The Clarion Volume 6 Number 1 (2017) PP 32-38

The Clarion

International Multidisciplinary Journal

ISSN : 2277-1697

Sustainable waste management: a case study in Guwahati.

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Abstract

The environmental threat to humanity due to unscientific and unhealthy disposal of waste is increasing day by day. Urban sprawl due to population growth combined with changing consumer habits have increased the per capita generation of waste over the years. This has made the task of Solid Waste Management even more challenging for Municipal Corporations. The key issues surrounding garbage collection and disposal are similar in major cities and towns of India, Guwahati being a typical example of the lot. Technology available in developed countries is hard to implement in India in this sector due to funds limitation, different demographic profile of users, general education and awareness level in the community regarding waste, cost of running sophisticated waste plants, associated infrastructure required to support the system and also the extent and character of the waste to be managed. Cities in developing countries hardly spend more than 0.5% of their per capita gross national productivity (GNP) on urban waste services, which covers only about one-third of overall cost. Under these stringent budgets and complex problems to deal with, it is vital to devise ways which would strike a balance between the cost effectiveness and the quality of the waste management process. Implementation of waste management with proper segregation and supporting technologies for processing the recyclables can go a long way in minimizing the energy consumed for manufacturing. The segregation process when done efficiently produces cleaner recyclables which has a better market value and lesser energy consumption in its life cycle from generation at source to a finished product and can be a sustainable solution to waste management. In this paper municipal waste collection at source using different types of waste receptacles have been experimented. A resident colony in Guwahati city was selected and 50 households were randomly selected for the study for 90 days. Two bin system and a designed segregation bin system were experimented. Data was compared using SPSS. It was found that the contamination level was low in the biodegradable and non biodegradable waste in the designed segregation bin system. It was also found that there was an improvement in the quantity of biodegradable and non biodegradable waste. Segregation at source if practiced could lead to zero waste locality with an economic viability.

Keywords: Recyclables, segregation, zero waste.

1. Introduction

Solid waste management has become one of the major issues in both urban and rural areas all over the world. With the progress of civilization, the waste generated become more complicated in nature. Cities in developing countries hardly spend more than 0.5% of their per capita gross national productivity (GNP) on urban waste services, which covers only about one-third of overall cost (World Bank, 1999). The complexities of issues surrounding the management of municipal waste in Indian cities are increasing even more day by day. An average citizen in India is far from the concept of segregation of waste and its benefits to the system. Open, uncontrolled and poorly managed land filling is commonly the practice in most cities. Currently, most garbage collection is done by depositing everything into a single container from where they are hauled to be dumped in dumping grounds or burnt in open air. Such practices have caused serious health problem due to release

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DOI number: 10.5958/2277-937X.2017.00005.3

of highly toxic gases and ground water contamination from pollutants and leachates (CPCB, 2000). Garbage needs to be sorted and segregated into various components and each of such components like textile materials; polythene, foodstuffs, metals and non-metallic would have to be handled separately at the disposal or recycling site. Waste management in developing countries seems to have low priority as they are more bothered about issues like hunger, health, water, employment and civil war (Chandrappa R. *et.al*, 2012). Financial situation of most municipalities in India are not in good health. The difficulties in providing the desired level of public service in the urban centers of India are often attributed to the poor financial status of the managing municipal corporations (MoEF,2000). 80–95% of total budget of Municipal Solid Waste Management (MSWM) constitutes the process of collection and transport of waste (Sinha, 1998).

2. Methodology

Dry and wet waste required to be segregated and collected at source, is the bottle neck of the Municipal Solid Waste Management. Segregation of waste is one of the critical activities in the Solid Waste Management as it saves undue efforts on transportation and disposal of recyclable or inert wastes. Studies revealed that the characteristic of waste generated consist of more biodegradable fraction and segregation of such wastes, before they are transported to the processing /disposal site, should be carried out. A two bin system was adopted for segregation of waste into dry and wet fraction at source of generation. Normal waste disposal kitchen bins made of plastic were distributed among the residents. Information about segregation and demonstration of the segregation procedure was done at the resident colony. Table 1 below shows the details of the waste collection area.

Table 1: Details of the waste collection zone

Sl No.	Item	Quantity
1	Place/Area	Games village, Guwahati
2	No. of households	90
3	No. of bins for wet waste	90
4	No. of bins for dry waste	90

The waste was collected in two types of temporary storage bins, one for dry waste and the other for wet waste, which are collected on daily basis from door to door. After collection of waste from door to door it was segregated into biodegradable and non biodegradable. Data collection was carried out for 90 days.

