

Solid Waste Management Systems in the Rural Southeast

Jesse R. Russell

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ABSTRACT

Part of an overall study of rural solid waste systems in the Southeastern United States, this report identifies and describes types and costs of 63 collection and 40 disposal systems used in rural communities and areas. Costs exceeded revenues in each case. Consolidation of small systems into larger, area-wide systems could generate more efficient, less costly operations. A later report will describe alternative systems best suited to small towns of various sizes, provide estimates on the amounts of solid waste to be generated in future years, and systems changes needed to handle this increased load.

Key words: Solid waste management, Costs, Revenues, Southeast United States.

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HIGHLIGHTS

Solid waste management systems operating in 1974 in the rural Southeast were not self-supporting. A study of 63 collection systems and 40 disposal sites disclosed that average costs for systems in small rural cities averaged nearly \$45,000 per year while revenues averaged only \$12,000. For county-owned systems, costs were \$35,000 and revenues \$17,000. Operating deficits were made up from taxes or other funds. Consolidation of small systems into larger, area-wide systems might permit more efficient and less costly operation.

Collection systems in small cities, serving an average 2,691 people, made up three-fourths of the systems surveyed, and county systems, providing service to about 11,145 people each, comprised an eighth of the systems surveyed. The rest were miscellaneous types not included in the detailed analysis. While city systems collected from house to house, most county systems placed containers at suitable sites along the road and collected at specified intervals.

Two types of disposal sites were used. Seventy-eight percent were landfills. Waste was covered daily with dirt to eliminate environmental hazards, and compacted to reduce volume. The other sites were open dumps, mostly owned by small cities. This type of disposal is no longer approved and dumps in use are being closed. City and county systems accounted for three-fourths of the total waste deposited at landfills, although private citizens could also use all sites.

Many systems did not charge for collection and disposal of solid waste; user charges did not cover operation costs. Average revenues from user charges for collection and disposal offset about 27 percent of total costs for city systems and about 49 percent for county systems. The total annual cost per capita of waste collection and disposal was \$16 for city customers and about \$3 for county customers. Total annual cost per ton of waste collection and disposal was approximately \$24 for city systems and \$17 for county systems.

Waste per capita averaged 2.1 pounds per day compared with the national average of 5 pounds. The low rate in the rural areas of the Southeast reflects in part the lack of house-to-house collection and the small amount of industrial activity.

SOLID WASTE MANAGEMENT SYSTEMS IN THE RURAL SOUTHEAST

Jesse R. Russell
Agricultural Economist

In the United States, the volume of solid waste generated daily per capita increased from 2.75 pounds in 1920 to about 5 pounds in 1970. It is expected to reach 8 pounds by 1980.^{1/}

As a result of Congressional passage of the Solid Waste Disposal Act of 1965, many State and local governments have enacted legislation imposing environmental regulations and restrictions requiring many changes in the collection and disposal of solid waste. Local governments and planners are faced with the problem of developing collection and disposal systems that will meet these environmental requirements at the lowest possible cost. Despite all the attention and planning efforts of Federal and State agencies, many rural areas in the Southeast need additional information to further their planning efforts.

This study provides information on costs, management, and types of solid waste collection and disposal systems now used in rural areas of the Southeast, and analyzes differences in these systems. It also compares labor requirements, equipment, and land used by the various systems.

Sample counties were selected from four Southeastern States -- Georgia, Alabama, South Carolina, and North Carolina. They were chosen to be representative of rural areas in the various regions: mountains, piedmont, and coast. In each county sampled, all rural cities and areas outside the cities were represented.^{2/}

To ensure that all solid waste systems were in rural areas, counties containing census districts with populations exceeding 10,000 were omitted. From the remaining list of counties, 25 were selected at random (table 1), and data were collected from each of them. These counties contained 125 cities with populations ranging from 102 to 9,670.

Two questionnaires were used -- one each for collection and disposal systems. These were designed to collect data on size of operations, management, financing, cost of operating, and other variables dealing with owning and operating collection systems and disposal sites. Data were obtained in 1974 by personal interviews with local government officials. A total of 103 questionnaires were completed -- 63 on collection systems and 40 on disposal systems.

