

822 PKPU96

LIBRARY IRC
PO Box 93190, 2509 AD THE HAGUE
Tel.: +31 70 30 689 80
Fax: +31 70 35 899 64
BARCODE: 14857
LO: 822PKPU96

Library
IRC International
and Sanitation
Tel: +31 70 30 689 80
Fax: +31 70 35 899 64

World Development, Vol. 24, No. 5, pp. 857-868, 1996
Copyright © 1996 Elsevier Science Ltd
Printed in Great Britain. All rights reserved.
0305-750X/96 \$15.00 + 0.00

0305-750X(96)00006-X

Household Demand for Improved Solid Waste Management: A Case Study of Gujranwala, Pakistan

MIR ANJUM ALTAF

The World Bank, Washington, DC, U.S.A.

and

J. R. DESHAZO*

Harvard University, Cambridge, Massachusetts, U.S.A.

Summary. — Solid waste management in most cities of the developing world is unsatisfactory despite consuming a relatively high proportion of municipal budgets. Most attempts at improving performance have focused on supply-side issues such as collection and disposal capacity but have not yielded significant results. This paper suggests a different approach based on integrating demand-side information into the planning process. The analysis calls into question conventional presumptions that households accord low priority to solid waste management compared to other urban services and are unwilling to pay for it. It also indicates that simple and inexpensive household surveys can provide valuable inputs into the planning process. Copyright © 1996 Elsevier Science Ltd

1. INTRODUCTION

Most municipalities in developing countries spend a large proportion of their budgets on the collection, transport, and disposal of solid wastes. According to Cointreau (1984, 1994, p. 41), in most cities in developing countries, municipal solid waste management costs consume 20–50% of municipal revenues yet collection service levels remain low with only 50–70% of residents receiving service and most disposal being unsafe. Poor solid waste management is a threat to public health and reduces the quality of life for urban residents. Moreover, the situation is likely to worsen due to continuing population growth and urbanization in developing countries.

Most attempts to improve solid waste management in cities in developing countries have focused on the technical aspects of different means of collection and disposal (Flintoff, 1984; WHO, 1971 and 1975). For example, over 1974–88, 66 of 71 World Bank loans in this sector were primarily for the procurement of waste collection vehicles (Bartone and Olivera, 1990). Recently, more attention has been paid to improving institutional arrangements for service delivery (Savas, 1979, 1982; Bartone *et al.*, 1991), with a special emphasis on privatization options (Cointreau, 1994).

By comparison, much less effort has been directed at investigating the demand-side aspects related to solid waste management.

In Pakistan, planning for the provision of municipal services is affected by two strongly held but untested beliefs about consumer demands. First, households consider the provision of such services to be an obligation of the government and resent paying for them and, second, households consider solid waste services less important than water and sanitation ser-

*Funding for the research (Altat, 1991) on which this paper is based was provided by the Department of Infrastructure and Urban Development at the World Bank. The paper was completed while the first author was Fulbright Fellow and Visiting Associate Professor, Department of Environmental Sciences and Engineering, University of North Carolina at Chapel Hill. Arif Sheikh provided exceptional support in the field and in the analysis. Carl Bartone, Geoffrey Read and Dale Whittington reviewed the survey instrument used in the study. Dale Whittington was also involved in initial discussions about the paper. Sandra Cointreau-Levine and anonymous referees provided valuable comments on earlier versions. The views expressed, however, are those of the authors who remain responsible for all errors. Final revision accepted: September 28, 1995.

822 - PKPU96 - 14857

ices. These beliefs were reiterated by planning officials during discussions preceding this study.

The purpose of the study was to verify these beliefs using demand-side information and to explore if such information could help improve solid waste management in developing countries. Households in Gujranwala, a dynamic secondary city in the Punjab, Pakistan, were surveyed about their existing solid waste disposal system, their willingness to pay for improvements, and the priority they attached to improvements in solid waste management relative to improvements in water supply and sanitation. Information on the supply of solid waste services was obtained by an analysis of the municipal budget, field observations and interviews with municipal officials.

The analysis shows that over half the solid waste generated in Gujranwala does not leave the city; not surprisingly, households were overwhelmingly dissatisfied with existing services. The results question providers' presumptions regarding the nature of demand and suggest that potentially valuable information can be obtained from household surveys. This information pertains to preferences over the components of solid waste service, spatial variation over types of neighborhoods, and willingness to pay for improved services. The information can be used to increase consumer welfare by providing services that are most in demand and to improve cost recovery by tapping into consumer willingness to pay. Given that such information is relatively inexpensive, it is important to incorporate it into the planning process.

Field procedures are reported in section 2. An overview of Gujranwala is presented in section 3. Section 4 describes the existing state of solid waste services in Gujranwala. Section 5 reports household attitudes and preferences regarding existing and improved services. Section 6 presents the experimental design and results pertaining to the elicitation of household demand for improved solid waste services. Section 7 provides a summary and suggests some directions for policy initiatives.

2. FIELD PROCEDURES

Supply-side information was obtained from municipal health department budgets for 1988-92, field observations between October and November 1990, and interviews with several department officials involved in the provision and planning of solid waste services.

The principal component of the study, however, was the development and implementation of a household survey intended to elicit three types of information: the perceived level of existing water, sanitation and solid waste services; household practices and attitudes regarding these services; and willingness to pay

for improved services. The contingent valuation method was used to elicit willingness to pay.¹

The sampling frame was provided by the Federal Bureau of Statistics (FBS). This census sampling frame divides Gujranwala into 436 enumeration blocks which represent neighborhoods containing 200-250 households. The blocks are stratified by income by the FBS. This stratification was retained for the study because municipal solid waste services are provided at the block and not the household level.

A two-stage, stratified sampling procedure was employed to generate a random sample of about 1000 households. First, 50 enumeration blocks were chosen based on probability proportionate to size resulting in the selection of 15 low-income, 25 middle-income and 10 high-income blocks.² Second, 20 households were selected from each block by randomly picking the starting house and then systematically sampling the block.

