)	Dwellings in dilapidated condition‡ (percent)
A	$2,840	$12,140	52	45	42	15.9
B	1,980	8,900	75	37	63	14.8
C	1,420	7,080	61	70	70	16.9

*Based on 1962 Cincinnati tax assessment.
†Median value based on total number of dwellings for each route.
‡Very bad condition; major repairs needed.

Information presented in these four tables indicates that the routes studied were similar with respect to dwelling and occupant characteristics.

TABLE 3

CHARACTERISTICS OF OCCUPANTS
OF ALL DWELLINGS FOR EACH ROUTE*
(Percentages)

Route	Heads of household with < 10th grade education	Heads of household unemployed	Families with income < $3,600
A	31.7	31.7	23.8
B	46.4	44.4	40.8
C	46.5	40.8	39.6

*Statistics furnished by Cincinnati Community Action Commission.

TABLE 4

DWELLER DENSITY*

Dwelling type	Route	Contributors per sample point (average)	Contributors per sample point (range)
Single family dwellings	A	4.0	1-9
	B	4.4	1-12
	C	4.5	1-11
Multifamily dwellings	A	10.6	4-21
	B	8.0	2-26
	C	6.5	3-14
Apartment houses	A	50.3	17-126

*Derived from door-to-door survey.

Data Analysis

The solid waste collected during the second week was separated to determine its characteristics (Table 5).

TABLE 5

RESULTS OF SOLID WASTE SEPARATION

Category	Percent of component (wet weight basis)*		
	Route A	Route B	Route C
Food	22.70	22.06	27.19
Paper	40.77	46.39	34.38
Plastics, rubber, leather	2.81	1.64	2.80
Textiles	1.11	3.03	1.85
Wood	0.28	0.12	0.67
Metal	8.43	8.39	10.19
Glass, ceramics	13.12	11.26	14.50
Ash, rocks, and dirt	5.03	6.86	5.44
Garden	5.66	0.28	2.95

*Average values obtained from 15 random samples per route.

The results were then compared to findings derived from a year-long study that had been made earlier of solid wastes generated in low-income areas of Jefferson County, Kentucky. The solid waste collected there, however, had been separated into only five categories; paper (all combustibles except

food wastes); garbage (food wastes); metals; minerals (ash, rocks, and dirt); glass (including ceramics). When the Cincinnati separation results were converted to these five categories, the results from both areas were similar (Table 6).

TABLE 6

SOLID WASTE CHARACTERISTICS BY AREA

Category	Percent of component (wet weight basis)	
	Cincinnati*	Jefferson County
Paper	48.2	56.4
Garbage	23.9	20.5
Metals	9.0	10.6
Minerals	5.7	1.1
Glass	12.9	11.2

*Result of combining routes for each component.

A summary of the means and standard deviations for each of the three quantities studied over the three-week period was formulated (Table 7).

These data indicate that waste generated by any given residence varied widely from week to week. Within any dwelling classification, however, there was a consistent relationship between the weekly per capita generation rate and the number of people in the dwelling type. It decreased as the

TABLE 7

SYNOPSIS OF STATISTICAL INFORMATION

Type	Route	Week	PCW		GCW		PCY	
			Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Single Family Dwellings	A	1	15.13	2.09	17.81	2.23	171.63	15.10
		2	18.31	2.80	17.93	2.45	206.20	21.55
		3	14.78	1.97	16.29	2.03	183.16	12.79
		Combined	16.07	1.32	17.34	1.28	187.15	9.88
	B	1	12.43	1.32	14.36	1.39	174.73	9.68
		2	12.60	1.85	14.33	2.04	177.65	13.84
		3	10.05	0.93	11.34	1.13	178.96	13.79
		Combined	11.69	0.82	13.34	0.96	176.97	9.21
	C	1	10.94	1.29	13.13	1.36	168.20	10.09
		2	11.83	1.35	13.96	1.53	171.23	10.60
		3	11.75	1.20	12.12	1.28	195.83	10.06
		Combined	11.51	0.73	13.07	0.81	177.82	6.08
Multifamily Dwellings	A	1	9.71	1.00	10.76	0.99	182.31	11.77
		2	9.00	0.94	9.91	0.95	183.50	10.24
		3	8.61	0.96	9.86	1.14	176.29	10.03
		Combined	9.11	0.56	10.18	0.60	180.75	6.19
	B	1	9.98	0.86	12.85	1.11	156.88	5.34
		2	10.04	0.87	11.50	0.92	176.34	8.19
		3	10.84	1.09	11.25	0.96	194.54	7.53
		Combined	10.29	0.54	11.87	0.62	175.07	4.41
	C	1	9.07	0.91	10.66	1.20	171.89	8.26
		2	9.87	0.87	10.65	0.85	187.21	8.70
		3	10.77	1.04	10.28	0.95	211.65	9.72
		Combined	9.91	0.54	10.53	0.58	189.99	5.45
Apartments*	A	1	5.46	1.24	4.97	1.19	221.82	15.77
		2	5.95	1.00	6.16	1.92	195.01	47.90
		3	9.33	1.57	5.70	1.39	330.71	94.39
		Combined	6.91	1.01	5.61	0.88	248.87	40.94