^{1/} Brunner, Dirk R. and Daniel J. Keller. Sanitary Landfill Design and Operation. U.S. Environmental Protection Agency, 1972.

^{2/} As used in this report, city means populated places with less than 10,000 population.

Table 1--Population, total households, and household density, 1970

State and county	Population 1970	Total households	Rural households	Urban households	Households per square mile
<u>Number</u>					
Alabama:					
Bibb	13,812	4,476	4,476	0	7.2
Crenshaw	13,188	4,656	4,656	0	7.6
Geneva	21,924	7,674	5,168	2,506	13.3
Randolph	18,311	6,442	4,494	1,948	11.1
Georgia:					
Bleckley	10,291	3,209	1,673	1,536	14.7
Burke	18,255	5,485	3,629	1,856	6.6
Dooly	10,404	3,412	3,412	0	8.6
Fannin	13,357	4,772	4,772	0	12.1
Greene	10,212	3,263	2,359	904	8.1
McDuffie	15,276	4,873	2,676	2,127	19.6
Mitchell	18,956	5,787	2,729	3,058	11.3
Polk	29,656	9,893	5,276	4,617	31.7
Schley	3,097	983	983	0	6.1
Union	6,811	2,581	2,581	0	8.4
N. Carolina:					
Brunswick	24,223	11,429	11,429	0	13.4
Chatham	29,554	9,583	7,977	1,606	13.5
Clay	5,180	1,918	1,918	0	9.2
Graham	6,562	2,266	2,266	0	7.8
Madison	16,003	5,555	5,555	0	12.3
Pender	18,149	6,626	6,626	0	7.6
S. Carolina:					
Chester	29,811	9,322	6,015	3,307	16.0
Colleton	27,622	8,539	6,518	2,021	8.1
Jasper	11,885	3,656	3,656	0	5.6
Lee	18,323	5,172	4,068	1,104	12.6
Oconee	40,728	13,922	9,602	4,320	21.3

Source: U.S. Dept. Commerce, U.S. Census of Housing Detailed Characteristics - HC-(1) B12 - 1970

DESCRIPTION OF SOLID WASTE MANAGEMENT SYSTEMS

Many different solid waste collection and disposal systems are used in Southeast rural counties. Variations occur most frequently in type and size of collection equipment and in the amount of labor and land used. Many of these items affect the costs of operation and the general success of the system. Collection and disposal, separate operations in most areas surveyed, are described separately.

Collection Systems

Five types of collection systems were identified, but only two were analyzed in detail -- cities and rural areas. Others were tabulated to account for the 63 systems surveyed, but were not analyzed because of the small numbers represented.

(1) Cities only involve collection within boundaries of rural cities. The population of the city is used for this group in analyzing data relative to such items as per capita costs.

(2) Rural areas involve systems operating in those areas of the county outside the city limits not covered by city collections.

(3) The cities and some adjacent homes group was separated from the cities only group because the actual population served was not determined. Areas lying outside the city limits and collected by the city were not covered by the county collections and could not be included in the city collection because it was impossible to determine the number of people served.

(4) Part of rural area. Here, collection and disposal systems covered only part of a county. The areas collected were only the most densely populated part of the county, and waste collection was really the beginning of a county system. Officials planned to include all of the county by adding additional routes each year.

(5) Other. One system did not fall into any of the other four categories and was excluded from the detailed analysis. It reflected the impact of a college on solid waste collection and disposal.

Counties in the sample had both county and city collection and disposal systems. In most cases, these units were separate operations owned and operated by separate government entities. Therefore, they were analyzed separately according to the area served.

Areas Served

Forty-seven of the sixty-three collection systems surveyed operated in cities and were owned by the city governments. They served 126,477 people or 2,691 per system (table 2). Although the number of routes operated by each system varied, the average was 3.4 routes per system.