Fifteen male enumerators, selected from students at a local college, were trained in the administration of the survey.³ The design of the questionnaire was preceded by discussions with 100 households. The contingent valuation sections of the questionnaire were pretested on 10-15 households each as they were developed. Enumerators then pretested complete versions of the questionnaire twice on a total of 90 households. The survey was implemented during October and November 1990. To ensure quality control the enumerators were not split into groups interviewing in separate areas; rather, the entire team visited each area together accompanied by the study director and the field supervisor. The completed questionnaires were checked daily for discrepancies which were removed by revisiting households, if necessary. All interviews were conducted in the Punjabi language and a total of 968 questionnaires were completed.⁴

3. OVERVIEW OF THE STUDY AREA

Gujranwala is a rapidly growing industrial city situated 70 kilometers north of Lahore, the capital of Punjab province in Pakistan. Its population increased from 380,000 in 1971 to 660,000 in 1981 and to an estimated one million in 1990. With an annual growth rate of 7.3% during 1971-81 it was the fastest growing city in Pakistan. Gujranwala is the second largest secondary city in the Punjab and is representative of a number of other secondary cities in the region that will be in the 0.5 to one million population size category within the next decade.

Both survey data and field observations indicate that single-family, owner-occupied dwellings are the norm in Gujranwala.⁵ Household size is large because of the presence of extended family members; the average size was just under 10 without any significant variation across types of neighborhoods. The average

number of years of education of the most educated male member of the household varied between eight for low-income neighborhoods and 11 for high-income ones; corresponding figures for the most educated female member of the household were five and nine years, respectively. Average monthly household income as computed from survey data was Rs. 2,770 for low-income neighborhoods, Rs. 3,350 for middle-income neighborhoods, and Rs. 4,170 for high-income neighborhoods. The average monthly income for the entire sample was Rs. 3,330.⁶

Compared to provincial capitals, secondary cities in Pakistan have been neglected in the provision of public infrastructure. In the case of Gujranwala, such neglect has created the paradox of a large, relatively affluent city lacking in basic public services such as water, sanitation and solid waste removal. Private response to the provision of inadequate water supply and sanitation facilities casts doubt on the belief that households are willing to pay very little for these services.⁷

Households in Gujranwala have invested surprisingly significant sums in private water and sanitation arrangements as a response to inadequate public services (for details, see Altaf, 1994). While over half the city's households (53%) have access to the public piped-water system, the performance of the system falls below their expectations and only one-third of these households rely solely on the piped connection. The rest have invested in supplemental devices such as motor-driven pumps to enhance the performance of the public service. Households without access to the public piped supply have, without exception, installed private handpumps or motor-driven pumps in order to extract groundwater.

In the case of sanitation, about 40% of households in the city have access to the public sewer line. Of the remaining, 63% have purchased and installed toilets with private septic tanks and this is the rapidly proliferating alternative. These observations on private response to the neglect of infrastructure in Gujranwala can be readily generalized to other secondary cities in the Punjab.

4. SOLID WASTE MANAGEMENT IN GUJRWALA

Solid waste composition has distinct characteristics in low-income developing countries. All easily transportable waste of value (paper, glass, tins, scrap metal, etc.) is purchased and recycled by private collectors who visit households regularly for this purpose. Thus the actual volume of waste to be disposed of outside the house is low, being about 0.50 kilograms per capita per day.⁸ High residential densities, however, result in the generation of considerable amount of total waste in most neighborhoods. The

waste consists primarily of organic matter from the kitchen which necessitates frequent disposal because of spoilage.

(a) Municipal service

Solid waste management in Gujranwala falls under the jurisdiction of the health department of the municipal corporation which employs the same staff for both sanitation and solid waste management. Funding for solid waste management in 1989-90 was Rs. 28 million, about 17% of the municipal budget. Allocating this over a population of 0.8 million which the municipality claims to cover would suggest that it spends approximately Rs. 35 (US\$ 1.8) per capita per year on solid waste management. This is slightly less than the lower-bound estimate of recurring costs (US\$ 2.3 per capita per year) for collection, street cleansing and disposal in the low-income country group (average annual per capita income of US\$350 in 1988) obtained from Cointreau (1994, pp. 41-44). In all probability, the difference is accounted for by actual coverage being lower than claimed by the municipality. The expenditure in Gujranwala is also comparable to that in Jakarta, Bangkok, Kuala Lumpur and Beijing which are among the 12 Asian metropolises for which current information is available (Shin *et al.*, 1992, pp. 123-124).⁹ The municipality neither privately subcontracts waste collection, nor levies direct fees on the public.

The labor allocation, equipment performance and operations in Gujranwala were similar to other cities in South Asia. The department employed 1247 sanitary workers in 1991-92 which falls within the range of 1-5 workers per 1000 inhabitants reported for the Indian subcontinent by Bhide and Sundaresan (1984).¹⁰ In 1991, the department reported having four trucks of which two were out of order; 29 tractors of which 13 were out of order; and 300-400 operable handcarts. Every three years, department policy allows purchase of two tractors, 10 trolleys, and 250 handcarts as replacements. Operable vehicles transport waste to five transfer stations within the city. In 1991, a 10-acre piece of land was rented about 12 kilometers from the city to serve as a landfill. Authorities reported no solid waste being disposed there as of early 1992.

The operating schedule of the department was reported as follows: nine tractors and two trucks operate between neighborhoods and the transfer stations in the city; five tractors operate between the transfer stations and temporary disposal sites outside the city. Each of these vehicles makes between two and four trips per day.

Rough estimates based on the operation of 11 vehicles devoted exclusively to the collection of household waste, making an average of three trips per day

show that the maximum amount of waste that can be removed from neighborhoods by the municipality is about 100 tons per day, assuming a carrying capacity of three tons per vehicle.¹⁰ This represents only 20% of the total waste generated (500 tons, using a daily per capita estimate of 0.50 kilograms for a population of one million). This estimate, which is similar to the one we estimate below based on household reports, suggests that the urban environment absorbs a huge amount of solid waste.

