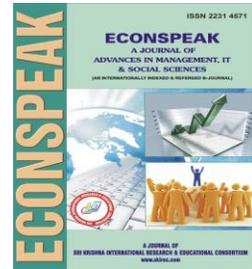




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## MUNICIPAL SOLID WASTE MANAGEMENT- ANALYSIS OF WASTE GENERATION: A CASE STUDY OF RAWALPINDI CITY, PAKISTAN

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### ABSTRACT

This study analyses the waste generation in Rawalpindi city. It consists of public survey, discussions with city staff involved in waste handling and management, determination of waste composition by segregation of 132 samples from four different sites of city, assessment of documents and field observation. For the study, stratified systematic random sampling techniques were adopted. Monitoring and supervision was not regular, 42.6% of solid waste is disposed off in open dumps without any further treatment or inspection and 24.1% of solid waste is burnt, and remaining solid waste is carried to sanitary landfill. Average solid waste generation is 1.87 kg/households/day and per capita waste generation rate is 0.32kg the daily. Recycling and composition of solid waste was found only 18% of the overall waste generation in city. Involvement of public, private sector, NGOs and use of technology to achieve any meaningful efficient municipal solid waste management (MSW) are also explored.

**KEYWORDS:** MSW generation, MSW quantity prediction, MSW management, Rawalpindi

## 1. INTRODUCTION

Waste management can be categorized in many groups such as residential, commercial, street sweeping, sanitation and industrial waste [1]. Human activities create waste and the mismanagement of handling storage and collection and dispose of solid waste can become dangerous to the eco system of whole area. In highly populated municipal areas of developing world the problems of solid waste are of utmost importance, whereas, in Pakistan nothing such happens. Developing nations by and large have higher food and yard Waste as compared to the developed nations with large segments of paper and plastic stuffing that can be recycled [2]. Currently waste management practices in Pakistan are not carried out in proper and effective way of primary gathering, shipping as well as discarding regarding area of locality in the city [3].

As a result, the ecological disaster hits the people on health grounds day by day. This cause involves all the concerned stakeholders of solid waste management directly or indirectly. This problem may include the rapid increase in urbanization, industrialization and urbanization tendency, commercial enterprises, low community participation, manufacturing, government role, service sector activities, limitation and potential of local waste management department [4]. The uncontrolled growth rate of population and rapid urbanization has become acute problem in Pakistan [5]. Due to low budget allocation for proper handling of waste, cities collect only 60 percent of the refuse generated in Pakistan [6]. Most areas lack refuse collection especially in low income communities. Locals of low income communities tend to dump their garbage near vacant area especially public places and rivers or burn it [7]. Local government and waste department are increasingly involved in administration of the solid waste. The uncontrolled growth rate of population and rapid urbanization is the major challenge for national and city government. There is dire need to improve managerial efforts to tailor the system effectively and efficiently. Without efficient and effective waste management program, the waste produced from a variety of human activities, both domestic and industrial, can consequence in health vulnerability and has a harmful impact on the environment. The solution of problem involves interdisciplinary fields such as city and local planning, economics status, geographical location, public health, communications, demography, and utilization of resources [8].

Rawalpindi is the third largest city of Pakistan [9]. The transfer of capital city from Karachi to Islamabad in 1959 had milled the number of masses to the city for employment and business activities. The city covers approximately 153 square kilometers (59 sq m). It is located in the northern region of Punjab province, 274 km (170miles) to the North West part of Lahore district. According to estimation, the current total population of Rawalpindi city is 3,039,550. The climatic features of Rawalpindi are humid

subtropical with hot and very long summer, mild, and short monsoon and wet winters. Rawalpindi gets 39 inches (990 mm) annual rainfall, mostly in the summer monsoon season. However, frontal cloud band also bring fairly important rainfall in the winter session.

## **2. RESEARCH OVERVIEW**

The research consists of both primary as well as secondary data collection and analysis. Authoritative, organized questionnaire is utilized for measurement of physical weight of solid waste generated in the city. Side by side, the secondary data were collected from the appropriate resources, organizations and individuals. The Participatory Reflection and Action techniques have been utilized for information survey. The total population was divided into the high income areas and the low income areas. Further, it was divided into the four different areas equal weights 33 were assigned to each area. North area was divided into the Pindora and the Saidpur. And South area was divided into the Kurtarpura and the Saraffa Bazaar (Fig. 1). Random sampling techniques were adopted for the selection of CHARGES from the sample areas. From the selected CHARGE, stratified sampling techniques were applied for the selection of blocks and streets. Physical waste data has been primarily collected at Loasar waste disposal site for one week to identify daily waste generation and collection quantity and the composition. Later, for the period of three months the sources point survey was conducted to determine generally the per-capita waste generation.

