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Generation and Management of Solid Waste in Bhopal Township

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Abstract: The collection, transport, treatment, and disposal of solid wastes, particularly wastes generated in medium and large urban centers, have become a relatively difficult problem to solve for those responsible for their management. The problem is even more acute in economically developing countries, where financial, human, and other critical resources are generally scarce. The present study was conducted to know the quantity of solid waste in seven wards of Bhopal district. An attempt has been made in this study to know the quantity of solid waste in seven wards of the city. People's awareness about solid waste management has also been addressed.

Keywords: Solid waste, Generation, Collection, Segregation, Disposal

1. Introduction

Solid waste generation is one of the three major environmental problems faced by municipalities in the world. Generally, it is positively related to the level of income and urbanization,

with higher income and more urbanized economies generating higher levels of solid wastes per capita (Omrane *et al.*, 2009).

The impact of waste through generation and accumulation on the environment and human health is significant such as (i) emissions to air, (ii) water and soil contamination, (iii) land degradation and (iv) habitat deterioration.

It includes the heterogeneous mass of garbage from the urban community as well as more homogenous accumulations comprising of countless different materials such as food wastes, construction wastes, industrial process wastes and pathological wastes (Turk and Turk 1984 and Joseph and Nagendran, 2004).

Solid waste generation and its impact is an emerging issue for public health aspects in the developing countries. In a developing country, the problems associated with solid waste management are more acute than in a developed country (Zerboc, 2003). The problem is further complicated by rapid growth in population and urbanization, which adds greatly to the volume of waste being generated and to the demand for waste retrieval service in municipal areas.

2.1. Study Area

Bhopal the capital of Madhya Pradesh state lies within north latitude of 23°16' and east longitude of 77°36', is located in the central part of India, and is just north of the upper limit of the Vindhya mountain ranges. Located on the Malwa plateau, it is higher than the north Indian plains and the land rises towards the Vindhya Range to the south. The city has uneven elevation and has small hills within its boundaries. The municipality covers 298 square kilometers. Old city- 41.58 Sq. Kms, BHEL -44.18 Sq. Kms, New city- 77.97 Sq. Kms, Village area- 122.15 Sq. Kms. Out of the total municipal area only 77.25 Sq. Kms is classified as the developed area. The rest consist of open spaces, water bodies and other unplanned peripheral areas some of which are being used as a dumping ground for the solid waste.

The present study was conducted to know the quantity of solid waste in five wards of Bhopal district. Six sites were selected. One site was selected from each ward and two sites were selected from ward No. 33. The wards from which sites were selected areas:

Site-1- Ward No. 33 (Jahangirabad ward) -from filtration plant to Malvianagar.

Site-2- Ward No. 33 (Jahangirabad ward) – slums, located in Malvianagar.

Site-3- ward No. 29 (Shivaji ward) – from link road to Shivaji nagar road.

Site-4- Ward No. 41 (Jinsi ward) - from Jinsi churaya to Premdipura, Bans gali check road.

Site-5- Ward No. 52-(Barkatullah ward) from Habibgang railway crossing to Shakti nagar Road, Jatkhedi to Bhavdi kali.

Site-6-Kasturba ward.

Site-7- Paras city Bhopal

For the purpose of solid waste management activities the municipal commissioner is assisted by 2-health officers, 4 Chief Sanitary Inspectors, 16 Sanitary Inspectors, 60 Sanitary Supervisors and 60 Jamadaars.