From the perspective of municipal authorities, the obstacle to providing adequate service is the lack of collection equipment exacerbated by the high proportion of inoperable vehicles. Such problems are not unique to Gujranwala: Oluwande (1984) notes that in China and Africa, authorities commonly have only between 20% to 50% of the operable equipment they need. Labor capacity, on the other hand, is not a limiting factor in service provision in Gujranwala. Even very conservative estimates of the amount of waste collected per worker per hour indicate that within the existing number of workers the total household waste generated daily in Gujranwala could be collected if the capital equipment were available and operating.¹¹

(b) Survey results

The municipality of Gujranwala claims to provide solid waste service to 80% of the city population. Survey results indicate, however, a much lower coverage suggesting either overstatement by the municipality or a mismatch between the perceptions of the municipality and households as to what constitutes acceptable service. Only one-tenth of sample households in low-income neighborhoods, one-fifth in middle-income neighborhoods and one-third in high-income neighborhoods reported regular municipal collection of solid waste.

As a result of the low coverage, households dispose solid waste over a variety of sites within the neighborhood. These include throwing the waste into the street or on unenclosed heaps from where it can be removed during the process of street cleaning. Table 1 shows the distribution of wastes from both houses and streets tabulated over disposal sites. About 20% of the households reported that their waste was collected directly by municipal collectors using handcarts. The remainder disposed of the waste outside the house with only 2% doing so in bins provided by the municipal corporation. The most common disposal site, reported by 30% of households, was an empty plot in the neighborhood.¹² Most other households used either a garbage heap or a sewage pond in the neighborhood or simply threw the waste into the street. Only 7% of households indicated that solid waste was disposed of by being burnt in their neighborhood.

Although about 70% of the households reported

that the municipal corporation or local council arranged for street cleaning, the waste removed from the streets and drains was no better disposed of. Around one-quarter of the households indicated that this waste was taken away by municipal collectors in handcarts. The rest reported that the waste did not leave the neighborhood. It was either disposed of in empty plots or added to garbage heaps. Some waste continued to remain in the streets from where it was removed during periodic special campaigns.

Based on survey responses, Figure 1 presents a flow diagram showing the overall pattern of disposal of solid wastes from households and streets. Total household solid waste generated is approximately 500 tons per day (based on a 0.5 kilogram per capita per day estimate for a population of one million) of which about 125 tons is removed regularly by the municipal corporation. This is only slightly higher than the estimate of 100 tons per day obtained from supply-side calculations and confirms the earlier conclusion that most of the solid waste generated in neighborhoods remains there.

The above disposal pattern gives rise to a number of public problems. First, the very high percentage (18%) of household waste disposed of in streets imposes significant unnecessary costs on the municipality; the costs per ton of cleaning open areas and streets are 2-3 times the costs per ton of collection according to Cointreau (1994, p. 42). Second, the empty lots into which 30% of household waste is being dumped are, in effect, small local landfills within neighborhoods with all the attendant public health hazards. Third, the waste disposed of in open heaps is further scattered by scavengers and stray animals. Fourth, 10% of households using bucket latrines (14% of city households use bucket latrines) stated that they emptied the excreta into one of the disposal sites from which waste did not leave the neighborhood.¹³ Fifth, uncollected or poorly disposed solid

Table 1. Distribution of Solid Waste from Households and Streets*

Disposal site	Percentage of waste from	
	Households	Streets
Municipal Collection	23	26
Empty Plot	31	17
Street	18	23
Garbage Heap	16	16
Drainage Ditch/Pond/Canal	7	8
Don't Know	5	8

*Some solid waste is thrown into the street by households. This is supposed to be collected during regular street cleaning. Not all is actually collected and accumulated waste is often only removed through periodic special campaigns.

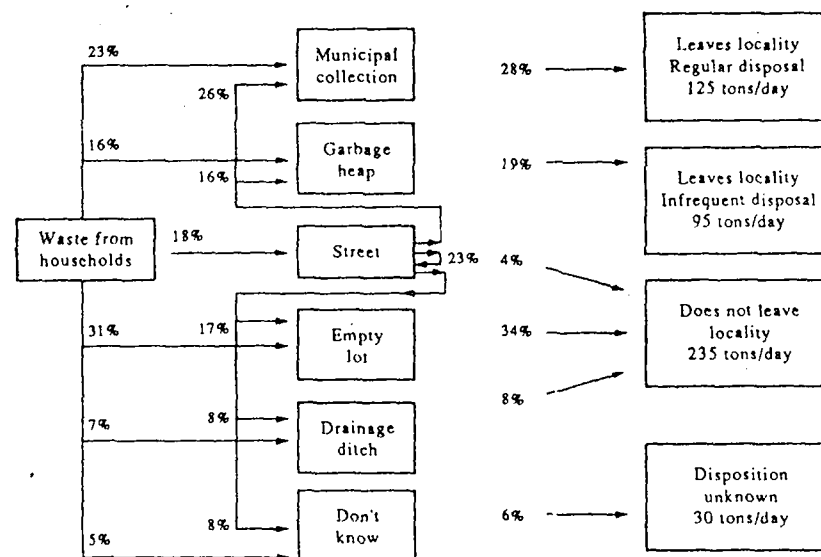


Figure 1. Waste flows in Gujranwala, Pakistan.

waste frequently impedes drainage, particularly since an increasing component of household waste is non-biodegradable plastic shopping bags which are not yet recycled.¹⁴

5. HOUSEHOLD ATTITUDES AND PREFERENCES REGARDING EXISTING AND IMPROVED SERVICES

Given the quantity of solid waste that is uncollected in neighborhoods it comes as no surprise that 74% of respondents were dissatisfied with the collection and disposal of household waste. Similarly, 72% were dissatisfied with arrangements for disposing of the waste generated by the cleaning of streets and drains.