Table 2--Selected characteristics of 63 solid waste collection systems, 1974

Characteristic	Cities only	Rural area of county	City and some adjacent homes	Part of rural area of county	Other
No. of systems	47	11	2	2	1
Average population served per system	2,691	11,145	1,325	2,000	1,650
Average number of routes operated per system ^{1/}	3.4	4.1	4.5	5.0	5.0
Average size of crew per system ^{2/}	7.3	2.7	2.4	2.0	3.0
Annual hours worked per unit per route:					
Route ^{3/}	3,328	1,697	1,966	1,683	1,560
Disposal ^{4/}	555	383	234	442	260
Total capacity of vehicles per system (cu. yd.) ^{5/}	40.1	27.3	30.5	32.5	30.0
Miles traveled annually on routes (per system) ^{6/}	14,355	13,425	8,190	12,480	7,800
Miles traveled annually to disposal site (per system) ^{7/}	555	383	234	442	260

^{1/} Average number of routes per week per system.

^{2/} Average number of employees per system for collection.

^{3/} Actual amount of man-hours worked per unit per route while collecting.

^{4/} Actual amount of route man-hours of collection crew utilized at disposal site.

^{5/} Total capacity of all vehicles used in collection process.

^{6/} Actual miles traveled on collection routes for all vehicles used in collecting waste.

^{7/} Actual miles traveled from end of collection route to disposal site.

The 11 county collection systems were owned and operated by the county government and were independent of the city collection systems. These systems in operation in 1974 served an average population of 11,145, but it was not determined how many actually used the service. There was an average of 4.1 routes per system. The counties were divided into sections, serviced weekly. Collection routes consisted of trips to pick up containers, usually 4 or 6 cubic feet in size, located along the roadside.

Two city collection systems served a few homes adjacent to the city limits. There were four separate routes serving about 350 households. Each route operated on separate days, serving 75 to 100 homes per day.

In some cases, the collection system served only parts of the rural area. The two included in this study served an average population of 2,000 each. These systems normally served the most densely populated area of the county daily, 5 days a week.

Labor Requirements

Labor requirements discussed in this section relate to the operation of an average route. In most cases, the route operated twice each week, although some operated weekly. The 3,328 man-hours required to operate a route for cities only (table 2) refers to each route. These cities operated an average of 3.4 routes per system. Total man-hours equal the number of routes times the average number man-hours per route.

Labor required to operate a collection route varied according to the type of operation. The type and quantity of labor required is a key to the success of the operation. In many cases, a collection crew worked only 3 or 4 days a week, rather than a 40-hour week.

A city collection vehicle normally operated with a driver and two or three pick-up men. The crew averaged about seven men per system (table 2). This would indicate the average system used two collection trucks. Time worked per city route averaged 3,328 hours on the routes and 555 hours at the disposal site, or a total of 3,883 man-hours per route.

The average rural system used a crew of 2.7 men -- a driver and one or two pick-up men. Occasionally, a driver and three men were used in the more densely populated rural areas. In most county systems, only one vehicle was used. An average of 2,080 hours of labor were required because of occasional short routes. As a result, the workers have extra hours the county could use in other work.

The two systems that operated in the city and some adjacent homes were similar to the cities only systems. The number of men in the crew varied because these systems used part-time workers performing other city work when they were not actually collecting waste. Total number of hours worked per route is a more dependable measure of labor required. Both systems required only 2 or 3 days per week, usually less than full 8-hour days.

Equipment Use and Capacity

Major equipment used were vehicles that collected and transported solid waste from the collection point to the disposal site. The total capacity of all vehicles in city and county systems averaged about 25 cubic yards. This is a better measure of solid waste handling capabilities than the number of vehicles used. Hauling capacity of city vehicles was greater than the rural vehicles but there was little difference in distances traveled by vehicles of the two systems (table 2).

Types of Customers

Major types of customers served by collection routes were households, industrial, commercial (such as restaurants), institutions (schools, hospitals), and rural residents. About 75 percent of all customers were households and 23 percent commercial users. Most rural residents were served by green boxes located at collection points.

City collections systems served 89 percent of all households served (table 3); 80 percent of the industrial customers were also served by city only collection systems. City routes served 97 percent of the commercial customers. There were few such customers in rural areas; many of those delivered waste directly to the disposal site.

