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Septage collection system economics

INTRODUCTION

The progressive development of sanitation facilities in growing areas, and the sequential stages of such developments with time are of great interest to the sanitation planners. Such unplanned and uncontrolled spontaneous developments of sanitation facilities provide valuable information about the society awareness for sanitation requirements, society initiatives to participate in sanitation projects, people's willingness to pay for the sanitation services, operation experiences, appropriateness of such technology and economics of the services.

The paper contains the economic characteristics of an intermediate sanitation system in a rapidly growing area in Jordan. The present system of sanitation in the area includes individual on-site septic tanks with private sullage-solid-mix collection by mobile tanks mounted on trucks. The contents are disposed of in an anaerobic pond for final stabilization. The pond is provided by municipal authority without any charge.

LOCATION AND SYSTEM BACKGROUND

This private septage collection system operates in the city of Irbid and its sub-urban areas. The city of Irbid is located at the northern border of Jordan. Until 30 years ago, the population of the city with its surroundings remained below 10,000. During fifties, sixties and seventies, the city has grown rapidly. The city is presetly the center of Irbid Governorate and is the center of country's largest university. The present population (1980) of the city with its surroundings is about 150,000. Among the adult (above 25) inhabitants of the area, 60 percent finished 8 years of schooling. Traditional Arab life style and way of united family living still exists. An average family has 21 members and an annual income of 4,000 J.D. (1 J.D. = 2.75 dollar).

Personal interviews with local elders revealed that about 50 years back, there was no defined sanitation facility within the area. About 30 years back, people started to use pit latrines. Since 20 years, single vault septic tanks started to be constructed with new houses. During the early development, solid-liquid septage would be carried away by donkey driven tanks to valleys away from the locality. Since 1975, by law every house must have septic tank or underground sewage disposal facility and such facilities need to be approved by the municipal engineers.

SEPTAGE MANAGEMENT SYSTEM

About 90 percent of the existing households in the Irbid area is served by septic tanks. The soil condition in the area is not suitable for sullage leaching systems. Hence a growing need for service to remove the septage was realized. At the demand for services, people interested in business started buying tank-trucks to serve the households for payments. Thus a free enterprise of private service developed.

Usually, the owner of the truck drives the vehicle with a helper and attends household calls. The names of the vehicle owners are registered with the municipality and appear in the local telephone directory.

Septage removal service thus remains as a commodity and the houseowners and truck operators bargain freely over the rate for the service. Hence a spontaneous rate has been evolved under competative economic market. Presently the rate varies from 5 to 6 J.D. per call. The physical and economical characteristics of the system appear in tables 1 and 2 respectively.

There are about 7,000 septic tanks for 150,000 people. Fifty percent of these septic tanks have some kind of soak pits attached to them. Average number of truck calls for each septic tank with pits is one per month when the number of calls for septic tanks without soak-pits is three per month.

OPERATION AND MANAGEMENT

Though the tank-trucks are owned by private individuals, however, they are registered with the municipality and their operation is closely supervised by the city municipal engineer and his staff. The municipality has no jurisdiction over truck ownership, vehicle maintenance, vehicle service schedule, service charges, limitation of service area and the number of customers. The principal supervision job of the city is to control the septage spillage, proper dumping of tank contents in the pond and the maintenance of the ponds. The city personnel involved in the system are Mayor(part-time), a full time sanitary engineer and four field staff including two with some public health background.

In case of on-route breakdown of a truck, the driver is supposed to call another truck to empty the tank contents at the owner's cost. The truck owner is penalised for any spillage of tank contents on roads or any other place other than the designated ponds. The trucks receive servicing in specified maintenance garages. These garages are very few in number and are located in the truck servicing section of city industrial area which is away from the city residential areas.

As the trucks are free to travel anywhere to pick up the waste, usually there is not any defined route for a truck. However, due to the local aquintance of the truck owner and his interest in operating in his locality, it was found that without very few exceptions, a truck usually maintains an area of service.

The truckers do have a tendency to accumulate calls so that the tank will be filled before it makes a trip to the pond. However, there is always a chance of his loosing his customer in cases of much delay. It was observed that nearly 50 percent of truck trips are

Table 1. Physical Characteristics of Irbid Septage Management System

Item	Description	Quantity	
1	Year, full fledged septage collection system started	1975	
2	Total number of household served	30,000	
3	Total number of septic tanks	7,000	
4	Area served	216	sq. Km.
5	Number of tank-trucks serving the area	70	
6	Volume of each tank-truck	6-9	cu. m.
7	Average number of tank-trucks working per day	60	
8	Tank-trucks receiving garage services per day	10	
9	Average distance travelled by each truck	50	Km.
10	Stabilization pond (anaerobic, unlined, earthen)		
	Area	100,000	sq. m.
	Depth	2	m.
11	Personnel		
	Private		
	a. Truck drivers	140	
	b. Helpers	140	
	City		
	a. Sanitary Engineer (part-time)	1/30	(one day per month)
	b. Pond attendent	1	
	c. Pond guard	1	
	d. Public-health inspector (part-time)	2	(30 days per month)
12	Time interval between septage pick-ups	10-30	days (2 calls per septic tank per month)
13	Tank-truck operation time	24	hrs.
14	Maximum length of pump hose in trucks	40	m.
15	Maximum distance from truck stop to septic tank	35	m

Table 2. Economical Characteristics of the Septage Management System

Item	Description	Quantity	
1	Tank-truck capital cost (usually Mercedese 5-6 yrs. old, bought from Germany)	5,000-10,000	J.D.
2	Fuel (100 liter per day per truck, diesel)	8.3	J.D.
3	Cost per truck call	5-6.6	J.D.
4	Personnel salary: a. Driver	200	J.D./month
	b. Helper	120	J.D./month
	c. Pond attendent	150	J.D./month
	d. Pond guard	80	J.D./month
	e. Sanitary Engineer	20	J.D./day
	f. Health Technician	5	J.D./day
5	Average maintenance cost per truck per month	35-45	J.D.
6	Cost for land (Pond)	1,000	J.D./hectare

made with tanks partially full.