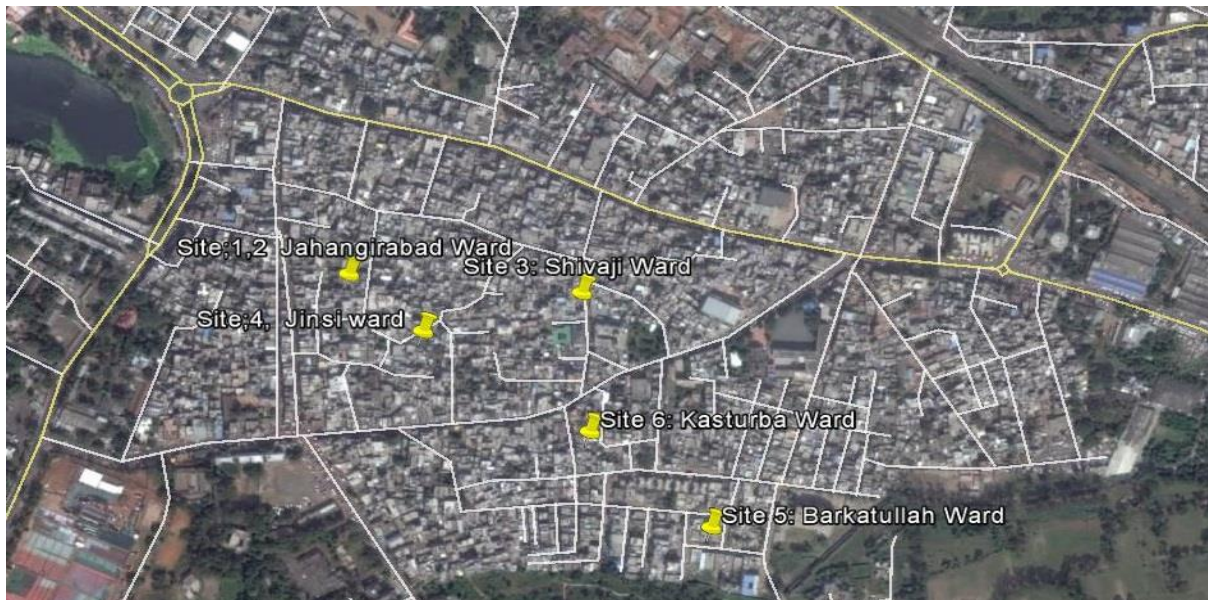


Fig. 1. Ward map of Bhopal Township



Fig. 2. Paras city Bhopal

2. Materials and Methods

In the present study both Primary and secondary data collection methods were used. In the present study primary information was obtained directly by weighing the garbage at the place of its origin besides interviewing the local residents at specific sites. The secondary data was obtained from books, magazines, research papers, municipal records, population census departments and libraries.

The houses that were selected for samples were selected by the process of random sampling technique keeping in view that different class of families are covered in present study. The waste generated during 24 hours in different wards has been accounted for, in the present work. For this door to door survey was conducted to get first-hand information from public. Two types of solid wastes (biodegradable and non-biodegradable) were recorded in the present investigation. Physical and electronic balances were used for measuring solid waste at all five sites.

3. Results

Site - 1 Households in Jahangirabad ward

100 houses were selected from site 1 with 621 family members. It was found that waste generated from these houses consists of garbage waste and polythene waste. These areas mainly dispose off their waste on roads. Due to non-awareness among residents they dispose their waste in open sites and on streets, In spite of daily collection of waste by municipality. Total waste generated was found to be 199.7 kg/day. Out of which recyclable waste was found to be 161.8 kg/day while, non-recyclable waste was found to be 37.9 kg/day. Average waste generated per house per day was found to be 1.9 kg/ day (Table 1).

Table 1. Solid waste generation in Jahangirabad Bhopal

Family size	No. of families	Waste Generated Kg	Average waste generated Kg/ person	Average waste generated Kg
3	10	9.8	0.32	0.98
4	25	27.7	0.27	1.108
5	20	29.3	0.29	1.465
6	17	32.4	0.31	1.905
7	17	37.4	0.31	2.2
8	10	24.3	0.3	2.43
9	3	5.9	0.21	1.966

Site – 2 Slum areas in Jahangirabad ward

Around 680 family members were living in 100 shanties. Collection of solid waste by Municipal Corporation is totally lacking in the interior areas of this site as there are very narrow lanes. Due to lack of awareness in this area most families dispose their waste in open areas. Open burning of municipal solid waste is common practice in this area. Total waste generated was found to be 124.5 kg/day. Out of which recyclable waste was found to be 95.4 kg/day. While non-recyclable waste was found to be 29.1 kg/day. Average waste generated per house per day was found to be 1.2 kg/day (Table 2).