Table 3--Customers served by 63 collection systems, 1974

Area served	Number and type of customers served					Green boxes ^{1/}	Total
	Households	Industrial	Commercial	Institution	Number		
Cities only	35,280	149	11,885	236	0	47,550	
Rural area of county	2,752	18	62	8	680	3,520	
City and adjacent homes	510	14	205	9	0	738	
Part of rural area	520	0	21	2	0	543	
Other	500	5	100	10	0	615	
Total	39,562	186	12,273	265	680	52,966	

^{1/} Green boxes refer to collection boxes located along roadside or other strategic locations and are used for general collection boxes for the public.

Disposal Systems

Disposal systems are the methods used in the final disposition of solid waste collected by the 63 collection systems in the sample. Characteristics described for the 40 disposal sites are: type of disposal system, site ownership, population served, size of disposal site, site users, volumes of waste, and charges to site users.

Types

Only two types of disposal systems were reported: landfills and open dumps. Landfills were the most common, accounting for 78 percent of the disposal sites (table 4).

Table 4--Ownership and area served for 40 disposal systems, 1974

Type of disposal site	Sites	Ownership		Area served		
		City	County	City only	Rural area of county	Entire ^{1/} county
Landfill	31	5	26	5	4	22
Dump	9	8	1	8	0	1

^{1/} Entire county including town and all residents of county.

The sanitary landfill is designed to dispose of solid waste and minimize environmental hazards. Standard operating procedures include spreading the solid waste in thin layers over a designated area of the landfill as soon as it is received, and compacting the waste to reduce its volume. At the end of the day's operation, the waste is covered with a layer of dirt and compacted again.

The dump site is simply a designated area where solid waste is delivered and dumped. With no dirt or any type of cover applied to the waste, it creates a health hazard. This type of site is no longer approved as a method of disposing of solid waste. Those in use are being closed.

Site Ownership

City governments owned 13 disposal sites in the survey and county governments owned 27 (table 4). City governments owned eight of the nine dumps. These dumps were in small cities that had a low tax base and were financially unable to purchase and operate a sanitary landfill. New laws require abandonment of these dumps and formulation of plans for other type of waste disposal as soon as possible.

Twenty-two of the county landfills received all the county's solid waste, including that from cities located in the county. Only four landfills served the rural areas exclusively. Five landfills, serving cities only, were owned by larger cities that could afford the necessary equipment, land, and labor.

Population Served and Size of Disposal Site

The 40 disposal sites in the survey served an average population of 8,628. About 70 percent of this population was served by the 23 county-owned sites (app. table 1). County sites had a total area of 897 acres, and averaged 39 acres per site and 3.7 acres per 1,000 population. The 13 city sites were much smaller than the county sites. Eight were dumps.

Site Users and Volume of Waste

There were four major users of disposal sites--private collectors, public collectors, industries, and individuals (app. table 2). Private collectors were usually individuals operating in a county or city; they collected waste from their own customers and delivered it to the disposal site. Public collectors were city or county collection systems. Industrial users were those not served by public or private collectors; they provided their own equipment to transport wastes to the disposal site. Individual users in most cases were those not served by collection routes.

Public collectors delivered the largest volume of waste to the disposal sites--a total of 98,722 tons per year. This accounted for about 75 percent of total waste delivered to all disposal sites. Most industries in or near cities were serviced by private collectors. Only 31 percent of industrial users hauled their own wastes, primarily small industries located in rural areas. These industrial users delivered only 9,092 tons per year to the sites.

The 130,602 tons of waste delivered to the sites came from a population of 345,128. This is an average of 756 pounds per year per capita, or 2.1 pounds per day. This volume is low compared with estimates for the United States from other studies which report 5 pounds per capita. The low rate in this study reflects the fact that much of the waste generated was not collected because pick-up service was not available to much of the rural population. There is also a relatively small amount of industrial activity in these rural areas.

Direct Charges to Site Users

Charges for disposal vary between and within type of user. About 38 percent of the private collectors were not charged for use of the site; 57 percent paid an average of \$1.37 per load deposited (app. table 2). Seventy-three percent of the public collectors were not charged for site use while 17 percent were charged an average of \$.037 per month per capita. These public collectors were usually small cities using a county-owned landfill; the county charged the cities a per capita monthly rate. County-owned landfills did not charge excessive rates to users. Private homeowners were never charged if they delivered their own waste to the site.

