COSTS OF SOLID WASTE MANAGEMENT IN RURAL TEXAS COMMUNITIES*

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Nationally, expenditures for solid waste collection and disposal are exceeded only by spending on schools and roads [3, p. 1]. In Texas, recent legislation which establishes minimum acceptable standards for disposal of municipal solid wastes materially affects the future costs of operating solid waste management systems for smaller rural communities.

The 1969 amendment to the Texas Solid Waste Disposal Act establishes the minimum legal standards for disposal operations in rural communities [2]. The State Department of Health was given the responsibility for enforcement of regulations involving the collection, handling, storage and disposal of municipal solid wastes. After January 1, 1973, data presented in support of the disposal operations in Texas communities larger than fifteen hundred people must be prepared by a registered professional engineer and submitted to the State Department of Health for approval. Under the auspices of this act all towns with a population of between three thousand and five thousand are required to operate a sanitary landfill with compaction and cover at least twice per week. All towns with population between fifteen hundred and three thousand must operate a sanitary landfill with compaction and cover at least once per week. All towns with a population over 5000 are currently required to compact and cover daily [2, pp. 10-11]. A 1971 Texas State Department of Health study stated that of 860 sanitary landfills surveyed, only 124 qualified under the new regulations. An additional 1,092 sub-standard or unauthorized landfills were identified [1, p. 51]. Most of these were in small rural communities.

The affected communities are faced with the immediate task of modifying and improving their solid waste management systems. Most cost information developed to date is available only for larger municipalities which have their own research capabilities or maintain more detailed audits than are available in the small rural communities. Information is needed on required investments and on the yearly operating costs for solid waste management systems in smaller communities which use sanitary landfills.

PURPOSE

This paper presents the results of a survey used to obtain cost and quality information on solid waste management systems in rural communities in Texas. Quality characteristics and cost budgets for typical collection systems using a sanitary landfill are presented. The relationship between per capita cost and community population is estimated for communities with populations ranging from five hundred to twenvy-five thousand.

METHODOLOGY

A questionnaire was designed and personal interviews were conducted with city administrators to determine system quality characteristics, (i.e., frequency of collection, special services, condition of collection equipment, etc.), to determine yearly operating costs for the solid waste management system and to determine methods for charging for services. A random sample of 36 rural communities was drawn. The sample was stratified on the basis of population as follows:

Category I - twenty-five hundred residents or less,

Category II - over twenty-five hundred, but less than ten thousand,

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Category III - ten thousand to twenty-five thousand.

System quality characteristics and cost information from the past fiscal year were collected for all thirty-six communities. Thirty-two of the responses were usable and generally represented similar quality characteristics and charges for household and commercial service. Ten responses represented community sizes within Category I (2500 or less), twelve within Category II (2500-10,000) and ten within Category III (10,000-25,000).

SYSTEM QUALITY AND COST CHARACTERISTICS

Although the thirty-two usable surveys were selected according to reliablity of reported costs and basic similarities of systems, some variation in quality among systems exists. Selected for illustration in Table 1 are certain quality factors to indicate the variation in collection and disposal characteristics among community size categories. The percentage of communities offering those service characteristics selected to reflect quality generally increased as community size increased for both collection and disposal phases of the systems. Ten percent of communities in the largest size group provided backdoor pickup.[1] Special services and special clean-up services were offered at no charge more frequently in larger communities. Moreover, a higher percentage of communities in the larger size groups operated covered landfills and offered access to the public at no charge (Table 1). The list of quality factors is not exhaustive but it is indicative of differences in system service quality among the sample communities. No acceptable cost data were found that would reflect variations in system quality characteristics in total system operating costs. Therefore, the variations in the quality factors listed in Table 1 and other quality factors not included are reflected in the cost figures reported in this paper.

Cost figures reported herein are total yearly operating costs for solid waste management systems including collection and disposal phases. The cost figures include fixed and variable costs for both

Table 1. **SERVICE QUALITY CHARACTERISTICS OF SOLID WASTE MANAGEMENT SYSTEMS BY COMMUNITY SIZE GROUPS, 32 RURAL COMMUNITIES IN TEXAS, 1972**

Service Quality Factor	Percent Offering Service			% of Total
	Community Size			
	0 - 2500	2501 - 10,000	10,000 - 25,000	
Collection Phase[a]				
Curb or alley pick-up	100	100	90	96.9
Backdoor pick-up	0	0	10	3.1
Special services[b]	60	83.3	90	78.1
Special clean-up[c]	60	75	100	78.1
Disposal Phase				
Covered landfill[d]	40	75	100	71.9
Use by public allowed:	100	100	90	96.9
a) no charge[e]	60	75	89	71.9
b) nominal charge[e]	40	25	11	33.3
Fenced to prevent unauthorized use	50	58.3	90	65.6

[a]Frequency of household collection is not listed as all towns had twice per week pickup.

