Improving Secondary Collection of Solid Waste: The Experience of Performance Based System in Lahore

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Abstract: Like cities of many developing countries, solid waste management in Lahore is a serious challenge and constrained by economic, institutional and operational factors. The Solid Waste Management Department (SWMD) of the City District Government Lahore (CDGL) initiated a performance based system (PBS) of secondary collection of waste with the view to improve the service and make effective use of the available resources. The paper provides an assessment of the new system using data regarding various aspects of waste collection service under the PBS and discussions with concerned officials. The analysis of data shows that there are signs of improvement both in terms of quantity of waste now lifted and brought to dumping site as well as the cost incurred on this service. The paper concludes that there is scope for replicating this system all across the city but certain aspects need to be given due consideration to ensure its smooth operation in the long run.
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1. Introduction

Inadequate arrangements for solid waste collection and disposal are one of the causes of environmental degradation in cities of developing countries. Concerned local agencies find themselves unable to handle increasing quantities of waste. This often results in uncollected waste on roadsides, street corners or other open spaces in cities thus posing health risks for the people (Kaseva and Mbuligwe, 2005, Rathi, 2006; Imam et al, 2008). Cities in Pakistan are also facing this challenge of increasing quantities of solid waste in the wake of rapid urban growth and economic development. For instance, Shoaib et al (2006) and Altaf & Deshazo (1996) highlight the problems of solid waste management facing the cities of Multan and Gujranwala respectively.

The city of Lahore is no exception to the above mentioned situation where the impact of improper management of solid waste has become more and more visible over the years. The Solid Waste Management Department (SWMD) of the City District Government Lahore (CDGL) is responsible for provision of waste collection and disposal service. But it is unable to extend this service to all parts of the city. The entire efforts are restricted to shifting waste from formal and informal collection points from parts of the city to dumping sites or low lying areas at the outskirts and regular road sweeping both manually and mechanically usually in affluent localities. Even secondary waste collection has been inefficient and marred by problems like less than expected number of trips of waste collection vehicles to lift the waste and fuel pilferage. Realizing this situation the SWMD launched a performance based system (PBS) of secondary waste collection involving payment of remuneration to drivers according to amount of waste delivered at officially managed dumping site. This paper provides an assessment of the PBS. The next section gives a brief situational analysis of waste management in Lahore. Then it explains the PBS introduced by the CDGL. This is followed by an analysis of the effectiveness of the system. The final section draws the conclusions.

2. Background

Being the second largest city of Pakistan and the capital of Punjab province, Lahore is a large sprawling city accommodating an estimated population of somewhere around 10 million as per mid-2006 government estimates (http://en.wikipedia.org/wiki/Lahore) [accessed March 14, 2011]. Over the years the city has evolved as a cultural, educational, recreational, transportation, and industrial centre of the nation. Rapid and continual increase in population, economic growth and consumption activities have been contributing to ever increasing quantities of solid waste in the city. Table 1 gives a description of waste composition and total

waste generated presently in Lahore. Around 5700 tons of solid waste is generated daily from different sources with organic waste being produced in largest quantity (approximately 3025 tons or 53% of the total waste). It may be pointed out here that approximately 350-450 tons of organic waste is utilized for preparation of compost using windrows method by a private contractor on BOT basis under public-private partnership arrangement with CDGL. The composting plant set up for this purpose is located at the only official dumping site at Mahmood Booti in the north of the city.

There is no proper system of door-to-door collection of waste from producers (e.g. households, commercial establishments etc.) except in some middle and high income localities where private sector operators offer this service on nominal charges. Generally waste is thrown by producers in or around waste containers (where available), open heaps at curb sides, open plots or other informal collection points or into open drains and sewers. The sanitary workers of the SWMD primarily collect waste by manually sweeping the streets and even by cleaning open drains and bring the same in handcarts or wheelbarrows to collection points. Waste from these collection points is then loaded onto vehicles of varying capacities by the concerned staff of SWMD and transported for final disposal (see below for details).