Table 2. Solid waste per house in Jahangirabad slum area

Family size	No. of families	Total Waste Generated Kg	Average waste generated Kg/Person	Average waste generated Kg
4	4	2.4	0.15	0.6
5	10	9.9	0.19	0.99
6	30	32.3	0.17	1.07
7	27	35.6	0.18	1.31
8	16	23.1	0.18	1.44
9	13	21	0.17	1.61

Site – 3 (Shivaji ward)

In Shivaji ward 521 family members were living in 100 households. It was found that both biodegradable and non-biodegradable waste is disposed off in the municipality bins that are kept by Bhopal municipal corporations (BMC) for collection of residential wastes. In the present site it was found that the houses do not dispose their wastes on streets and in open areas due to awareness among the respondents. There is daily collection of waste by municipality workers. However, door to door collection is lacking. Total waste generated was found to be 162.6 kg/day. Out of which recyclable waste was found to be 130.0 kg/day while, non-recyclable waste was found to be 32.6 kg/day. Average waste generated per house per day was found to be 1.6 kg/day (Table 3).

Table 3. Solid waste generation in Shivaji ward

Family size	No. of families	Total Waste Generated Kg	Average waste generated Kg/ person	Average waste generated Kg
3	15	12.4	0.27	0.82
4	20	44.5	0.55	2.225
5	22	35.1	0.31	1.595
6	18	32.2	0.29	1.78
7	7	34.4	0.7	4.91
8	8	21	0.32	2.625

Site – 4 (Jinsi ward)

In 100 households selected by random sampling around 606 persons were living. It was found though the respondents that they mainly dispose their wastes in municipality bins. Total waste generated was found to be 187.4 kg/day. Out of which recyclable waste generated was found to be 154.9 kg/day while, non-recyclable waste generated was 32.5 kg/day. Average waste generated per house per day was found to be 1.8 kg/day (Table 4).

Table 4. Solid waste generation in Jinsi ward in Bhopal

Family size	No. of families	Waste Generated Kg	Average waste generated Kg/ person	Average waste generated Kg
3	6	5.7	0.31	0.65
4	15	17.6	0.29	1.173
5	19	29.5	0.31	1.552
6	20	36.8	0.3	1.84
7	17	38.1	0.32	2.241
8	13	30.67	0.29	2.359
9	10	26.6	0.29	2.66

Site – 5 (Barkatullah ward)

In Barkatullah ward 542 family members were residing in 100 houses. It was found that the waste mainly consists of garbage waste and polythene waste. The area mainly disposes their waste in the municipality bins that are kept by BMC Bhopal municipal corporations for collection of residential wastes. Due to awareness among the residents they do not dispose the wastes in open sites and on streets. There is daily collection of waste by municipality workers. Total waste generated was found to be 164.7 kg/day. Out of which recyclable waste generated was found to be 132.9 kg/day. While non-recyclable waste generated was found to be 31.8 kg/day. Average waste generated per house per day was found to be 1.6 kg/day (Table 5).

Table 5. Waste generation in Barkatullah ward

Family size	No. of families	Waste Generated Kg	Average waste generated Kg/ person	Average waste generated Kg
3	10	9.8	0.32	0.98
4	25	27.7	0.27	1.108
5	20	29.3	0.29	1.465
6	17	32.4	0.31	1.905
7	17	37.4	0.31	2.2
8	10	24.3	0.3	2.43
9	3	5.9	0.21	1.966

Site -6 (Kasturba ward)

In Kasturba ward 547 family members were residing in selected 100 houses. It was found that the residents throw waste in municipality bins that are kept by BMC. Total waste generated was found to be 158.3 kg/day. Total recyclable waste generated was found to be 125.9 kg/day. Total non-recyclable waste generated was found to be 32.4 kg/day. Average waste generated per house per day was found to be 1.5 kg/day (Table 6).