COSTS OF SOLID WASTE COLLECTION

The cost of solid waste collection and disposal is an increasing community cost for city and county governments. Escalating costs of equipment and labor in recent years, coupled with additional environmental restrictions, have forced officials to evaluate their collection and disposals systems. Costs of collection and disposal are analyzed separately. Collection costs are the most expensive segment of solid waste management costs and consist primarily of equipment and labor costs.

Labor Costs

In the survey sample, labor requirements varied with the type of collection system used. The type of pick-up used, curb or back door, accounted for a considerable variation in collection labor costs.

Labor used in collecting solid waste for the 47 city units averaged 11,882 hours per system (table 5). This is an average of 6.5 men, each working 1,828 hours per year. Wages averaged \$2.42 per hour. These city systems are the most important of all types of collection systems in this study.

Rural area systems used fewer men per crew than city systems, primarily because many rural systems consisted of collection boxes along the roadside and house pick-up was not provided. Rural crews averaged 2.6 men per crew working 1,912 hours per man per year. Labor cost for rural systems averaged \$2.29 per hour.

The other three types of areas served, shown in table 5, were not significant in analysis of total costs. They were basically variations of the rural and city systems. Hourly wages were about the same for each type of system.

Equipment Costs

Annual fixed costs for collection equipment include depreciation charges, interest on investment, and taxes and insurance. The city systems averaged fixed costs of \$5,691, the highest surveyed of all systems (table 5). Annual depreciation accounted for 64 percent of fixed cost, followed by 30 percent for interest costs. Taxes and insurance accounted for only 6 percent. Many systems were free of taxes because of city ownership.

Average fixed equipment costs for rural collection systems were \$4,998, or 88 percent of the average cost for city systems. Proportionate shares for depreciation, interest, and taxes and insurance were about the same as the city systems. The lower cost for county systems primarily reflects a smaller average initial investment and a lower quality of service.

Variable equipment costs include repairs, fuel, batteries, tires, and all other expenses associated with operating and maintaining the equipment. City collection systems averaged annual variable costs of \$3,344 (table 5). The

Table 5--Cost components of 63 collection systems, 1974

Item	Cities only	Rural area of county	City and some adjacent homes	Part of rural area of county	Other
			<u>Number</u>		
1. No. of systems	47	11	2	2	1
2. Average number of employees used per system	6.5	2.6	3.0	2.0	3.0
3. Average total hours worked per system	11,882	4,970	4,992	3,840	5,040
4. Population served	2,691	11,145	1,325	2,000	1,650
5. Total tons collected per system	1,803	1,456	780	1,300	1,560
Average annual costs per system:			<u>Dollars</u>		
6. Salary	28,769	11,395	12,300	9,600	12,600
7. Fixed equipment ^{1/} costs	5,691	4,998	2,252	2,277	3,190
8. Variable equipment costs	3,344	2,756	1,575	1,725	1,600
9. Total (6+7+8)	37,804	19,149	16,127	13,602	17,390
10. Per capita collection cost (9÷4)	14.04	1.72	12.17	6.80	10.54
11. Per ton collection cost (9÷5)	20.97	13.15	20.67	10.46	11.15
12. Total revenue per system	11,877	12,455	7,000	13,500	0
13. Community costs per system ^{2/} (9-12)	25,927	6,694	9,127	102	17,390

^{1/} Fixed cost based upon replacement cost of all equipment regardless of age.

^{2/} The cost of operating above the fee charges for 1 year's operation. Community pays for this from taxes or other charges.

largest component was fuel (55 percent), followed by equipment repairs (20 percent). The total variable equipment cost for city systems was \$1.02 per hour of equipment use.

Fuel accounted for 52 percent of the total average variable costs for rural systems. These costs averaged \$588 less than variable costs for city systems. They averaged \$1.19 per hour of equipment use.

Total equipment cost for city collection systems averaged \$9,035 per year; 63 percent was fixed cost. Collection averaged 1,803 tons per year at \$5.01 per ton.

Average total equipment costs for rural systems was \$7,754, about 14 percent below the average for city systems. Fixed costs accounted for about 64 percent. Collection averaged 1,456 tons per year at \$5.33 per ton.