The rate of collection of waste generated in Lahore has been observed to be around 76% but only part of it reaches at the official dumping site for final disposal. In the absence of adequate dumping sites at appropriate locations, the rest of the collected waste is dumped by drivers at any open space in and around the city. The uncollected waste (24%) is left at roadsides, street corners or open plots thus creating environmental nuisance and posing health risks for the people (Ernst Basler/ICEPAK, 2007, and KOICA/World Bank/KEI/SLC, 2007). A considerable amount of recyclable waste is also collected by scavengers from containers, informal collection points as well as from the dumping site. According to an estimate, roughly 15,000 scavengers are involved in recycling activities in Lahore and the total market value of recyclables is estimated to be around Rs. 2-3 million per day (Ernst Basler/ICEPAK, 2007).

The practice of disposing off hospital waste (generated at the estimated rate of 3.5 tons per day) together with municipal waste also poses risks for human health and environment. For instance, there are 40 hospitals in the public sector in the city but only 4 have incinerators for hazardous waste which according to an estimate accounts for 29% of hospital waste. Generally sweepers of the hospitals collect waste from inside the hospital premises and throw it in roadside containers meant for household and commercial wastes (Ernst Basler/ICEPAK, 2007).

The SWMD of the CDGL has a total of 8,544 staff to ensure proper handling of waste in Lahore. This includes 7,897 sanitary workers responsible to clean the roads and transfer waste from collection points to vehicles for further disposal. Although this strength of sanitary workers has been observed to be appropriate (810 inhabitants per worker based on 2006 estimated city population of 6.4 million) if compared to international bench mark (1000 to 1500 inhabitants per worker). Their number would need to be increased any way if 100% waste is to be removed from the city. Moreover, there is a big shortage of professional staff at the supervisory and management level (Ernst Basler/ICEPAK, 2007). The situation concerning solid waste management expenditure and cost recovery has also not been encouraging. For instance, the SWMD spent around Rs. 1459 million during the budgetary year 2006-07 (which formed 16% of the total budget of the CDGL) on waste management. As much as 82% (of Rs. 1459 million) was used in payment of salaries to staff while the rest of money was exhausted on fuel, some repairs and maintenance. But against the spending, the recovery of cost of service (through solid waste management fee imposed @ 30% on water bill) was hardly 8% of the total recurrent costs (Ernst Basler/ICEPAK, 2007).

3. Secondary Collection of Waste in Lahore

The SWMD has a fleet of over 350 vehicles for transportation and secondary collection of waste from containers, skips, and open collection points located across various parts of the city. This includes arm rollers, open body trucks, tractors with trolleys/buckets, and compactors. These vehicles have been allotted for each of 9 administrative sub-divisions (town municipal administrations) of the city. The drivers and helping staff of each vehicle are required to collect waste from formal and informal collection points along a route and bring it to official dumping site for final disposal. For this purpose they are given a fixed amount of fuel depending upon the expected number of trips (generally 4 to 6) from various parts of the city to the dumping site. However, despite receiving fuel for expected number of trips, the drivers actually make as few trips up to the official dumping site as possible (generally not more than 2 trips) or curtail the trips by dumping waste (removed from the affluent or politically influential localities) in low income localities or areas having no political voice. The fuel thus saved is then sold by the drivers in the market at comparatively low price to supplement their income. These weaknesses in the waste management system have also been noted by others (see for instance,

Iftekhar, 2003; Khan, 2004). The system has failed to perform satisfactorily due to lack of proper monitoring arrangements and method (for example accurate maintenance of log book) for controlling the movement of vehicles as well as lack of proper mechanism to measure work efficiency (for example the amount of waste lifted by drivers of each vehicle).