[b]Special services would be scheduled pickup of items such as used appliances, masonry, brush, dead animals, etc., at NO ADDITIONAL CHARGE.

[c]Included are city-wide clean-up days sponsored either by city administration or service organization (i.e., Jaycees, Chamber of Commerce, etc.) if city collection and disposal facilities made available at NO ADDITIONAL CHARGE.

[d]Included only if community meets or exceeds minimum legal requirements for compaction and cover.

[e]Percent of those towns allowing public use of disposal site.

[1] Ten percent represents 1 response of 10 in the larger category, yet is a useful descriptive statistic indicating increased service quality in the larger communities.

Table 2. ESTIMATED BUDGET FOR A SOLID WASTE MANAGEMENT SYSTEM, 32 RURAL TEXAS COMMUNITIES, 1972 (AVERAGE OF SAMPLE DATA)

Item		Cost	
Population	6,744		
Number of residences served	2,120		
Number of businesses served	219		
Total Revenues (residential and commercial)			$56,759
Total Costs:			
labor costs[a]	$45,909		
cost of fringe benefits	6,886		
Total labor costs		$52,795	
equipment operating expense[b]	4,968		
collection equipment depreciation[c]	3,125		
disposal equipment depreciation[d]	1,962		
Total equipment costs		10,065	
Total Cost for the fiscal year			62,860
Total deficit			$ 6,101
Per capita revenues	$8.42 per year		
Per capita costs	9.32 per year		

[a]Typically includes two three-man crews and allowance for supervisor and billing clerk salaries.
[b]Includes maintenance, gas, oil, tires, insurance, etc.
[c]Depreciation based on an 8-year life.
[d]Depreciation based on a ten-year life.

phases of the systems combined. Table 2 illustrates the costs and revenues associated with operating a solid waste management system typical of the sampled communities. The mean population of the towns surveyed was 6744 persons with an average of 3.2 persons per household. The cost figures in Table 2 are mean values of the calculated costs for each major category, and the total revenue figure shown is the sample mean of revenue as reported in city audits. In all cases, direct labor costs and the cost of fringe benefits were the major contributors to total system cost. The labor costs were calculated from current hourly or weekly rates in each community for each job classification. The collection equipment depreciation figure of $3,125 indicates an average investment of $25,000 in collection equipment for the mean community size (Table 1).[2]

At the mean community size of 6,744, average costs exceeded average, reported revenue by $.90 per capita. This implies that sampled communities in this size range tend to subsidize their solid waste management systems from general revenue or other municipal funds.

COSTS AND COMMUNITY SIZE

The relationship between total cost and community size was estimated using least squares regression for those communities which actually used a sanitary landfill. This included 22 communities with population of 3000 and over. Total system cost was regressed on several independent variables including population, number of residences, and number of commercial and industrial establishments served by the system individually and in several combinations. A number of alternative equation specifications were used. These included linear, log-linear and quadratic. The two variable equation, regression total cost on population in quadratic form, as specified in equation (1) provided the best fit to the sample data:[3]

[2]None of the sampled communities reported actual depreciation schedules. Depreciation costs were estimated assuming a straight line schedule for an eight year life on collection equipment and a ten year life on disposal equipment.

[3]This equation implicitly assumes that community population serves as an adequate proxy variable for community solid waste output. While a direct and close relationship would be expected, per capita solid waste output may vary among communities and probably increases with community size. Sample data on neither total nor per capita waste output were sufficient to utilize in this analysis.

(1) Cost = 42,298.64 + .000462 P^2
(8.8)*

Cost = total system cost

P = population

R^2 = .7948

The relationship between per capita cost and community size (population) were of interest in this analysis since per capita costs more clearly reflect economies of size and provide a direct measure of per capita revenues required for the operation of a self-sufficient solid waste management system for differing community sizes. Total costs per capita were derived from equation (1) as indicated in equation (2),

$$\text{(2)} \quad \text{Total Cost Per Capita} = \frac{42{,}298.64}{P} + .000462P$$