2.1 Data tabulation and analysis

Structured questionnaire was administered to collect primary data at various stages of the research. Data tabulation and analysis was performed using Statistical Package for Social Science (SPSS). Various descriptive and inferential statistical analyses were conducted for data analysis. Master data sheet was developed for database of two bin system and segregation bin system. The variable was taken as numeric with nominal scale. Data on biodegradable, non biodegradable and contaminated waste was recorded for a total of 180 days, 90 days for each bin design system. The variables were taken as numeric with a measure of metric scale in kg for the different types of waste. One way ANOVA was performed for biodegradable, non biodegradable and contaminated waste for two bin and segregation bin system.

2.2 Collection of MSW using two bin system

A two bin system was adopted for segregation of waste into dry and wet fraction at source of generation. Normal waste disposal kitchen bins made of plastic were distributed among the residents. Information about segregation and demonstration of the segregation procedure was done at the resident colony. The waste was collected in two types of temporary storage bins, one for dry waste and the other for wet waste, which are collected on daily basis from door to door. Waste was collected from 50 households for 90 days and weighted using electronic weight balance to the accuracy of two decimals. After collection of waste from door to door it was segregated into biodegradable, non

biodegradable and contaminated waste.

2.3 Collection of MSW using segregation bin system

Data collection of waste composition was done from the single bin segregation system. Contamination of recyclables was found to be reduced in the single segregation unit. This was statistically proved from the data comparison of both the systems using SPSS. Data on the waste categories viz. biodegradable, non biodegradable and contaminated waste was collected by using the segregation bin.

3. Results

Physical characteristics of waste at primary collection point were calculated using two bin system and segregation bin system. The data collected was analysed using SPSS for biodegradable, non biodegradable and contaminated waste.

3.1 Two bin system

Table 2 below shows the mean values of biodegradable, non biodegradable and contaminated waste derived from the statistical analysis using SPSS.

Table 2 : Mean values of type of waste using two bin system

Sl. No.	Type of waste	Mean (kg)
1.	Biodegradable	42.19
2.	Non biodegradable	5.23
3.	Contaminated	9.07

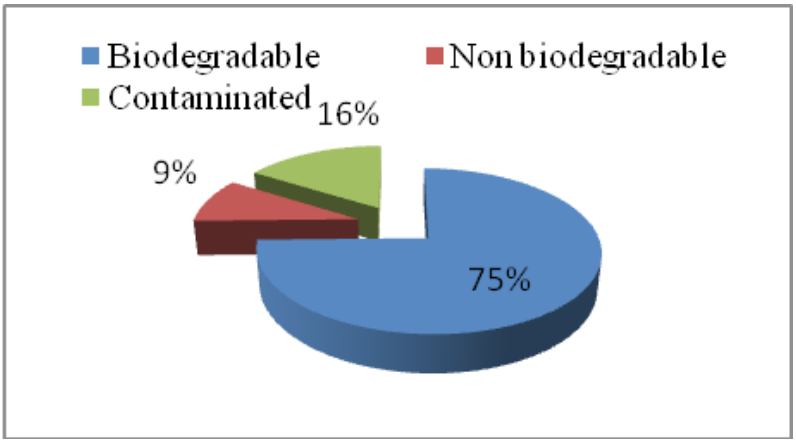

Fig. 1: Percentage of different types of waste using two bin system

It was found that there is a high level of contamination in the two bin system which exceeds the non biodegradable waste percentage as shown in fig. 1. This contamination was due to the mixing of dry waste with wet waste disposed into the dustbins. The dustbins allocated for disposing dry waste was found to be contaminated with food waste and also with contaminated polythene bags as the major components. Similarly the dustbin allocated for collecting wet waste was also found to be contaminated with polythene bags, disposable plates, cups etc.

3.2 Segregation bin system

Waste was collected using the designed segregation bin from 50 households for 90 days and the different quantities of biodegradable, non biodegradable and contaminated waste was measured. Table 3 shows the mean values of biodegradable, non biodegradable and contaminated waste for the designed segregation bin derived from statistical analysis using SPSS.