*Sampled on Route A only.

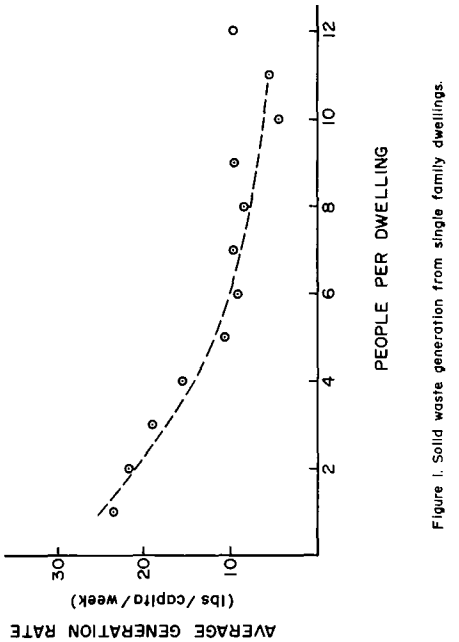

Figure 1. Solid waste generation from single family dwellings.

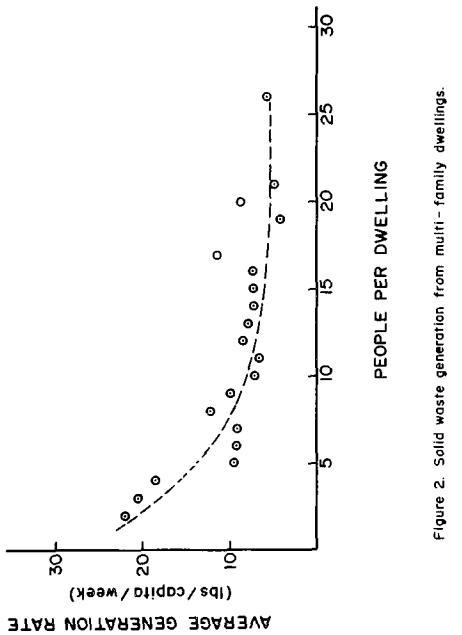

Figure 2. Solid waste generation from multi-family dwellings.

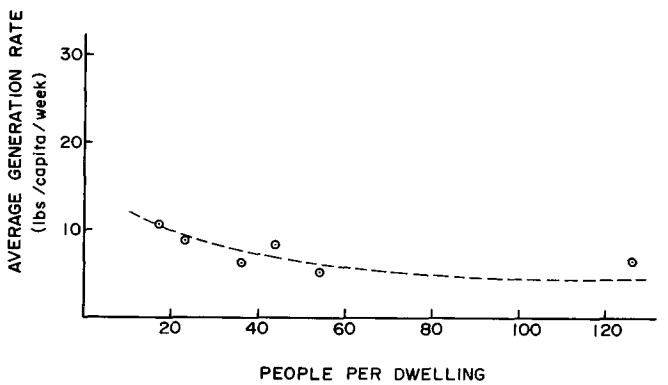

Figure 3. Solid waste generation from apartment houses.