## **3. WASTE GENERATION AND COMPOSITION**

Solid waste generated in this study finding is compared. Households waste generation daily capacity was 0.25 kg per capita daily, that is increased to the 0.32 kg as indicated in Table 1. This determines that day by day amount of waste generation increases due to change of lifestyle that transfers from manual to disposals. The households waste generation daily capacity in the city is 0.32 kg determined in the study which is about 0.32 (60%) per person each year and the previous study shows 0.25 (56%) per person each year which is about 4% increase in generation of waste from previous study conducted by KOICA-World Bank in 2007. A waste characterization study of household waste stream was conducted, which vary regarding all components. The waste stream composition such as food waste is about 53.7% which is higher in quantity than other components in (Fig. 2).

According to the sample, the households size in the city varies between the low income and the high income areas, with low income areas having more family members (6.21) compared to high income areas (5.53). However, due to differentiated lifestyle, different income levels and differing neighborhoods, despite having smaller household size, the high income households produce more waste

per person (0.35kg) as compared to the low income areas (0.29kg), where per capita waste generation for the city stands at 0.32kg per day shown in Table 2.

The waste generation per households in the high income areas stands at 1.93 kg/H H/day compared to the low income areas it is 1.80 kg/H H/day. Thus, the average waste creation in the city is 1.87 kg/H H/day. According to the estimates, total MSW creation is 972 tons/day, out of that 303.08 tons is generated by high income communities, and the 669.57 in low income communities. With the given capacity, if SWM department operates at the full capacity. It would only collect and transport around 584 tons of waste from Rawalpindi city to the final landfill point each day which is 61% of total waste generation. Consequently, a significant amount of waste is still left untouched in the streets, roads and open spaces. There is a gap of 388.65 tons, which escapes disposal each day in city in (Fig. 3). If the condition prevails, the situation will worsen in the rainy season.

#### **4. MUNICIPAL WASTE COLLECTION SERVICES**

Municipal waste is generally composed of vegetable/putrescible, paper, glass, different plastics, bones, and metals and miscellaneous. The responsibility of overall waste management and collection rests with the municipalities. Traditionally, in Pakistan, the local government collects households waste in high to low income areas. Solid waste collection services by City District Government's averages only 60 % of waste generated in Rawalpindi; however, for cities to be comparatively clean and out of health vulnerability, at least 80% of these waste quantities should be collected [10]. In Rawalpindi, open dumpsites are common, due to low operating costs and lack of expertise and equipment. Open dumps are unsanitary and generally smelly which attract insects, rats, and scavenging animals. Surface water percolating through the trash can dissolve out or leach harmful chemicals that are then carried away from the dumpsites in surface or subsurface runoff. Among these heavy metals may constitute an environmental problem, if the leachate migrates into surface water or ground water.

The accessible fleet for primary waste collection and transportation generally is composed by donkey, handcarts and bullock carts; for secondary collection and transport, open trucks, tractors trolley systems and arm roll container are used. Waste department has hired the number of sweepers and sanitary workers to provide door to door services to every household. However, the collected amount of waste is much less, mostly in low income areas. The overall disposal method in the city is given in Table 3.

#### **5. SOLID WASTE TREATMENTS**

There is enormous number of illegal and unofficial dumping sites at many open spaces. There is no primary waste management and storage method regulated by solid waste management department, but it is left to the households, which alternatively results in the bulk of waste all over the area. Study

found that no any convenient method was typically used in the low-income area; it was also found that many areas lack basic solid waste services. On the other hand, in the high income area, little shaped method applied by authority.

Waste management department constructed 68 open dumping sites around the city, secondary method of waste collection is utilized at the first stage, waste is stored out of city in the bed of Soan River, then with the help of heavy containers and lifters it is sent to sanitary landfills. Rawalpindi has one sanitary landfill; one official dumpsite located in the bed of Soan River and many unofficial dumpsites beside the city. The sanitary landfills are 74 km away from city located at Loasar which was planned without technical capability and landfill status due to inefficient utilization of resources, and low intention of daily treatment and caring of landfill site.