Table 3 : Mean values of type of waste using segregation bin

Sl. No.	Type of waste	Mean (kg)
1.	Biodegradable	44.05
2.	Non biodegradable	6.53
3.	Contaminated	5.42

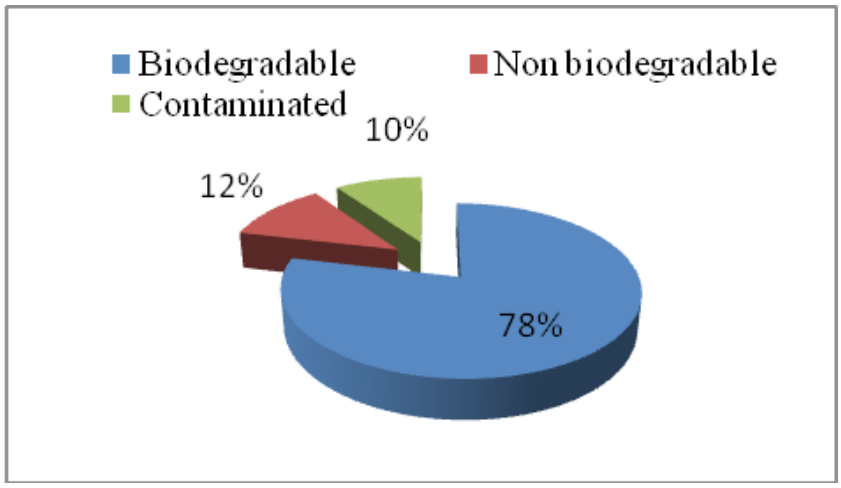

Fig. 2 : Percentage of different types of waste using segregation bin system

It was found that biodegradable waste consists of the highest fraction as 78% followed by non biodegradable waste at 12% as shown in fig. 2. The contaminated waste was found to be 10% which is to be disposed into the landfill.

3.3 Comparison of two bin system and segregation bin system

On the basis of the collected data inferential statistics has been conducted to study the variance of amount of various types of waste viz. biodegradable, non biodegradable & contaminated waste with respect to two different designs of segregation bin.

Null hypothesis : There is no significant difference in the amount of biodegradable waste, non biodegradable waste and contaminated waste collected with two different ideas for collecting waste viz. two bin system and improvised segregation bin. One way ANOVA was conducted for a significance level of 0.05. The null hypothesis was rejected at significance level 0.048, 0.00 and 0.00 respectively.

The descriptive statistics showing the mean values of two bin system and segregation bin system for biodegradable waste is shown in table 4.

Table 4: Mean values of two bin & segregation bin for biodegradable waste

Biodegradable Waste				
	N	Mean	Minimum	Maximum
Two Bin System	90	42.19	30.52	67.73
Improvised Segregation Bin	90	44.05	31.48	70.72

Comparison of two bin system and segregation bin system in the amount of biodegradable waste collected from 50 households for 90 days taking the mean values are shown in fig. 3.

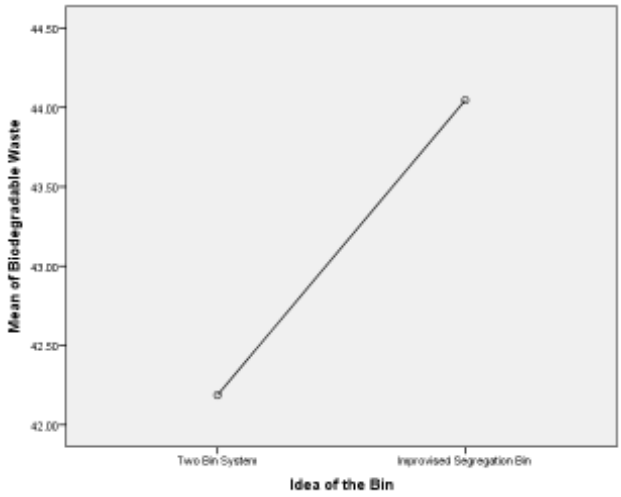

Fig. 3: Comparison between two bin system and improvised segregation bin for biodegradable waste

The descriptive statistics showing the mean values of two bin system and segregation bin system for non biodegradable waste is shown in table 5.

Table 5 : Mean values of two bin & segregation bin for non biodegradable waste

Non-biodegradable Waste				
	N	Mean	Minimum	Maximum
Two Bin System	90	5.23	2.98	8.45
Improvised Segregation Bin	90	6.53	3.56	12.35

Comparison of two bin system and segregation bin system in the amount of non biodegradable waste collected from 50 households for 90 days taking the mean values are shown in fig. 4.