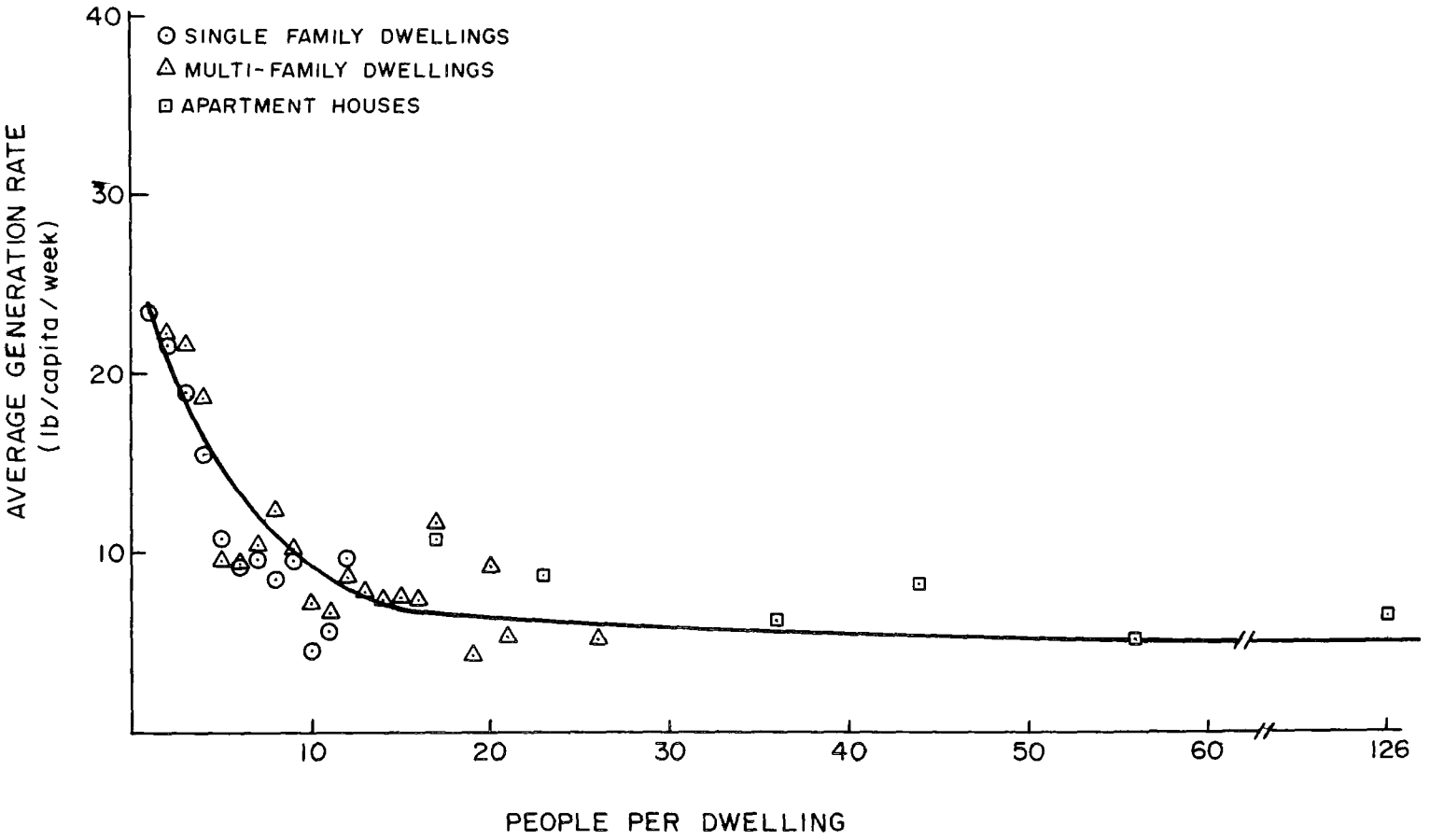

Figure 4. Solid waste generation from single family, multi-family and apartment houses.

number of people increased (Figures 1 to 3) but became asymptomatic (constant) to a value of 6 pounds after a value of 15 people per dwelling was reached (Figure 4). The explanation for this may be in the relationship established between average total waste generation per sample point and the number of people per dwelling for all dwelling types (Figure 5). A single family home with two people in it, for example, generated an average of approximately 33 pounds per week. The fact that the trend line begins at a point greater than zero indicates that the dwelling unit and its grounds contributed to the solid waste stream.