At present solid waste is dumped without any sanitary consideration on the bed of Soan River where the open dumping is creating not only a number of environmental problems, but also posing threat to the health of local residents. The situation in Soan River shows distressing picture, particularly of its localities situated along the river side such as Dhok Chapper, Mohabat Colony, Gulraiz Charistain Colony, Sharoon Colony and Akramabad have been affected severely and children have gone through the hospital treatment as they are suffering from malaria, diarrhea, eye allergy and itching. The dumpers of solid waste department are regularly throwing garbage on the river bed instead of dumping site at Loasar.

## **6. INSTITUTIONAL FRAMEWORK**

In Pakistan environment laws are divided into three ranks: federal, provincial and local level. At the federal level, The Factories Act 1934 was first legislated to incorporate effective and efficient arrangement for the disposal of solid waste and effluent in factories in Pakistan. The Pakistan Environmental Protection Act (PEPA, 1997) is the overarching text for water, waste, air and so on. It covers all economic and social conditions affecting the public life. At the provincial level, Government of Punjab legislate the Punjab Local Government Ordinance (PLGO, 2001) to declare solid waste management as within the competences of the Local Governments. In addition, every local-level government enacts various regulations related to waste management issues. The responsibilities of the city are much greater than that of other provincial Districts of Punjab, while its revenue sources are very limited to those assigned responsibilities to Districts in the Punjab [11].

## **7. PRIVATE SECTOR PARTICIPATION**

The private sector has contributed in the waste management services of Punjab for about 15 years and from 06 years in Rawalpindi. City district government (CDGs) and Tehsil municipal administration (TMA)

explore the privatization as alternative due to the lack of proper equipment and manpower [12]. Rawalpindi municipality hired private companies to manage the waste issue as a pilot test in 2005. One of them was very successful to continue the contract until now in Shalala -1 Union Council, while other ended up in the failure.

### **8. SOLID WASTE RECYCLING**

In fact, currently waste department has no proper recycling arrangement in place. The trash collectors who arrange number of trips to different drums and discarded areas and earn approximately Rs: 100 to 300/day. As a whole, however, according to estimates the recyclable wastes grow each year.

### **9. CONCLUSION AND RECOMMENDATION**

It was found in the study that decision making in Rawalpindi and Pakistan in general is top-down and bureaucratic. There is big gap between decision makers and the communities in terms of information. Communities are not informed completely about the decision initiated by waste management authority. It results in the number of the executive plans falling at the initial stage due to lack of public participation and support. It was further observed through study that many people regarded waste as a big threat for all, but very few people regarded waste as a prior problem. It was observed that manual collection of waste is tiresome and slow process. The shortages of sanitary workers add fuel to fire by rendering manual efforts to null. So use of technology would not only speed up the process but also help in reducing cost of collection and manpower. In addition, it was also found that the processes and executive plans initiated by one set of people in power are often abandoned or neglected in mid-way if a new set of people come in power. Finally it was observed that the grassroots levels organizations have potential to influence and persuade the SWM in an effective manner by involving and ensuring public participation in decision making process and in waste management system.

#### **9.1 RECOMMENDATIONS**

1. Community participation can carry the large burden involvement of community in helping the management of waste can produce outstanding result. It will help to enhance the speed of work being done in this regard and add efficiency and performance in addition.
- 1) Manual collection of waste is tiresome and slow process. The shortages of sanitary workers add fuel to fire by rendering manual efforts to null. So use of technology would not only speed up the process but also help in reducing cost of collection and labor.
- 2) For proper Municipal solid waste management in development countries, involvement of non government organizations should always be part of external support package. So Involvement of

non-governmental organizations (NGO's) would directly effect on the performance of the organization.

- 3) The district administration is ill equipped when it comes to collection of 980 tons of garbage being produced on daily basis. It has lesser number of waste bin and sanitary workers. Keeping in view the inadequacy of efforts and fund of the district administration, it is considered appropriate to let private sector participation will increase quality of services.

Joint efforts are always fruitful. What seems impossible or unachievable task can become very much achievable and possible task, once the efforts and responsibilities are divided among all segments of society. It is not the sole responsibility on any one sector or organization. It demands sustain and consistent efforts on the behalf of all groups and members of the society. Public services delivery which is very much a dream in the country like Pakistan can become a reality by involving all leaving none.