When respondents were asked what measure would contribute most to improving the situation, 41% indicated improved collection from houses, 34% indicated better street and drain cleaning, and 22% indicated more regular emptying of municipal garbage bins. These responses indicate that a majority of respondents rate improving the cleanliness of the neighborhood as more important than the convenience associated with household pickup. These preferences, however, vary by type of neighborhood. Table 2 shows the distribution of responses by income level of neighborhood. Lower income neighborhoods, with least access to municipal services, are predominantly

concerned with improved street and drain cleaning; middle-income ones are split between house pickup and street and drain cleaning; upper income neighborhoods, with reasonable street-cleaning service, indicate a clear preference for improved house pickup. Table 3 shows the same distribution by access to existing services. It is apparent that wherever sewer and piped water services are available, the preference is for house pickup; in other areas, street and drain cleaning are preferred.

Households were also asked their opinion regarding the respective merits of public and private provision of solid waste management services. Slightly more (49%) preferred public to private provision (44%) with more educated and affluent households favoring the latter.

To obtain a sense of the relative priority attached to improved water, sanitation and solid waste management services, households were asked to indicate which service they would want the municipal corporation to provide first in their neighborhood if all services were free but only one could be provided for budgetary reasons.¹⁵ Improved sewerage was ranked first by 42% of the households, improved solid waste management by 32%, and improved water by 27%. This is not surprising since the provision of water is most amenable to a private solution in Gujranwala, and, as reported earlier, most households have upgraded their water facilities to levels affordable to them.

Table 2. Preferences over components of improved solid waste service by income level of neighborhood

Type of Neighborhood	Households with access to regular solid waste service		Component of improved solid waste service ranked first						
			Street/drain cleaning		Municipal bin emptying		House pickup		
	No.	%	No.	%	No.	%	No.	%	
Low Income	287	31	10	123	42.9	80	27.9	84	29.3
Middle Income	468	50	20	151	32.3	109	23.3	208	44.4
High Income	185	19	30	55	29.7	28	15.1	102	55.1
Total Households	940	100	19	329	35.0	217	23.1	394	41.9

Table 3. Preferences over components of improved solid waste service by access to existing municipal services

Access to existing services*	Number of households		Component of improved solid waste service ranked first					
			Street/drain cleaning		Municipal bin emptying		House pickup	
	No.	%	No.	%	No.	%	No.	%
None	384	40.9	174	45.3	99	25.8	111	28.9
SW Collection only	37	3.9	16	43.2	10	27.0	11	29.7
Sewer only	45	4.8	11	24.4	12	26.7	22	48.9
Piped Water only	125	13.3	41	32.8	29	23.2	55	44.0
SW Collection + Sewer	20	2.1	5	25.0	6	30.0	9	45.0
SW Collection + Piped Water	76	8.1	18	23.7	12	15.8	46	60.5
Sewer + Piped Water	169	18.0	44	26.0	33	19.5	92	54.4
SW Collection + Sewer + Piped Water	84	8.9	20	23.8	16	19.1	48	57.1
Total	940	100	329	35.0	217	23.1	394	41.9
Total excluding areas without any service	556	59.1	155	27.9	118	21.2	283	50.9

*Sewer service, piped water service, municipal solid waste (SW) collection.

Table 4 presents the ranking for improved services when the respondents' access to existing municipal services (piped water, piped sewerage, municipal collection of solid waste) is taken into account. The overwhelming demand for sewer service comes from areas where none of the three services is available. Outside such areas, improved solid waste service is ranked first by 39% of the households, improved water is ranked first by 32%, and improved sewerage by 30%.

An indirect indication of demand for improved solid waste services is also available. Table 5 presents the reasons given by households for their preference ranking of the three improved services. The fact that water is a more basic need is obvious from the fact that the majority of households who ranked water first mentioned greater need as the primary reason for their choice. These are clearly poor households who have been unable to afford an adequate private solution to satisfy their water needs. Cleanliness of the neighborhood, however, was the major reason given by those who ranked either improved sewerage or solid waste

as their preferred service. Of those preferring sewerage, a significant minority (33%) cited drainage of water which is related to improved solid waste collection as noted earlier. Health considerations were important for 16% of those who ranked solid waste first. Neighborhood cleanliness, drainage of water and health are all negatively affected by poor solid waste collection and disposal.

6. WILLINGNESS TO PAY FOR IMPROVED SOLID WASTE MANAGEMENT

The above evaluation of demand for improved solid waste services yields important preference information but is unable to provide a quantitative measure of demand. To obtain such an estimate an alternative, improved solid waste service, based on pretesting, was described to respondents. The contingent valuation method was used to elicit the maximum monthly amount that households would be willing to pay for the improved service.

Table 4. Improved service preferred by access to existing municipal services

Access to existing services*	Improved service ranked as first choice							
	Number of households		Improved sewerage		Improved water		Improved solid waste	
	No.	%	No.	%	No.	%	No.	%
None	387	40.9	231	59.7	74	19.1	82	21.2
SW Collection only	35	3.7	18	51.4	11	31.4	6	17.1
Sewer only	48	5.1	6	12.5	18	37.5	24	50.0
Piped Water only	124	13.1	53	42.7	29	23.4	42	33.9
SW Collection + Sewer	20	2.0	2	10.0	8	40.0	10	50.0
SW Collection + Piped Water	77	8.1	35	45.5	28	36.4	14	18.2
Sewer + Piped Water	171	18.1	41	24.0	51	29.8	79	46.2
SW Collection + Sewer + Piped Water	85	9.0	12	14.1	32	37.6	41	48.2
Total	947	100	398	42.0	251	26.5	298	31.5
Total excluding areas without any service	560	59.1	167	29.8	177	31.6	216	38.6

*Sewer service, piped water service, municipal solid waste (SW) collection.

Table 5. Reasons for household preference over municipal services (percentage of households)

Reasons	Service ranked first		
	Water	Sewerage	Solid waste
Cleanliness of area	0	48	74
Drainage of water	0	33	1
Health considerations	6	3	16
Greater need	74	8	3
High current expenditure	8	0	0
Other	12	8	6

(a) Contingent valuation module

A typical contingent valuation module has two major components: a description of the service being offered including conditions of availability and a procedure to elicit a respondent's willingness to pay for it with minimum bias. The exact description of the improved solid waste service offered in Gujranwala is presented in Appendix A.