Total Collection Costs

Total cost of solid waste collection was higher for city systems than for rural systems (table 5). Labor accounted for 76 percent of the city costs and 60 percent of rural costs. Total per capita collection costs for the city systems averaged \$14.04 (table 5).

Rural systems, on the average, served over four times as many people as the city systems, resulting in a much lower average per capita cost of \$1.72. The rural systems may not actually be used by so many more people, but the service is available at collection sites. The city routes actually serve each customer.

The total cost of collecting solid waste for the city systems averaged \$20.97 per ton per year (table 5). These systems collected an average of 1,803 tons of waste from a population of 2,691, or 3.7 pounds per capita per day.

The cost per ton for rural collectors averaged \$13.15 per ton per year. These systems collected an average of 1,456 tons per year from a population of 11,145, or 0.7 pounds per capita per day. The method of rural collection again accounts for the lower cost. House-to-house pick-up is not customary.

Collection Revenues

On the average, revenues collected from users of solid waste collection systems were less than costs for all groups. City systems collected approximately 31 percent of their costs in user charges. The average rural system defrayed 65 percent of their costs from user charges (table 5). Some systems collect enough fees to cover total costs, but many city and rural systems have no direct charge to customers. These pay costs from county or city tax revenues.

COST OF DISPOSAL SYSTEMS

Labor Costs

The major type of labor used in disposal was the machine operator, who was generally in charge of the entire disposal operation. There were 31 such employees for the 40 disposal sites (app. table 5). In some cases, usually the larger sites, a supervisor was employed in addition to the machine operator. There was only one part-time worker in the entire sample. A total of 42 employees worked at the 40 disposal sites, and each worked an average of 1,735 hours per year. The average annual labor cost was \$5,334 per man.

Equipment Costs

The total cost of equipment is divided into fixed and variable costs. The fixed costs include such items as depreciation, interest, and taxes. The variable expenses include fuel, tires, repairs, and other items directly related to equipment operations.

Thirty-one sites used machinery in their disposal operations (app. table 6). Twenty-four were owned by the county and seven by the city. The other nine were dumps which used no machinery.

The county-owned disposal systems had average fixed costs of \$5,741 per year. Depreciation of equipment averaged \$3,384 per system, or 59 percent of all fixed costs. Interest on machinery investment accounted for 36 percent of fixed costs.

The city-owned disposal systems had average fixed costs of \$5,193 per year. Depreciation of equipment accounted for 60 percent of the total fixed costs, about the same as for county-owned systems. This reflects the fact that both types of systems used the same type of disposal equipment and had similar investments.

The variable cost of disposal for the county-owned systems averaged \$2,013 per year per system (app. table 7). Fuel accounted for 52 percent of total variable costs. Repairs accounted for an additional 26 percent.

The city-owned systems had average annual variable costs of \$1,737 per system. Fuel costs were 53 percent of the total. Repairs on vehicles accounted for 28 percent of the variable costs.

Facility Costs

Facilities used in disposal systems are defined in this study as the buildings on the premises, land purchased, fences, gates, bridges and roads, and other site improvements. They are a fixed cost reported separately.

The county systems averaged \$1,051 for annual facilities cost (app. table 8). Interest accounted for 73 percent of the total.

City facilities were usually much smaller than the county facilities. They had less land, and 8 of the 15 were dumps with no equipment, sheds, or storage areas. Very few dumps had any type of fencing around the area. The low cost of dumps reduced the average cost of the city-owned sites to only \$349 per unit per year. Interest accounted for 82 percent of total facility cost per system.

Total Disposal Costs

Total costs for labor and equipment used in disposing of solid waste for the county-owned systems averaged \$15,586 per system in 1974 (table 6).

The city disposal systems were normally much smaller; annual costs averaged only \$6,698. This cost is influenced by the nine dump sites, which were small and had low operating costs. Total cost per capita of city disposal systems averaged 63 cents more than county systems (table 6). County systems have larger populations to serve and less waste per capita. The collection systems had basically the same operations but nine of the city systems had no machinery costs or labor at the site. County systems had a higher waste disposal cost per ton than the city systems. The larger sites, with more equipment and labor and less waste per capita, had higher costs per ton. The county systems disposed 0.3 ton per capita per year; the city disposed 0.6 ton per capita per year.