#### **ACKNOWLEDGEMENT**

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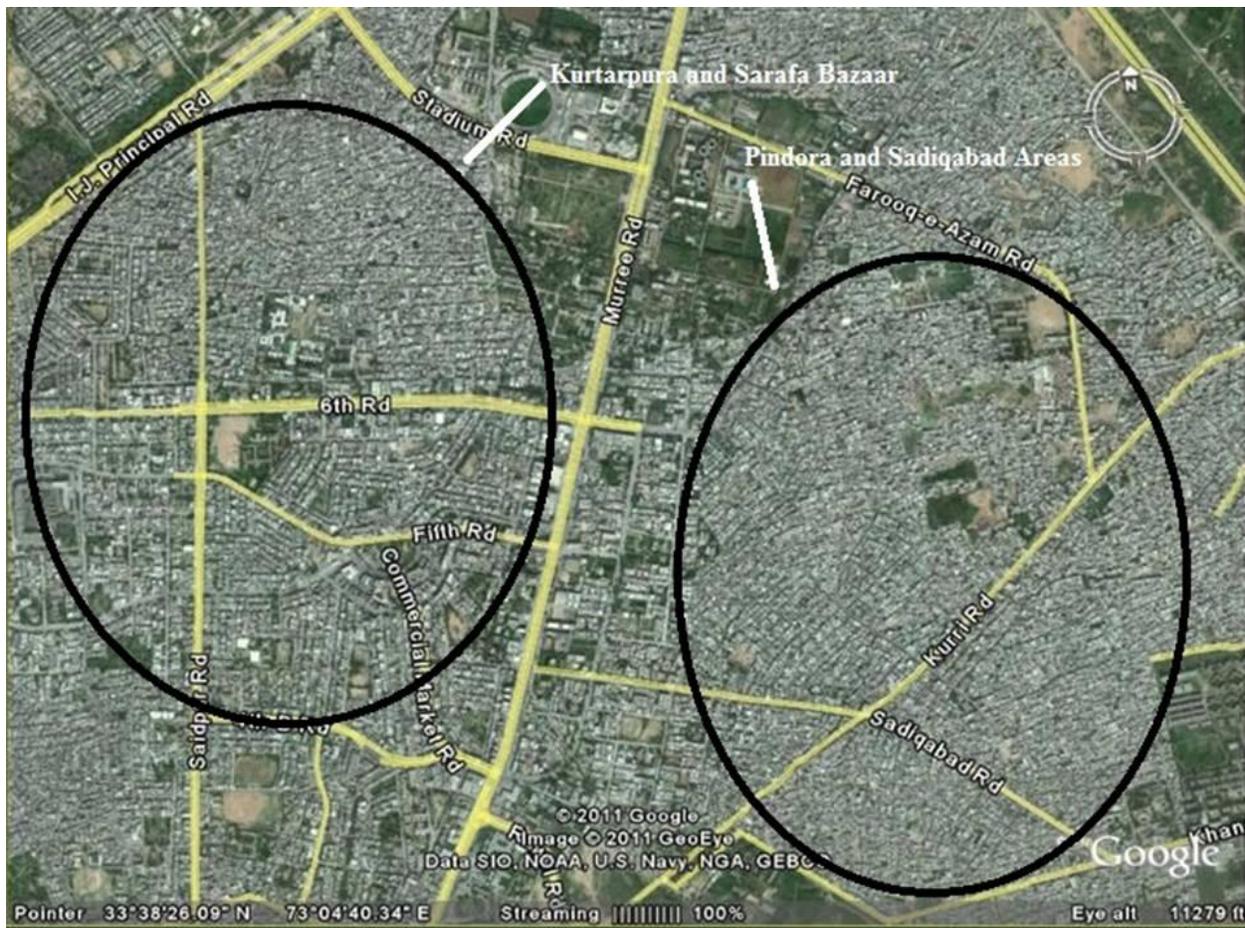
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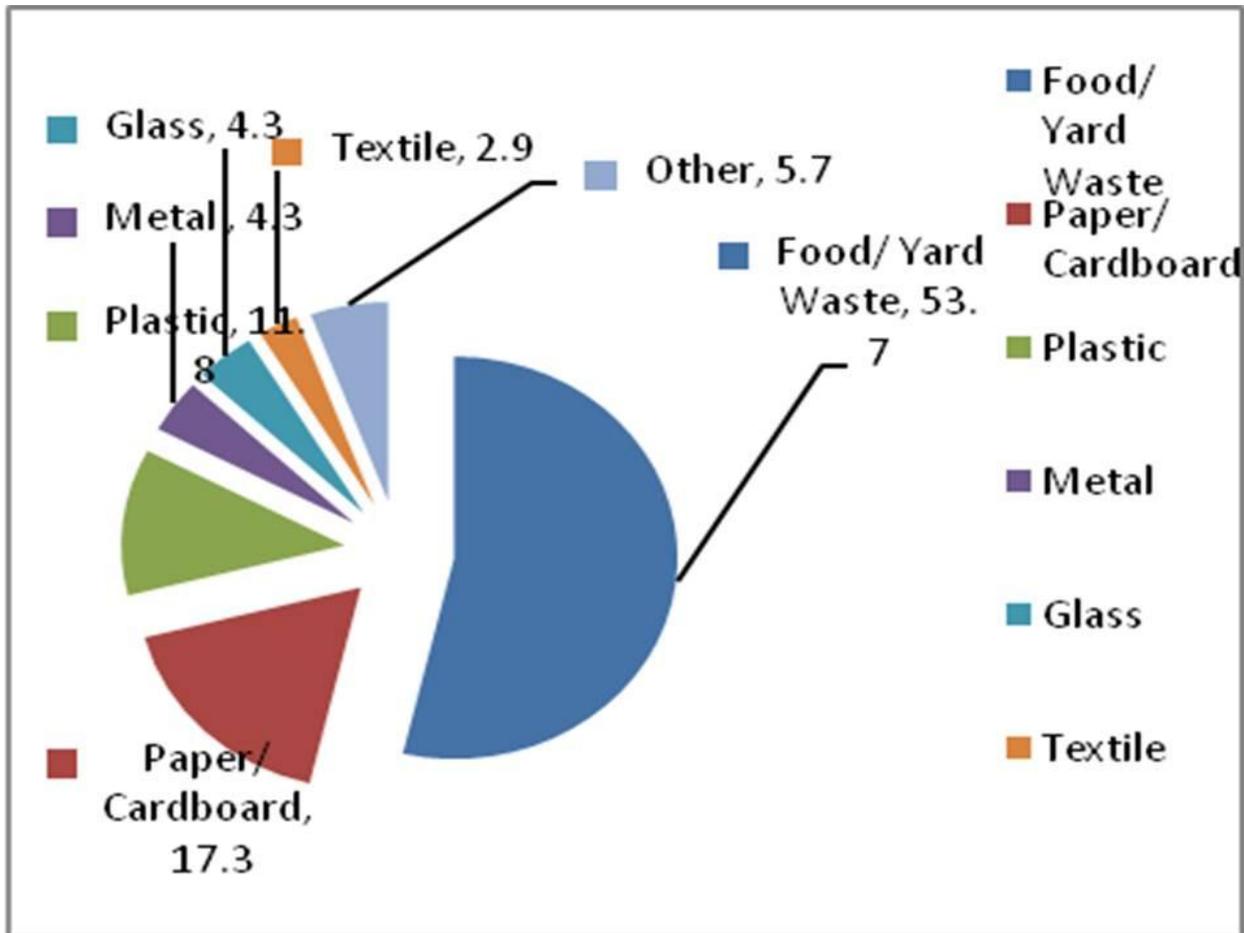
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**Figure Error! Main Document Only.: Sample Area a) Pindora and the Saidpur, b) Sarafa Bazaar**