4. The Performance Based System

The increasing level of inefficiency of SWMD in lifting waste from various locations in the city prompted the CDGL to bring some change for improvement. After reviewing the existing situation, the CDGL realized that the SWMD has the potential to improve service delivery at least by ensuring that the available resources in the form of staff, vehicles, and fuel are used to optimal level. It also identified the need to change the secondary waste collection system from input (providing diesel) to output/performance based (measured in terms quantity of waste brought to dumping site) by creating some incentive for the drivers for efficient working. Therefore, it planned the performance based system (PBS) of secondary waste collection whereby drivers of collection vehicles were to be paid in cash on the basis of amount of waste delivered at the dumping site. For this purpose a weighbridge along with computer centre was established at the dumping site (which started functioning in January 2006). It was expected that besides motivating the drivers to remove maximum quantity of waste, the new system will help in making the city clean. Moreover, it will not only resolve the problem of fuel pilferage but also ensure that drivers will be left with no option but to bring it to dumping site unlike the past practice of dumping the waste any where else.

The next section provides an assessment of this new system of secondary waste collection. The assessment is based on data obtained from the office of the SWMD Lahore regarding 15 vehicles for which it was possible to make comparison of before and after situation of amount of waste delivered at disposal site (efficiency) and cost incurred in this process (cost-effectiveness). Discussions were also held with concerned officials to clarify various aspects of the new and conventional systems of secondary waste collection. The impact of the PBS on cleanliness around collection points is based on comparative field observation done by the second author as part of her M Sc thesis (see Nazir, 2009) along selected two PBS and two conventional routes in Lahore.

4.1 General

The new system was launched in February 2006 initially on 44 selected routes with those waste collection vehicles already responsible (even before the PBS) to bring solid waste at official dumping site at Mehmood Booti (where weighbridge was setup). In the beginning, the fleet involved in collection and transport of waste comprised of arm-roll trucks, open trucks (dumper), tractor trolleys and compactors. Later, open trucks, tractor trolleys and compactors were pulled out of the PBS due to problems in managing the operation of these vehicles. For instance, these vehicles were to be used to remove waste from open dumps and heaps of rubbish located along the prescribed routes (unlike arm-roll trucks which were to collect waste from containers). But the staff (usually 1 driver and 2-4 helpers) of these vehicles started collecting waste from here and there as well in addition to the open dumps along the prescribed routes so as to bring more and more waste to the dumping site and hence earn as high incentive payments as possible. Similarly there were conflicts related to fuel consumption per trip. For instance, the drivers claimed higher quantities of fuel use (due to collecting waste from various places other than those along the prescribed route) as compared with the pre-determined average quantities applied by managerial staff while calculating the incentive payments. The later were based on average fuel consumption by a vehicle plying on a prescribed route.

Presently, 100 (out of 362) routes in 6 (out of 9) towns are operational under the PBS. Arm-roll trucks are involved in collection and transport of waste from containers placed along the allocated routes. One vehicle is allocated one route and the driver is accompanied with a helper. Although the number of containers/skips (collection points) varies from one route to another depending upon the nature of waste generating area and route-length, each vehicle on average lifts waste daily from 6-7 Containers/skips placed at different locations along the route. In the beginning waste removal was done seven days a week along PBS routes but now it is done six days a week with Sunday as weekly holiday. A team of inspectors is responsible to monitor the operation of staff along PBS routes with the view to maintain efficiency in waste collection and disposal.

4.2 Waste delivery at disposal site

Table 2 provides a comparison of waste delivery situation of selected vehicles before and after the introduction of PBS. It is clear that there is a significant improvement in waste delivery at the disposal site with an overall average increase of 67% in waste lifted per month by the selected vehicles on their respective routes over the years. It may be pointed out here that variation in amount of waste collection/delivery is bound to occur due to unavoidable factors like absence of the driver of

vehicle from duty due to ailment or similar other reason, waste collection vehicle requiring repair and maintenance, lack of enough waste along the route thus making it possible to lift the waste in fewer number of trips than those completed routinely in a day etc.