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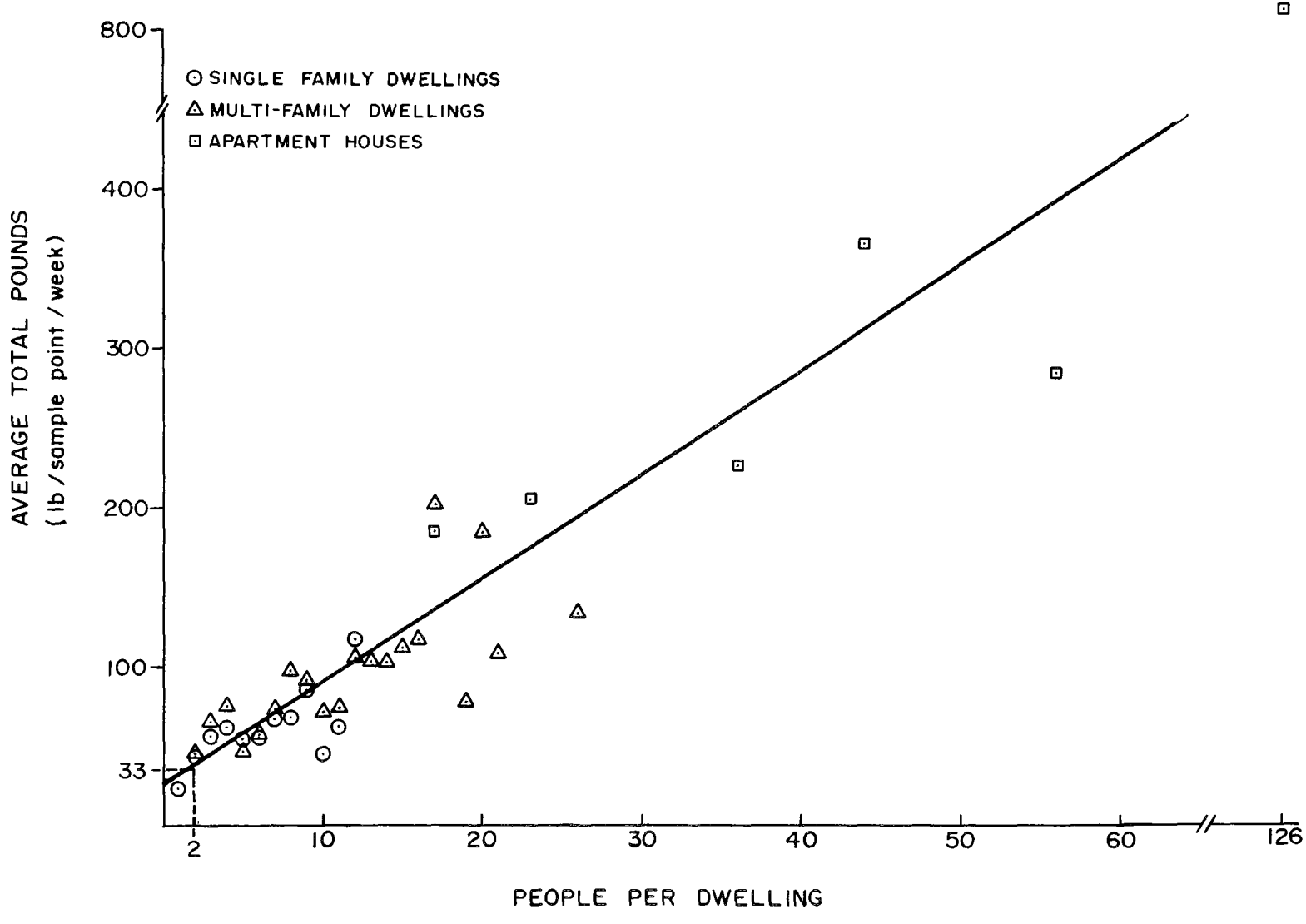

Figure 5. Solid waste generation from single family, multi-family and apartment houses.