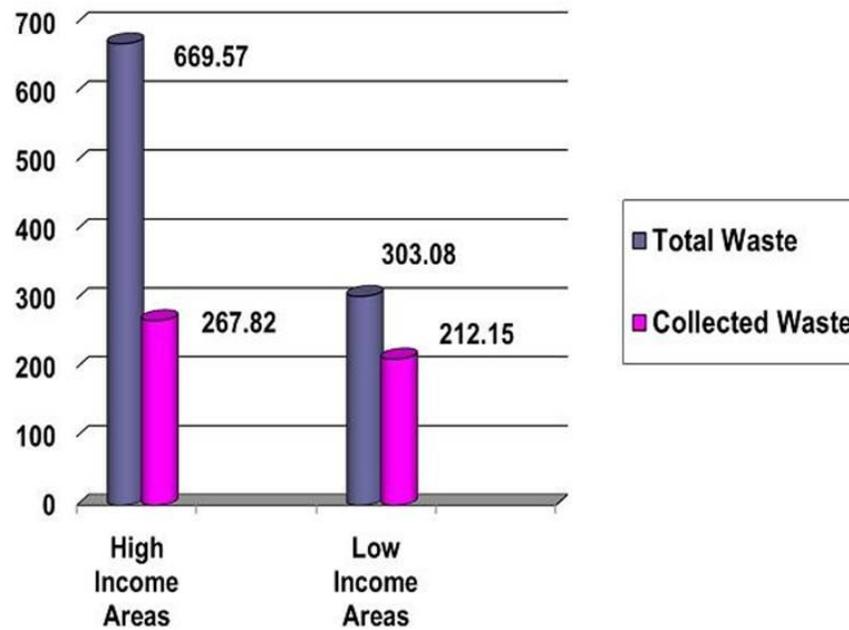
The total population was divided into the high income areas and the low income areas. Further, it was divided into the four different areas equal weights 33 were assigned to each area. North area was