4.3 Quantity of waste per trip

Table 3 shows that more waste per trip on average is carried by vehicles and brought to the disposal site under PBS (3.86 tons) as compared with the conventional system (3.1 tons). In general there is an average increase of around 1 ton of waste per trip indicating a considerable raise in overall efficiency of waste collection and disposal under the new system.

4.4 Cost of lifting waste from collection points and bringing it to disposal site

The data presented in table 4 indicates that overall there is reasonable reduction in cost involved in lifting waste under PBS (at an average of Rs. 145 per ton) as compared with the conventional system (at an average of Rs. 201 per ton) considering the January 2006 rate of diesel, that is Rs. 37.21 per liter. In absolute terms, although the data shows increase in cost of lifting waste under the PBS (chiefly due to rise in price of diesel over the years), it would still be fairly economical if compared with the cost currently incurred under the conventional system. Unfortunately no organized data concerning vehicles operating under conventional system is available unlike the PBS in which case proper record keeping is done on computers on daily basis. But the increasing number of PBS routes is an indicator of this fact that the new system is more cost effective in operational terms thereby providing sufficient justification for the SWMD to keep bringing other routes under the PBS.

4.5 Increase in income of waste lifting staff

One of the chief reasons behind improved efficiency of the operational staff in collection and delivery of waste under the PBS is the financial incentive tied with the amount of wasted lifted. Table 5 provides a comparison of income of drivers/helpers of waste collection vehicles under conventional system and PBS for the month of Jan 2006 with that of May 2008. As clear from the said table, there is a significant increase in monthly income of drivers and helpers of all the vehicles under the PBS ranging from 37% to 171% with an average increase of 96%. The financial incentive gained under the PBS is shared by the driver and helper of each vehicle in proportionate with the level of official salaries drawn by their colleagues under the conventional system.

4.6 Cleanliness around collection points

Nazir (2009) notes the difference of cleanliness around the skips (large waste containers) along two PBS and two conventional routes in Lahore. It was observed at the time of survey that most of the containers along conventional routes were brimming with waste while most of those placed along PBS routes were emptied. But cleanliness around skips on PBS routes was only slightly better as compared to situation on conventional routes. This was perhaps due to the fact that most of the containers got over flow daily because of low capacity to accommodate the amount of waste generated thereby leaving the people with no choice but to throw waste around the containers. Scavenging activities also cause spreading of waste around containers but these activities were found low on PBS routes due to regular emptying of waste containers.

5. Concluding Remarks

The analysis of data as presented above clearly indicates that the secondary waste collection service under PBS, which has been initiated by the SWMD of the CDGL to bring improvement, is working efficiently and effectively. The increase in amount of solid waste being brought up to the disposal site, the overall reduction in cost of lifting the waste, and increase in income of the concerned staff of the SWMD, all serve as indicators of improvement in secondary waste collection along PBS routes in Lahore. Maintaining proper record and close monitoring of field staff have further ensured that the waste collection and disposal service under the PBS remains effective. However, the issue of cleanliness around skips needs to be addressed properly to improve aesthetic conditions and prevent scavenging. Similarly, interviews with officials of SWMD revealed that vehicle depreciation of waste collection vehicle due to increased number of trips under the PBS is another issue. This not only requires strengthening of existing workshops of the SWMD but also additional funds to purchase new vehicles which would be needed any way to expand the waste collection and disposal service under the PBS to the remaining towns of Lahore. Purchase of new containers and hiring of additional staff would be other areas of investment to continue effective implementation of the PBS. Another pertinent issue is the shrinking capacity of existing official waste dumping site in the wake of improvement in waste collection efficiency under the PBS (Nazir, 2009). In this context the CDGL would need to find new sites and invest in necessary infrastructure to ensure safe disposal of city waste in future.