Table 6. Waste generation in Kasturba ward

Family size	No. of families	Waste generated Kg	Average waste generated Kg/ Person	Average waste generated Kg
3	14	13.2	0.31	3.76
4	17	21.2	0.31	2.32
5	21	29.6	0.28	1.5
6	17	28.9	0.28	1.55
7	20	40.7	0.29	1.13
8	9	21.4	0.29	2.19
9	2	3.3	0.18	8.7

Site-7 Paras city Bhopal

The well managed Paras city has door to door collection systems besides there is a common society bin also where, the residents themselves or their maid servants dispose off the waste. The capacity of society bin is 60 Kgs and 1 bin is allotted for waste collection of 2 blocks. Rag pickers segregate different recyclable components of the waste (Table 7) and sell them at recyclable centres @ Rs.2000 to 2500 per month.

Table 7. Average composition of different categories of household waste.

Category of waste	Plastic	Paper and cardboard	Polythene	Glass	Metal	Mis.	Dirt and ash etc.	Food waste	Total
Composition in Kg	14.30	18.06	4.56	12.8	14.3	17.3	79.0	265.2	425.3

The waste collected by the municipal authorities from the adjoining roads / streets is given in Table 8. An amount of 17.63 kg / day is collected by the corporation

Table 8. Average composition of different categories of street sweeping waste

Category of waste	plastic	Yard trimming / garden waste	Dirt and ash etc.	Mis.	Total
Composition in Kg	0.9	8.8	6.0	1.9	17.63

4. Discussion

The Bhopal city is divided into 14 zones having 70 wards. Each zone consists of 4-5 wards. Six wards were selected for the present study in order to present a comprehensive picture. All these five sites show lot of variation in their waste generation due to their different life styles. In the present study it was found that waste generation is highly linked to the economic condition of the families. In the present study it was found that the families dispose off their waste without any segregation process. They dispose their degradable and non-degradable wastes together.

The total waste generated is very low in slum areas as compared to other sites this is due to socio economic and life style of people living in these sites which is very low as compared to other sites. The waste disposed off in municipality bins also gets transported without segregation by the municipality authority of Bhopal. The waste is later taken to the disposal site at Bhanpur which is located at a distance of 16 kms from the city.

Rag pickers play an important role to collect the recyclable waste from disposal sites. It was found during the present study that the respondents suffer many health problems related to open disposal and open burning of waste like headache, fever, asthma, and chronic bronchitis. The rag pickers are least found in Barkatullah and Kasturba areas because of the daily collection of solid wastes.

The improper and inadequate solid waste management in old Bhopal city has crippled not only the hygiene management of the city but has also adversely influenced the poverty alleviation programs. It has also affected the two lakes upper lake and lower lake in the city. Throwing of solid waste into nearby drains and water bodies by local residents, results in chocking of sewerage/storm water drains causing flooding in monsoon season besides polluting the water bodies.

The huge quantity of waste production and improper methods of waste disposal were found to be causing pollution of both water soil air which finally affects the human health.

The city requires substantial improvement in the prevailing solid waste management practices to raise the overall quality of life in view of the irreversible urbanization. To maximize efficiency and effectiveness of municipal management system it is necessary to tackle the problem systematically

keeping different dimensions of solid waste management in view and devise cost effective systems which would be viable in the available socio-economic and politico environmental setting.

5. Conclusion

In the present study it was found that the waste generation is directly or indirectly proportional to the economy of the area and also life standards. The maximum waste generated was seen in site 1- Jahangirabad ward which is very densely populated and the people living there are also economically sound. The least waste generated was in site 2- slums in Jahangirabad the people living there have low economy and have also lower life standards and are known to generate waste in very low as compared to other sites.

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