The trucks operate during day and night. Night calls are made where the truck drivers are familiar with the locations of the septic tanks.

COST

The cost of a household for cleaning the septage depends on the number of times a septic tank needs to be cleaned within certain time. On average, each septic tank needs cleaning twice a month. Based on the average cost of 5.8 J.D. per call, the cost per household of 21 people (average number of people per septic tank) is 11.6 J.D. per month which amounts to 32 U.S. dollar. This amount is directly for tank-truck service. Customers do not directly pay or are charged for municipal services. The municipality part of the operational cost is nearly 250 J.D. per month. This cost is met from the municipal general annual budget. However, when this cost is distributed over 7,000 customers, the cost per customer is insignificant.

At an average of two calls per month per septic tank, total number of expected calls Is 14,000 per month i.e. 467 calls per day. Assuming equal number of calls for each truck, the number of calls for each truck is 8 per day. Daily income of a truck at 5.8 J.D. per call amounts to 46.4 J.D.. Bare operational cost of a truck is nearly 4.6 J.D. per day. Hence a truck owner receives nearly 8.3 J.D. each day. At this capital return rate and at an interest rate of 10 percent, the average capital cost on a truck may be realized in three years.

WORKERS' HYGEINE

A health related survey indicated no reports of unusual sickness or absence in work amonst the truck drivers and helpers.

While on duty, the drivers and the helpers use hand gloves and work clothes which they leave in trucks before returning home. The municipality provides hygeine and helth advisory services to drivers and helpers. They are advised to take precautionary immunisation from government medical centers free of charge.

DISCUSSION

Irbid septic tank septage collection and disposal is an unique example of how private business interests may be utilized with benefits in programmes which are long known to be public burden. The problem of sanitation is treated as collective public problem and in many parts of the world, it is entirely managed by public agencies.

The treatment of the tanker services as a free commodity and maintaining the bargaining position for the septic tank owners have resulted in a balanced and economically healthy service rate for the system. Apparently a $32 dollar bill per month for sewage appears to be too high in comparison to worldwide estimated rate of $9 per month per household[1]. However, the number of household members is about 4 times more than average household size anywhere else. Considering this factor, the sewage cost in Irbid is reasonable.

Recently some truck route scheduling study indicated that some saving in truck operational may be acieved if the trucks travel only through specified set routes. However, such advisory comments were not effective as the truck drivers and owners are free to operate without any organized controls, administration or pricing system.

In year 1980, the city of Irbid has undertaken the project of phase construction of a conventional sewage collection and treatment system. The project feasibility study mentioned several pluses in favor of the conventional pipe-network sewage collection system including the economic feasibility. Household sewage service cost was estimated to be 11 J.D. per month per household. Assuming that a household at best will be willing to pay 3 percent of its income for sewage service, the average household income in the service area should be more than 367 J.D. per month. Household income projection indicated that such income level will be achieved before the pipe-network sewage collection system starts operation. In case, incomes fail to reach the target, some Government economic subsidy will be necessary.

Irbid sewage management system passed throuh an ideal course of sanitation development. In developing countries, such sequential development of sanitation facilities probably is the most desired solution considering capital shortcomings and lower personal incomes. In sequential developments, the economic standard of the people goes up along with the attainment of higher users' comfort and hygienic safety.

Early planning of such sequences of developments are of much interest to the national planners. For determination of such time sequences of appropriate facilities, some relationships are needed to be developed, which relate the personal income, minimum sanitation standard and community desire for comfort. The following is an expression based on household income and facility cost on customers and was found to be very much representative of the natural time sequences of sanitation development in Irbid area. The relationship may be used if present household income and estimates of user's costs for various sanitation facilities are known.

$$\frac{C_i(1+a)^{n_i}}{f} = H(1+b)^{n_i} \qquad (1)$$

where:

C_i = present monthly hosehold cost for ith mode of sewage facility;

a = cost index yearly increase in fraction of previous index (average);

b = income index yearly increase in fraction of previous index (average);

H = present monthly household income;

f = fraction of household income people are willing to spend for sewage facility(3% appears to be a fair assumption ?);

n_i = number of years in future after which ith mode of sewage facility will be economically feasible.

It is obvious that whatever the reason may be, if a community decides to adopt a sewage facility before its economical due time, the system needs to be subsidized financially from country's internal or external sources.

REFERENCE

1. J.M. Kalbermatten, D.S. Julius and C.G. Gunnerson,'Appropriate Technology for Water Supply and Sanitation : Technical and Economical Options,' World Bank Technical Report, December, 1980.