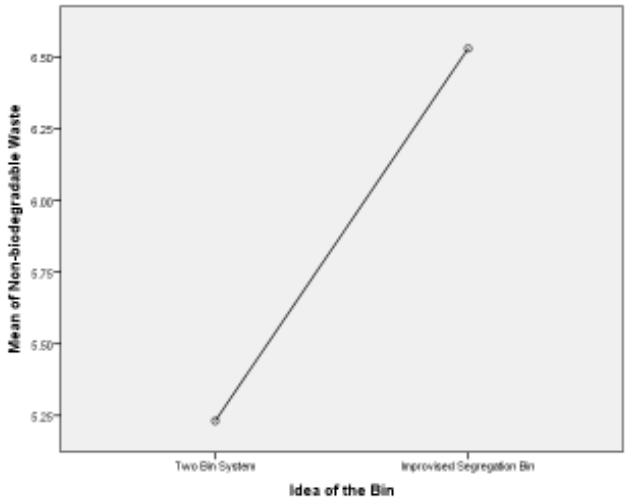

Fig. 4: Comparison between two bin system and improvised segregation bin for non biodegradable waste

The descriptive statistics showing the mean values of two bin system and segregation bin system for contaminated waste is shown in table 6.

Table 6: Mean values of two bin & segregation bin for contaminated waste

Contaminated Waste				
	N	Mean	Minimum	Maximum
Two Bin System	90	9.07	6.76	11.93
Improvised Segregation Bin	90	5.42	3.46	12.80

Comparison of two bin system and segregation bin system in the amount of contaminated waste collected from 50 households for 90 days taking the mean values are shown in fig. 5.

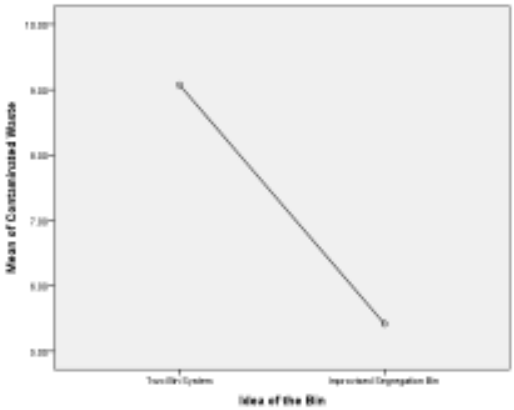

Fig. 5 : Comparison between two bin system and improvised segregation bin for contaminated waste

4. Discussion

The results obtained out of the segregation at source process demonstrated the importance of the process to be in the waste processing flow. Even though local authorities have financial constraints and unscientific dumping of waste is an easy practice, the segregation of waste at source will have to be given high priority. Segregation at source data stresses the urgency to integrate the process in the waste management process to minimize the impact and damages to the environment which are irreversible. It offers a feasible strategy where recycling targets could be achieved right away without major changes in the SWM chain which is a major challenge in the current scenario. It also offers a blueprint for zero waste planning of places and shows the potential to achieve them in due course of time if taken forward. The successful running of the facility and delivery of the desired outcomes brings out a feasible sketch of a model which could be replicated in for the creation of zero waste places in other cities.

5. Conclusion

In this paper an attempt has been made to bring out the key issues in waste disposal in the current system of management in Guwahati. Strict monitoring of the process of disposal from the point of generation to the site of disposal is needed to maintain health and safety of the citizens and the personnel involved in the process. There is seen to be lack of awareness among the public regarding safe and environment friendly waste disposal practice. The design of a single segregation bin to be used at the source of generation has addressed the issue of responsible waste disposal and also educated the public on the environmental benefits of segregation at source. The learning curve of the sample population was seen to progress as the research evolved and progressed. The desired outcome of recyclables with minimal level of contamination was achieved in terms of segregation at source by responsible disposal of waste after several trials with different recycling proportions. The urgent need to construct sanitary landfill sites has been flagged up by

this research.

The receptacle designed for segregation at source can be further developed in terms of materials and design for use in different waste situations and characteristics. Cost and portability aspects can be taken up for further development through research which would enable its use for a larger and varied audience. Research on the efficiency attribute can be carried out further to enhance the total output of recyclables.

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