Disposal Revenues

It is difficult to identify revenues realized from disposal operations, as billing normally covers both collection and disposal. There are no revenues from the disposal operation except for charges to industrial or commercial users. In some cases, county-owned disposal systems charge cities for using their disposal facility. The surveyed county-owned systems had an average annual revenue of \$4,576 and a total cost of \$15,586 (app. table 9).

There was no revenue attributed to the 15 city-owned systems because disposal charges were not separate from collection charges. Cities usually charged the household and commercial customers a monthly or quarterly fee. However, many city systems did not charge for either collection or disposal service; the entire cost was paid by city taxes.

TOTAL SYSTEM COSTS AND REVENUES

Total Cost

Total costs for collection and disposal operation for the two types of systems are average costs and do not reflect the relationship between total cost and community size or the amount of waste handled. This type of analysis will be covered in a later publication.

Table 6--Annual cost components of 63 collection and 40 disposal systems, 1974

Item	County	City
		<u>Number</u>
1. Disposal sites	25	15
2. Population served per site	11,757	3,413
3. Tons disposal per site	3,880	2,240
		<u>Dollars</u>
4. Total cost of disposal per site	15,586	6,698
5. Per capita disposal cost per site (4÷2)	1.33	1.96
6. Per ton disposal costs per site (4÷3)	4.02	2.99
7. Average per capita cost for collection (item 10, table 5)	1.72	14.04
8. Average per ton cost for collection (item 11, table 5)	13.15	20.97
9. Total system cost per capita (5+7)	3.05	16.00
10. Total system cost per ton (6+8)	17.17	23.96

Per capita cost was considerably higher for city systems than for county systems (table 6), because of the much greater population served by the county system. Because county systems do not collect from each house, the number of residents actually using the rural systems was indeterminate and the quality of service received was lower.

Total Revenue

Average revenues from user charges for collection and disposal offset about 27 percent of total costs for city systems and about 49 percent of total costs for county systems (table 7). In many cases, neither county nor city

systems made a charge for collection or disposal. Some city systems had a small charge for collection, but never charged for disposal. City and county governments paid for equipment and services out of general taxes or grants. Revenue received usually came from charges to private industry and small token charges from homeowners. The difference between revenue and costs was paid for by taxes and other community funds. There was much variation in the way user charges for collection and disposal were applied.

Table 7--Annual community costs for solid waste management, 1974

Ownership	Average cost	Average revenue	Community cost ^{1/}
		Dollars	
City	44,502	11,877	32,625
County	34,735	17,031	17,704

^{1/} Community cost is the difference between cost and revenue and must be paid from other community revenues.

CONCLUSIONS

Data presented in this report describe existing solid waste management systems in the rural Southeast United States. They report what exist and should not be interpreted as ideal waste management systems.

The solid waste management systems described did not collect sufficient revenue to cover all costs. These operations, in most cases, are considered to be community services. Costs not covered by user charges are paid for from other community revenue.

Some operations could be combined by small city and county governments operating as one unit. This would assist considerably in decreasing costs for such items as landfills and other disposal sites. Equipment costs could be decreased, because as the units are now operating much of the equipment is not being utilized economically. The waste must be covered daily and it is not economical for three or four small cities to purchase equipment for this use individually. One disposal site with one piece of equipment and an operator could accommodate all cities plus the rural residents of a given county.

The size and type of collection vehicle should be given consideration. Much of the collection equipment used is not the most economical unit for the volume of waste collected.

Appendix Table 1--Characteristics of 40 disposal sites, 1974

Area served	Number of sites	Type of site		Population served	Area of sites
		Dump	Landfill		
			Number		Acres
Cities only	13	8	5	40,202	155
Rural area of county	4	0	4	64,000	160
Entire county	23	1	22	240,926	897
Total	40	9	31	345,128	1,212

Appendix Table 2--Characteristics of collectors for 40 disposal sites, 1974

Type of collector	Number of users	Tons deposited per year	Method of charging
Private collectors	21	14,426	<u>2/</u>
Public collectors	59	98,722	<u>3/</u>
Individuals (homeowners)	<u>1/</u>	8,362	<u>4/</u>
Industrial	58	9,092	<u>5/</u>
Total	138	130,602	

1/ The number of homeowners hauling waste to disposal site was not available. Estimates were not made because no records were usually kept for this type of user.