The relationship of per capita total cost and community size as specified by equation (2) is shown diagrammatically in Figure 1. This relationship was estimated based upon cost information from 22 communities with a population of 3000 or more. Economies of size in the operation of a solid waste management system are indicated for community size up to a population of approximately 9600 (Figure 1). The relatively high per capita cost for small communities may be explained by the lumpiness of inputs, primarily that of collection equipment and associated labor costs. Per capita costs decline rapidly as fixed equipment investments and associated labor inputs are spread over a larger population base. The minimum per capita cost of approximately $8.80 is reached at a population of approximately 9600 persons. The increase in per capita cost beyond this point may be attributed primarily to a number of factors. First, quality of service was not strictly equivalent for all communities in the sample. Service quality improved as community size increased (Table 1). The survey results indicated that in the larger communities, as revenues generated from solid waste management services tended to meet or exceed the costs of operating the system, additional services were offered. Larger communities also tended to make investments in larger and more sophisticated collection and disposal equipment. In part, these investments were the result of more stringent regulations applying to larger communities. Moreover, solid waste systems for larger communities were required to accommodate a larger volume of waste material from commercial and industrial sources. Increased costs for handling this non-household waste would be reflected in higher per capita costs for the larger communities.

METHOD OF REVENUE COLLECTION

The communities surveyed had similar methods of charging for both residential and commercial collection service. In most cases, the charge was based upon an equal and uniform fee for household service with some variation in charges for commercial service.

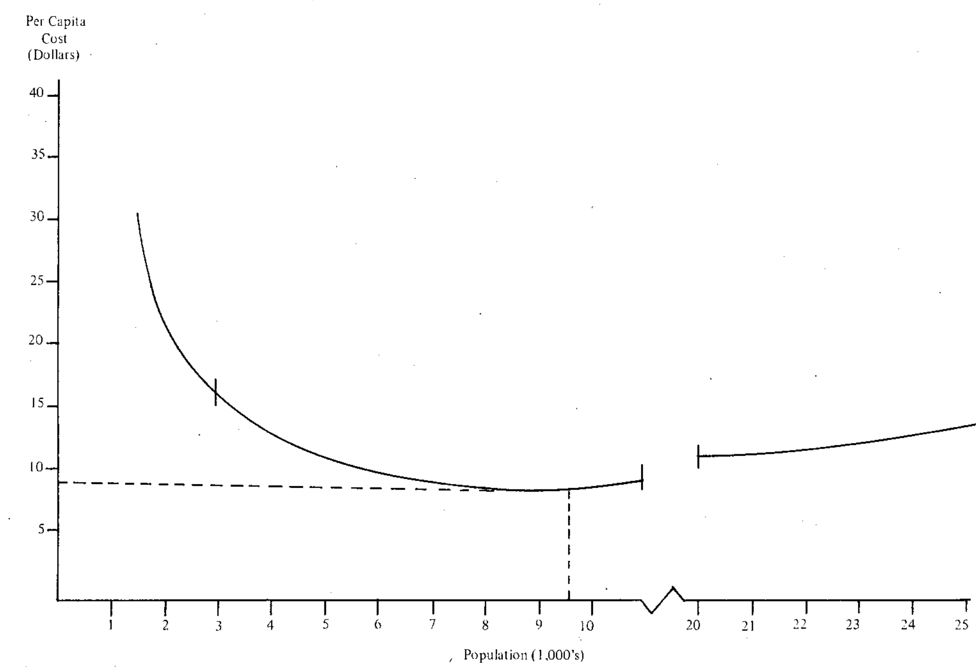

Figure 1. ESTIMATED PER CAPITA COST FOR SOLID WASTE MANAGEMENT IN RURAL TEXAS COMMUNITIES, 1972.

The differences in commercial service fees depended primarily upon the volume of solid waste collected primarily by the larger towns in the sample.

CONCLUSIONS AND IMPLICATIONS

The quality of collection service in the smaller communities was inferior to that of the larger communities in the sample. In most cases, the present disposal methods practiced by these smaller communities do not conform with the legal minimum requirements for communities of their size as stated by the recent amendment to the Texas Solid Waste Disposal Act [1, p. 51]. Improvements in the solid waste management systems in these communities will increase costs where per capita costs are already high. Charges for household and commercial services do not cover present system costs in communities with a small population base. Small communities presently tend to operate low quality systems and to subsidize these systems from general revenue or other non-specific municipal funds. Improvements in system quality and economies of size are realized as the population base becomes large enough to defray the fixed costs of collection and disposal equipment and associated labor costs.

The results of this analysis suggest that multi-community solid waste management for small communities located nearby one another may be feasible. Serving an expanded population base represents a feasible method for reducing per capita costs for small rural communities. Although multi-community systems would incur certain costs not considered in this study, including increased transportation costs, rural collection containers or transfer station costs, etc., these additions to costs of a multi-community system would likely be offset by the economies and efficiencies in serving the larger population so long as wastes were not transported an excessive distance.

As small communities change their systems to meet minimum regulatory requirements, the feasibility of equipment leasing arrangements and co-ownership of equipment with other local government departments, and other alternatives, should be investigated to reduce fixed investments in system equipment.

REFERENCES

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