An iterative bidding procedure with follow-up was used to elicit a respondent's willingness to pay. The respondent was first asked whether or not he or she would accept the service offered at a given monthly fee. Depending upon a YES or NO response the monthly fee was raised or lowered and the question repeated. A maximum of two iterations were employed. The procedure ended with an open-ended question enquiring the respondent's maximum willingness to pay for the service. Those who were not interested in the service at any price were asked to state the reason for their decision.

A split-sample experimental design was employed to test three specific hypotheses. First, to test whether the value of the monthly fee mentioned to respondents affected their responses (starting point bias), half the respondents were offered a high fee (Rs. 20 per month) and half a low fee (Rs. 10 per month). These values were determined based on pretest responses.

Second, to test whether the type of provider affected respondents' willingness to pay, half of respondents were told the service would be provided by the municipal corporation and the other half was told it would be provided by a private firm.

Third, because solid waste has a public good aspect, it was expected that the respondents' willingness to pay might be affected by their judgement how many other households in the neighborhood would subscribe to the service. In order to test whether these expectations would affect their choice two scenarios were offered. Half the respondents were asked to assume that 75% of households in the neighborhood would accept the service; the other half was asked to assume that 25% of households would accept the improved service. It was hypothesized that respondents valued positively the external benefits in addition to private benefits, the first scenario would elicit a higher willingness to pay.

Together, these three tests resulted in a 2 x 2 x 2 experimental design with eight versions of the bidding game. These versions were randomly administered to the sample households. Appendix B provides one version of the bidding game — the starting point (Rs. 10 per month), low connect scenario (25% of households in neighborhood accepting improved service), with service provided by the municipal corporation.

(b) *Willingness to pay*

The results of the contingent valuation survey show that of the 968 households in the sample, 794 (82%) were interested in the improved solid waste service offered and 695 (71%) were willing to pay a positive amount for it. The mean willingness to pay of the latter was Rs. 11.20 per month. Of the 99 households who were interested in the service but not willing to pay anything for it, a majority (84%) considered the provision of such a service to be a responsibility of the government. The average stated willingness to pay of all those who were interested in the service offered was Rs. 9.80 per month. If a zero willingness to pay is assumed for households not interested in the service, the average willingness to pay over the entire sample was Rs. 8.04 per month. Table 6 shows the percentage of households that would subscribe to the improved solid waste service at different price levels. Just over half the households would subscribe at a tariff of Rs. 10 per month.

Of the 174 households (18%) who indicated no interest in the improved service offered, 62% asserted that collection and disposal of solid waste was the government's responsibility while 29% were satisfied with the existing service. Households not interested in the improved service had a lower than average proportion of women and children in the house and were thus likely to generate a lesser amount of kitchen waste.

Both bivariate and multivariate analysis of the willingness-to-pay bids of households interested in the improved service confirm that the bids are not random but are related to household socioeconomic characteristics in a way one would expect. Table 7 shows that the bids increase systematically with increases in average education, discretionary income, and wealth. A multivariate analysis of the bids shows that wealth, household expenditure, and discretionary income are indeed significant positive determinants of willingness to pay. The key independent variables are significant and have the predicted sign suggesting that solid waste service is a normal economic good with implications for household welfare. The multivariate results are presented in Table 8.¹⁶

(c) *Tests of hypotheses*

The multivariate analysis indicates the absence of starting point bias. In addition, no statistical difference was found in the willingness-to-pay bids of respondents given the different service provider options (private versus public). This is consistent with the information obtained through a direct question in the survey which showed roughly equal numerical preferences for the two modes of service provision.

Table 6. *Household willingness to subscribe to improved solid waste service by price of service*

Tariff (Rs./month)	Households willing to subscribe to service	
	No.	%
0	968*	100.0
5	695	71.8
10	514	53.1
20	151	15.6
25	17	1.8

*The willingness to pay of households who did not respond to the bidding game is assumed to be zero.

Table 7. *Household willingness to pay for improved solid waste service by socioeconomic characteristics*

Socioeconomic characteristic	Percentage of sample	Mean WTP bid (Rs./month)
<i>Education of respondent (years)</i>		
0-8	36	6.4
9-12	41	8.5
> 12	23	10.4
<i>Replacement value of house (Rs.)</i>		
0-100,000	44	8.6
100,000-150,000	4	9.0
150,000-300,000	26	10.6
> 300,000	26	12.2
<i>Employment of servant (proxy for discretionary income)</i>		
No	90	7.2
Yes	10	11.5

No statistical difference was found in the willingness-to-pay bids of respondents presented with the high (75%) and low (25%) neighborhood service acceptance scenarios. This is not compatible with the direct evidence reported in Table 4, which shows that respondents stated a preference for solid waste or sanitation services because they felt it would improve neighborhood cleanliness or environmental and health conditions. A number of interpretations may explain the insignificance of the variable in the multivariate results. First, respondents may not have believed the acceptance scenario presented to them. Second, they might not have associated externalities with the proportion of households accepting the service since this was not explicitly mentioned in order to avoid biasing responses by providing leading information. Third, they may have genuinely seen no difference between the 25% and 75% acceptance scenarios on the grounds that neighborhood benefits would not accrue unless all households subscribed to the service. Given that the valuation of environmental externalities is important but as yet infrequent in developing countries, all these explanations form testable hypotheses for future work.

Table 8. *Multivariate (OLS) analysis of willingness-to-pay bids for improved solid waste service*

Variable	Parameter estimate	T-value	Variable
Constant	5.45	2.46*	-
Household size	-0.20	-0.26	9
Proportion of adult women in household	-1.80	-0.64	0
Proportion of children (under 15) in household	2.73	1.48	0
Sex of respondent 1 = Male; 0 = Female	1.42	1.37	0
Age of respondent (years)	-0.05	-2.27*	39
Schooling of respondent (years)	0.05	0.83	7
Number of adult male earners in household	0.88	3.04†	1
Household expenditure/capita/month (100 Rs.)	0.43	3.44†	3
House replacement value (100,000 Rs.)	0.38	2.72†	2
Discretionary income dummy 1 = Household employs servant; 0 = no servant	2.58	2.88†	0
Service acceptance scenario dummy 1 = 75% households accept; 0 = 25% accept	0.09	0.18	0
Service provider dummy 1 = private provider; 0 = municipality	0.13	0.27	0
Starting point dummy 1 = Rs. 20 per month; 0 = Rs. 10 per month	0.72	1.46	0
Interview environment dummy 1 = Listeners present; 0 = respondent alone	-0.84	-1.63	0
Number of observations = 649		R-Squared = 0.15	

*Significant at the 5% level.