divided into the Pindora and the Saidpur. And South area was divided into the Kurtarpura and the Saraffa Bazzar.



**Figure Error! Main Document Only.: Percentage Composition of Waste in the City**

This figure showing the percentage composition of waste generated in the city. The waste stream composition such as food waste is about 53.7% which is higher in quantity than other components, paper is about 17.3 % and other components contribute almost equal wait.



**Figure Error! Main Document Only.: Total Waste Generation and Collection in the City**

Total waste creation is 972 tons/day, out of that 303.08 tons is generated by high income communities, and the 669.57 in low income communities. Collected waste is around 584 tons of waste each day which is 61% of total waste generation. There is a gap of 388.65 tons, which escapes disposal each day in the city.

**Table 1: Comparative Households Waste Generation**

Type of Waste	KOICA-World Bank- 2007		Survey Findings- 2014	
	Kg/ capital/ year	Kg/ Capital/ Year (& %)	Kg/ capital/ year	Kg/ capital/ year (& %)
Household	93	0.25 (56%)	115.5	0.32 (60%)
Other wastes	71	0.19 (44%)	75	0.20 (40%)
Total MSW	164	0.45	190.5	0.52

**Table 1** showing the households waste generation daily capacity in the city is 0.32 kg determined in the study which is about 0.32 (60%) per person each year and the previous study shows 0.25 (56%) per person each year which is about 4% increase in generation of waste from previous study conducted by KOICA-World Bank in 2007.

**Table 2: Waste Generation Estimation in Sample Areas**

	High Income	Low Income	Overall
Current projected population	865,967.79	2,173,582.20	3,039,550
Average H H size*	5.53	6.21	5.87
Waste generation* (kg/day) per capita	0.36	0.29	0.32
Average waste/H H/ day* (kg)	1.93	1.80	1.87
Total waste generation by H Hs* (tones/day)	303.08	669.57	972.65
Waste generation per month* (tons/day)	9,092.4	20,087.1	29179.5
Waste generation per year* (tons/day)	109,108.8	241,045.2	350154

**Table 2** with low income areas having more family members (6.21) compared to high income areas (5.53). The high income households produce more waste per person (0.35kg) as compared to the low income areas (0.29kg), where per capita waste generation for the city stands at 0.32kg per day. The waste generation per households in the high income areas stands at 1.93 kg/H H/day compared to the low income areas it is 1.80 kg/H H/day. Thus, the average waste creation in the city is 1.87 kg/H H/day. According to the estimates, total MSW creation is 972 tons/day, out of that 303.08 tons is generated by high income communities, and the 669.57 in low income communities.

**Table 3: Percentage Distributions of Disposal Method**

Disposal method	% of total households	High Income % of total households	Low Income % of total households
<b>Total</b>	100	28.49	71.51
Regular Public Collection	58.81	63.44	36.56
Irregular Public Collection	1.44	47.71	52.29
Private Collection	0.70	12.61	87.39
Burn	23.60	12.33	87.66
Bury	1.42	7.00	93.00
Dumping: (all types)	6.46	9.33	90.70
Dumping: River/Pond	0.49	9.46	90.99
Dumping: In own yards	3.89	5.67	94.33
Dumping: In municipal sites	1.12	20.36	79.64
Dumping: Other	1.00	11.21	88.79
Other	0.43	14.29	85.71
Not reported	1.01	34.06	66.16

**Table 3** Showing the percentage distributions of disposal method, the collected amount of waste is much less, mostly in low income communities. And regular collection is 58.81 percent out of which more than 60 percent is collected from high income areas. Burning of waste was found 23.60 percent mostly common in low income areas.