2/ 38% had no charges; 5% \$75/month; 57% averaged \$1.37/load.

3/ 73% had no charge; 7% averaged \$237.5/month; 17% were charged 3.7 cents/per capita/month; 3% were charged \$8.00/load.

4/ No charge for home users.

5/ 78% no charge; 2% \$100/month; 20% average charge of \$1.42/load.

Appendix Table 3--Total per system annual variable cost of equipment for 63 collection systems, 1974

Area served	Systems	Hours used	Repair cost	Fuel cost	Tires and battery cost	Misc. cost	Total variable cost
	<u>Number</u>	<u>Hours</u>			<u>Dollars</u>		
City only	47	3,269	664	1,851	635	194	3,344
Rural area of county	11	2,324	580	1,423	602	151	2,756
City and some adjacent homes	2	1,550	300	850	325	100	1,575
Part of rural area of county	2	1,990	375	1,000	250	100	1,725
Other	1	1,770	300	900	250	150	1,600

Appendix Table 4--Total per system annual fixed costs of equipment for 63 collection systems, 1974

Area served	Systems	Depreciation	Interest	Tax, insurance, etc.	Total fixed cost
	<u>Number</u>			<u>Dollars</u>	
City only	47	3,644	1,700	347	5,691
Rural area of county	11	3,213	1,477	308	4,998
City and some adjacent homes	2	1,384	743	125	2,252
Part of rural area of county	2	1,479	578	220	2,277
Other	1	2,025	990	175	3,190

Appendix Table 5--Type of workers, hours worked, and annual salaries for personnel utilized for 40 disposal sites, 1974

Type of employee	Employees ^{1/}	Total hours worked per year	Total annual salaries per year	Average salary
	Number	Hours	Dollars	
Supervisor	10	19,104	56,580	5,658
Operator	31	53,076	163,230	5,265
Part-time worker	1	1,440	4,200	4,200
Total	42	73,620	224,010	5,334

^{1/} Nine sites did not hire any personnel. The supervisors were additional personnel to operators, etc. Only 31 machine operators were used; 9 sites had no machinery or operators.

Appendix Table 6--Total annual fixed costs for all equipment used in 40 disposal sites, 1974

Ownership	Sites	Depreciation	Interest	Taxes and insurance	Total fixed costs per site
	Number	Dollars			
City	7 ^{1/}	3,125	1,839	229	5,193
County	24 ^{2/}	3,384	2,064	293	5,741

^{1/} Eight sites owned no equipment.

^{2/} One site owned no equipment.

Appendix Table 7--Total per site annual variable equipment costs for 40 disposal sites, 1974

Ownership	Sites	Hours of use	Repairs	Fuel	Tires, batteries, etc.	Misc. cost	Total variable cost
	<u>Number</u>	<u>Hours</u>	<u>Dollars per site</u>				
City	71/	1,171	493	921	194	129	1,737
County	242/	1,258	533	1,050	278	152	2,013

1/ Eight owned no equipment.

2/ One owned no equipment.

Appendix Table 8--Total per site annual cost of facilities utilized at 40 disposal sites, 1974

Ownership	Sites	Total cost of facilities	Interest	Depreciation	Total fixed cost
	<u>Number</u>	<u>Dollars per site</u>			
City	15	5,183	285	64	349
County	25	13,989	769	282	1,051

Appendix Table 9--Total costs and revenue per average disposal site, 1974

Ownership	Sites	Total cost of disposal	Total revenue from disposal	Community cost ^{1/}
	<u>Number</u>	<u>Dollars</u>		
City	15	6,698	0	6,698
County	25	15,586	4,576	11,010

1/ Numbers in this column represent the amount needed above total revenue to cover costs of operation. Revenue is the amount received from fee and other charges to the public.