†Significant at the 1% level.

7. SUMMARY AND DIRECTIONS FOR POLICY INITIATIVES

Both survey data and information about municipal collection capacity confirm that over half the household solid waste generated in Gujranwala remains in residential neighborhoods. Not surprisingly, households were overwhelmingly dissatisfied with existing solid waste services and responsive to both the public and private benefits of improved management. In many areas of the city, improvements in solid waste service were placed ahead of improvements in water and sewer service. This was because improved cleanliness of the neighborhood was important for most residents. The positive and significant correlation of disposable income, education and property values suggests that solid waste service is a normal economic good, the demand for which increases with affluence. This is important to keep in mind in the context of dynamic cities such as Gujranwala.

The case study suggests that survey information can provide useful inputs when planning for improved solid waste management in Gujranwala. First, contrary to widely held beliefs, solid waste service is not the lowest priority among municipal services for urban residents. Indeed, there were many areas of the city where solid waste service was given the highest priority ahead of water and sewer services. Second, demand for specific components of solid waste management (e.g., street/drain cleaning, municipal bin emptying and household pick-up) varied by neighborhoods. This spatial variation in preferences provides

the opportunity to increase consumer welfare by locating funds between urban services and by giving the provision of solid waste service top spatial concerns.

The results also indicate some prospects for limited cost recovery with households currently willing to pay an average of Rs. 8-10 per month for improved solid waste services. It is encouraging to note that, contrary to general belief, only 20% of the households considered free provision of solid waste service a responsibility of the government; 80% of the households were willing to pay for improved service. Absolute willingness to pay for the improved service was low (and much lower than the municipality's Rs. 35 per household per month for provision of existing service) perhaps because there is no tradition in the city of paying for either public solid waste or sanitation services nor is there much credibility in the capacity of the public sector to deliver on its commitments. High priority should be accorded to increasing the credibility needed to prevent complete disengagement with the public sector, to tap household willingness to pay and to build on it in the future. The approach would be to initiate a good demonstration project in an area with high demand for service. The objective would be to convince residents that significant improvements in neighborhood cleanliness are actually possible in order to raise general willingness to pay over time.

At a more general level, the case study reveals that unnecessary costs are being generated by a high proportion of household waste being disposed of in the

These costs could be reduced by special targeting for more efficient house or neighborhood collection.

The case study also clearly identifies the fact that the existing capital-labor mix in the provision of municipal solid waste services is grossly inefficient. This is a pervasive problem in developing countries where the public sector is often the employer of last resort and incentives for the maintenance of capital equipment are absent. Given these deep-rooted institutional and incentive problems, the infusion of capital equipment is unlikely to improve the situation even though limited transport capacity seems to be the immediate bottleneck. Laying off personnel may also be politically difficult in the short term. One possible solution (which has not been evaluated in this paper) could be to test the feasibility of privatizing solid waste collection and disposal service in an area of the city where the survey indicates the acceptance of the privatization option is greatest. Solid waste services are among the easiest of municipal services to privatize and competition can be introduced through a bid-

ding process much more readily than for water and sanitation services (Cointreau, 1994). At the same time, the municipality can continue to provide service in some areas of the city to retain backup capacity. Such an arrangement could yield valuable evidence on the relative efficiency of public and private providers in Pakistan while at the same time acting as a spur for the public sector to improve its performance.

While the applicability of the numerical results obtained in Gujranwala may be limited to comparable cities in the Indian subcontinent, the major contribution of this case study is the general demonstration that demand information obtained relatively easily and inexpensively can provide a useful input in planning improved provision of public services. Citizen participation in public policy decisions in developed countries is ensured through the institution of open hearings and the presence of informed citizen interest groups. In the absence of such institutions, the contingent valuation method provides a feasible mechanism to achieve the same objective in developing countries.

NOTES

1. The contingent valuation method is one in which respondents are interviewed and directly questioned about how much they are willing to pay for amenities or services. For details of the method, see Mitchell and Carson (1989).

2. Note that the percentage of high-income households in cities such as Gujranwala ought to be less than the percentage of high-income neighborhoods because relatively more low- and middle-income households are located in high-income neighborhoods than vice versa. The percentage of low-, middle- and high-income households based on reported asset ownership in the survey was 33%, 54% and 13%, respectively.

3. The use of male enumerators does not lead to a bias given the objective of the study. The objective was not to estimate and compare the separate willingness to pay of male and female respondents which could be affected if female respondents were inhibited by male enumerators. Rather, the objective was to estimate the amount that the household was likely to pay. The decision on financial commitments in Pakistan is almost exclusively made by the male head of household. In the study, 93% of the respondents were male and therefore the use of male enumerators was appropriate. The methodology is general, however, and where warranted both female enumerators and respondents can be included in the survey.

4. These did not include any of the pretest questionnaires.

5. No apartment housing was encountered during the survey and only 4% of respondents were renters.

6. All figures have been rounded off. At the time of the survey US\$ 1 exchanged for Rs. 19.75.

7. This quantity is based on Yunus (1980) and Zafar (1980) for Lahore and Karachi, respectively and surveys of waste generation in cities in the Indian subcontinent (Holmes, 1984; Nath, 1984). More recent estimates for 12 Asian metropolises are presented in Shin *et al.* (1992). The estimates for the Indian subcontinent are comparable. Waste generation per capita is higher in East Asian cities on the average.