Table 1: Physical Composition of Waste in Lahore

Sr. No.	Description	Tons per day	% Weight
1	Vegetable & Fruit Residues	1744.5	30.72
2	Paper	153.3	2.70
3	Plastic & Rubber	319.7	5.63
4	Leaves, Grass, Straws etc.	1136.9	20.02
5	Rags	423.0	7.45
6	Wood	70.4	1.24
7	Bones	58.4	1.03
8	Animal Waste	143.6	2.53
9	Glass	39.7	0.70
10	Metals	18.1	0.32
11	Dust, Dirt, Ashes, Stones, Bricks etc.	1570.2	27.65
12	Unclassified	0.56	0.01
Total		**5679**	**100.00**

Source: CDGL, 2008

Table 2: Comparison of waste delivery by selected vehicles under conventional and performance based systems

Vehicle No.	Waste lifted (tons per month)						
	Conventional system (Jan 2006)	Performance based system					
		May-08	Sep-08	May-09	Sep-09	May-10	Average
Shalimar Town							
A-18	517	1383	647	455	472	809	753
A-71	775	1388	1002	413	947	1141	978
ISA-275	302	912	537	499	541	598	617
ISA-276	379	826	605	535	577	858	680
Aziz Bhatti Town							
ISA-269	270	673	440	368	404	495	476
ISA-286	173	681	291	307	380	496	431
Ravi Town							
A-72	652	836	970	753	755	961	855
ISA-274	315	992	850	707	610	530	738
Gulberg Town							
A-59	610	1201	800	592	497	1025	823
A-64	503	953	477	811	869	1071	836
A-65	325	883	688	689	666	1161	817
A-75	510	990	954	404	585	893	765
ISA-282	246	644	305	342	302	396	398
ISA-298	226	580	396	289	326	395	397
ISA-305	227	780	518	404	363	421	497
Average	402	915	632	505	553	750	671
%age increase	-	128	57	26	38	87	67

Source: SWMD/CDGL, 2010

Table 3: Comparison of waste per trip delivered at disposal site under conventional and performance based systems

Vehicle No.	Waste per trip (tons)						
	Conventional system (Jan 2006)	Performance based system					
		May-08	Sep-08	May-09	Sep-09	May-10	Average
Shalimar Town							
A-18	3.98	5.22	4.65	4.1	4.46	4.35	4.56
A-71	4.08	5.3	4.57	4.69	4.53	4.58	4.73
ISA-275	2.32	3.36	2.81	2.83	2.66	3.01	2.93
ISA-276	2.11	3.25	3.02	2.84	2.75	3	2.97
Aziz Bhatti Town							
ISA-269	2.97	3.35	3.14	3.04	2.91	2.98	3.08
ISA-286	2.51	3.3	2.91	3.07	2.99	2.97	3.05
Ravi Town							
A-72	4.29	5.43	5.39	5.05	4.9	5.01	5.16
ISA-274	2.23	3.31	3.32	2.95	2.7	2.94	3.04
Gulberg Town							
A-59	4.04	5.41	5.13	5.06	4.6	4.59	4.96
A-64	4.06	5.35	4.38	4.77	4.77	4.63	4.78
A-65	4.01	5.49	5.21	5.18	4.93	5	5.16
A-75	4.18	5.27	4.99	5.25	4.3	4.7	4.90
ISA-282	1.91	3.28	2.75	2.9	2.83	2.97	2.95
ISA-298	1.95	3.28	2.69	2.78	2.67	2.92	2.87
ISA-305	1.8	3.24	2.86	2.63	2.63	2.33	2.74
Average	3.10	4.26	3.85	3.81	3.64	3.73	3.86
% age increase	-	37	25	23	18	21	25

Source: SWMD/CDGL, 2010

Table 4: Comparison of cost of lifting waste and delivering it at disposal site under conventional and performance based systems

Vehicle No.	Conven-tional system	Performance based system					
	Cost per ton (Rs)* (Jan 2006)	Cost per ton @ Jan 2006 fuel price per liter (Rs) / Cost per ton @ actual fuel price per liter in respective month (Rs)**					Average
		May 2008	Sept 2008	May 2009	Sept 2009	May 2010	
Shalimar Town							
A-18	116	79 / 106	81 / 145	94 / 145	92 / 164	108 / 224	91 / 157
A-71	120	83 / 112	85 / 152	99 / 151	97 / 174	83 / 173	89 / 152
ISA-275	157	102 / 137	107 / 192	141 / 216	137 / 245	103 / 215	118 / 201
ISA-276	156	108 / 146	115 / 205	150 / 230	147 / 261	126 / 261	129 / 221
Aziz Bhatti Town							
ISA-269	223	149 / 201	159 / 285	206 / 316	202 / 360	143 / 296	172 / 292
ISA-286	319	145 / 196	155 / 277	201 / 308	198 / 353	132 / 275	166 / 282
Ravi Town							
A-72	142	104 / 140	107 / 191	124 / 190	122 / 217	95 / 198	110 / 187
ISA-274	188	132 / 178	141 / 251	182 / 280	179 / 319	131 / 272	153 / 260
Gulberg Town							

A-59	135	106 / 144	110 / 196	127 / 195	125 / 223	75 / 155	109 / 183
A-64	174	135 / 182	147 / 262	161 / 247	159 / 284	91 / 188	139 / 233
A-65	230	159 / 214	165 / 295	189 / 290	187 / 333	106 / 219	161 / 270
A-75	203	138 / 186	143 / 255	156 / 239	163 / 290	106 / 219	141 / 238
ISA-282	273	179 / 242	192 / 344	248 / 380	244 / 435	212 / 441	215 / 368
ISA-298	302	196 / 264	211 / 377	248 / 380	244 / 435	215 / 446	223 / 380
ISA-305	280	149 / 201	159 / 284	183 / 280	179 / 319	145 / 301	163 / 277
Average	201	131 / 177	138 / 247	167 / 256	165 / 294	125 / 259	145 / 247
% age decrease/increase	-	35 / -12	31 / 23	17 / 27	18 / 46	38 / 29	28 / 23

* Rate of diesel in January 2006 was Rs. 37.21 per liter.
** Rate per liter of diesel was Rs. 50.21 in May 2008, Rs. 66.48 in September 2008, Rs. 57.04 in May 2009, Rs. 66.26 in September 2009, and Rs. 77.19 in May 2010.
Source: SWMD/CDGL, 2010

Table 5: Comparison of income of drivers of waste disposal vehicles under conventional and performance based systems

Vehicle No.	Conventional system (Jan 2006)			Performance based system (May 2008)			
	Expenditure (Rs.)	Cost of fuel @ Rs. 37.21 per lit.	Salary of Driver/ Helper (Rs.)	Expenditure (Rs.)	Cost of fuel @ Rs. 50.21/lit	Income of Driver/ Helper (Rs.)	%age increase in income
Shalimar Town							
A-18	59872	42047	17825	147174	117542	29632	66
A-71	92617	74792	17825	155416	122763	32653	83
ISA-275	47407	29582	17825	124960	85056	39904	124
ISA-276	59314	41489	17825	120708	86060	34648	94
Aziz Bhatti Town							
ISA-269	60244	42419	17825	135171	98412	36759	106
ISA-286	55221	37396	17825	133636	98261	35375	98
Ravi Town							
A-72	92878	75053	17825	117152	92788	24364	37
ISA-274	59314	41489	17825	176336	128036	48300	171
Gulberg Town							
A-59	82198	64373	17825	172490	137475	35015	96
A-64	87780	69955	17825	173720	142998	30722	72
A-65	74756	56931	17825	188937	153592	35345	98
A-75	103594	85769	17825	183979	154195	29784	67
ISA-282	67128	49303	17825	155776	118094	37682	111
ISA-298	68245	50420	17825	153512	117742	35770	101
ISA-305	63593	45768	17825	156738	117994	38744	117
Average	71611	53786	17825	153047	118067	34980	96

Source: SWMD/CDGL, 2010

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