8. The lower-bound estimate derived from Cointreau is \$3.8 per capita per year. This includes, however, all capital, debt service, operating and maintenance costs. Recurrent costs, borne out of the municipal budget, are generally of the order of 50% of total costs (Sandra Cointreau, personal communication). It is not clear as to what components are included in the estimates reported by Shin *et al.* The estimate of recurrent costs for Gujranwala should be taken as a lower bound since the coverage of 80% of the city population reported by the municipality is most likely an overestimate.

9. Bhide and Sundaresan report that the range for the number of workers per 1,000 inhabitants is 1-3 for 75% of the cities and 3-5 for 25% of the cities with larger cities generally having more workers. According to Cointreau (personal communication) the existing number of workers per 1,000 inhabitants in Bombay, Delhi and Calcutta are 2.6, 3.2 and 4.6, respectively.

10. Typical vehicles in the Indian subcontinent have a capacity of 5-8 cubic meters. The average density used in the calculation of solid waste disposal is 330 kilograms per cubic meter (Sandra Cointreau, personal communication).

11. Diaz and Golucke (1985, p. 49) report that in developing countries the average amount of waste collected by a

three-man crew is on the order of one ton per hour. We assume that only half the number of hours from an eight-hour shift are devoted to actual collection work. Further, the Diaz and Golucke estimate includes Latin American countries with mechanical loading from curbside containers. Manual loading, typical of most subcontinental cities, is a slower operation. We use an estimate of 0.1 tons per worker per day based on data for Bombay provided by Cointreau (personal communication) in Bombay, a six-person crew fills a 10 cubic meter truck (3.5 tons) once in five hours on the average.

12. This practice is not discouraged by absentee plot owners who value the filling material.

13. The health risks from this practice are increased

because half the respondents extracted some water from the shallow aquifer, which being less than 50 feet in depth, may be vulnerable to contamination.

14. Solid waste blocks open street drains and is often dumped into sewers through missing manhole covers. The nonbiodegradable shopping bags get inflated and block sewer pipes.

15. The free provision scenario was used to control for the effects of perceived price differentials on preference ordering.

16. The objective of the multivariate analysis is not to provide an explanation for the willingness-to-pay bids obtained but simply to establish that they are not random.

REFERENCES

- Altuf, M. A., "Willingness to pay for improved water and sanitation services in Gujranwala, Pakistan," Mimeo (Washington, DC: Infrastructure and Urban Development Department, The World Bank, December 1991).
- Altuf, M. A., "Household demand for improved water and sanitation in a large secondary city: Findings from a study in Gujranwala, Pakistan," *Habitat International*, Vol. 18, No. 1 (1994), pp. 45-55.
- Bartone, C. R., and C. Olivera, "A unit cost model for solid waste collection," Urban Note, No. UE-1 (Washington, DC: Infrastructure and Urban Development Department, The World Bank, 1990).
- Bartone, C. R., L. Leite, T. Triche, and R. Schertenlieb, "Private sector participation in municipal solid waste service: Experiences in Latin America," *Waste Management and Research*, Vol. 9, No. 6 (December 1991), pp. 495-509.
- Bernstein, J. D., "Improving the urban environment through investments in solid waste management," Urban Note, No. UE-2 (Washington, DC: Infrastructure and Urban Development Department, The World Bank, 1992).
- Bhide, A. D., and B. B. Sundaresan, "Street cleansing and waste storage and collection in India," in J. R. Holmes (Ed.), *Managing Solid Waste in Developing Countries* (New York: John Wiley & Sons, 1984), pp. 139-149.
- Cointreau, S. J., "Solid waste collection practice and planning in developing countries," in J. R. Holmes (Ed.), *Managing Solid Waste in Developing Countries* (New York: John Wiley & Sons, 1984), pp. 151-182.
- Cointreau-Levine, S., "Private sector participation in municipal solid waste services in developing countries," Urban Management Programme Discussion Paper, No. 13 (Washington, DC: The World Bank, 1994).
- Diaz, L. F., and C. G. Golucke, "Solid waste management in developing countries," *Bicycle*, Vol. 26, No. 6 (1985), pp. 46-52.
- Flintoff, F., "Management of solid wastes in developing countries," Regional Publications South-East Asia Series, No. 1, Second edition (New Delhi: World Health Organization, 1984).
- Holmes, J. R., "A review of municipal waste management practices in three South Asian cities," in J. R. Holmes (Ed.), *Managing Solid Waste in Developing Countries* (New York: John Wiley & Sons, 1984), pp. 273-290.
- Mitchell, R., and R. Carson, *Using Surveys to Value Public Goods: The Contingent Valuation Method* (Washington, DC: Resources for the Future, 1989).
- Nath, K. J., "Metropolitan solid waste management in India," in J. R. Holmes (Ed.), *Managing Solid Waste in Developing Countries* (New York: John Wiley & Sons, 1984), pp. 47-69.
- Oluwande, P. A., "Assessment of metropolitan solid waste management problems in China and Africa," in J. R. Holmes (Ed.), *Managing Solid Waste in Developing Countries* (New York: John Wiley & Sons, 1984), pp. 71-89.
- Savas, E. S., "Public vs. private collection: A critical review of the evidence," *Journal of Urban Analysis*, Vol. 6, No. 6 (1979), pp. 1-13.
- Savas, E. S., *Privatizing the Public Sector: How to Shift Governments* (Chatham, NJ: Chatham House Publishers, 1982).
- Shin, E., R. Gregory, M. Hufschmidt, Y. Lee, J. E. Nickl, and C. Umetsu, "Economic valuation of urban environmental problems with emphasis on Asia," Mimeo (Washington, DC: Infrastructure and Urban Development Department, The World Bank, 1992).
- World Health Organization, "Solid waste disposal and control," Technical Report Series, No. 484 (Geneva: WHO, 1971).
- World Health Organization, "Solid waste management Report of Regional Seminar in Bangkok, No. SEA/RS San/158 (New Delhi: WHO, 1975).
- Yunus, M., "Solid waste management for the city: Lahore," Mimeo (Lahore, Pakistan: Lahore Municipal Corporation, 1980).
- Zafar and Associates, "Engineering and economic feasibility of composting in Karachi," Mimeo (Karachi, Pakistan: Karachi Municipal Corporation, 1980).

APPENDIX A: DESCRIPTION OF IMPROVED SOLID WASTE SERVICE

Suppose that it is decided to offer a new solid waste collection service to households in this neighborhood. A person would pick up the waste from your house each day. The waste from all the houses subscribing to the service would be disposed of properly. It would be hauled away from this neighborhood in trucks to a municipal landfill. It would not be left around the neighborhood in rubbish heaps or municipal bins. This waste collection service would thus address two problems: your waste would be picked up regularly from

your house, and your waste would not be left around the neighborhood to create a sanitary problem.

This kind of service can only be offered if a sufficient number of households agree to purchase it and agree to pay a monthly charge on a regular basis.

The service can be offered by the municipal corporation or by a private firm. In either case each household could decide whether it wanted to accept this service or not.

APPENDIX B: BIDDING GAME FOR IMPROVED SOLID WASTE SERVICE

This is the low starting point version of the bidding game. In the high starting point version the opening value in Q.1 would be Rs. 20 per month. A YES response would lead to Q.3; a NO response would lead to Q.2 with the value lowered to Rs. 10 per month.

1. Suppose the municipal corporation were to offer this improved waste collection and disposal service in this neighborhood, and the monthly charge was Rs. 10 per month. Assume that 25 percent of the other households in the neighborhood decided to accept the new waste collection service. Would you accept this service, or would you want to continue using your existing system?
 - 1) YES — Accept new service — continue
 - 2) NO — Continue using existing system — go to Q.3
2. Suppose the municipal corporation decided that the monthly fee for the improved waste collection and disposal service was Rs. 20 per month and that 25 percent of the other households in the neighborhood still decided to accept the service. Would you still accept the new service, or would you now want to continue using your existing system?
 - 1) YES — Accept new service
 - 2) NO — Continue using existing system

3. What is the maximum monthly bill you would be willing to pay for this new waste collection and disposal service?
 - 1) Maximum bid Rs. _____
 - 2) Don't want service at any price
 Enumerator: Is the respondent's maximum bid greater than zero?
 - 1) YES — Greater than zero — Stop
 - 2) NO — Bid is zero — Continue
4. Could you tell me the main reason why you do not want to pay anything for an improved waste collection service?
 - 1) Don't trust/like a private company
 - 2) Don't trust/like the corporation
 - 3) Satisfied with existing system
 - 4) Government's responsibility to provide waste collection free
 - 5) Service would probably not be reliable
 - 6) Only a few people would use the service and the neighborhood would still be dirty
 - 7) Cleaning of streets and drains is not included in this service
 - 8) Other (specify) _____



Pergamon

World Development, Vol. 24, No. 5, pp. 869-885, 1996

Copyright © 1996 Elsevier Science B.V.

Printed in Great Britain. All rights reserved.

0305-750X/96 \$15.00 + 0.00

0305-750X(96)00007-1

Catching Up in the Postwar Period: Puerto Rico as the Fifth "Tiger"?

WILLIAM J. BAUMOL

and

EDWARD N. WOLFF*

New York University, New York, U.S.A.

Summary. — Puerto Rico experienced one of the world's most rapid growth rates in both GDP per capita and labor productivity — a performance that puts it into the same league as Japan, South Korea, Taiwan and Singapore. Moreover, Puerto Rico significantly narrowed the productivity gap between itself and the United States. Special circumstances played a role in its development, including unrestricted emigration to the mainland, generous federal transfer payments, and special tax incentives for investment. But our analysis suggests that even without these advantages annual growth in GDP per capita would have averaged 3.8% over 1950-90, instead of its actual rate of 4.2%. Copyright © 1996 Elsevier Science Ltd

I. INTRODUCTION

Puerto Rican economic development is a subject that should be of particular interest to economists in the United States, given the special relationship between the two geographic areas. But there is another reason the subject should command our attention — the general lessons it provides for development policy. The extraordinary accomplishments described in this paper provide valuable lessons for less-developed countries (LDCs) that hope to improve their growth performance. The postwar history reported here shows how much can be accomplished by a program of cooperation between a rich, developed economy and one that is initially far less developed, though the evidence suggests that US assistance to Puerto Rico may have played a role more modest than usually supposed. It also suggests, in contrast with the other success stories, such as that of South Korea, that there is not just one path that can lead to growth. For example, a key to Puerto Rico's progress was its success in attracting external investment, while South Korea relied primarily on investment from domestic sources.

The data on the level and growth rate of labor productivity along with the statistics on the level and growth of per capita GDP in the Commonwealth of Puerto Rico tell a dramatic story. Whether because of the island economy's association with the United States or despite it, in the period since WWII Puerto Rico appears from the available data to have achieved economic progress that places it among the frontrun-

ners of the world's economies.¹ But these results must be tempered by the fact that Puerto Rico's unemployment levels, which have ranged between 15 and 20% of the labor force since 1975 (see Table 6 below), are of a magnitude unknown in mainland United States since the Great Depression. The resulting income inequalities on the island go far in explaining the flow of Puerto Rican migrants, temporary and permanent, to the slums of mainland cities. It is these impoverished migrants who account for the widespread impression that Puerto Rico is a desperately poor land. The economic status of the island is also a paradox in other respects. On the one hand, its per capita GDP (\$9,052 in 1990) is higher than that of any other country in Latin America, but at the same time that figure is only about three-quarters of the per capita GDP of Mississippi, the poorest state of the United States.

In this paper we show that Puerto Rican labor pro-

*We are extremely grateful to Dean Angel Ruiz of the InterAmerican University at San Juan for his help in gathering the data and his valuable comments and suggestions, as well as to Alan Krueger and three anonymous referees for their helpful comments. We are also deeply indebted to the Andrew Mellon Foundation for its crucial support of this and other related research on the economy of Puerto Rico, and to the C.V. Starr Center for Applied Economics, New York University, for its administrative and other forms of assistance to the project.

Final revision accepted: August 28, 1995.