Evaluation of Solid Waste Collection and Segregation: A Case Study of Integral University Campus, Lucknow

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Abstract - A Solid Waste Management (SWM) may be defined as the discipline associated with the control of generation, storage, collection, transfer, transportation and disposal of Solid Waste (SW) in such a manner that is in accordance with the best principles of public health, economic, engineering, conservation and other environmental consideration that is also responsible for public attitude. Various studies reveal that about 90% of MSW is disposed of unscientifically in open dumps and landfills creating a lot of problems to public health and environment. In the present study of Integral University (IU) Campus, Lucknow, an attempt has been made to provide a comprehensive review of the finding problems and prospects of solid waste. A detailed investigation was made regarding the methods of practice associated with sources, quantity generated, collection, transportation, storage, treatment and disposal of SW in IU Campus. To achieve this goal the data regarding SWM in IU Campus was obtained through questionnaire, individual field visits and interaction with concern authorities. Photographic evidences were also made about the current practice adopting towards different phases of SWM in the campus.

Index Terms - Solid Waste, Solid Waste Management, Segregation, Disposal, Leach ate, Landfills, Vermi composting.

1. INTRODUCTION

Next to China, India is the second most populated and economically growing country of the world. In future increasing levels, rapid economic growth and rise in community living standards will significantly accelerate the MSW generation rate. Issues associated with waste disposal have become challenging as more land will be needed for their ultimate disposal. The waste poses serious hazard to human health and environment if improperly stored, treated, transported, disposed off or managed. (Misra et al, 2005) Small amount of leachate can pollute large amount of ground water.

Like most of the other infrastructural services has come under great stress, consider low priority areas, SWM was never taken up seriously either by public or by concerned authorities and now the piled up waste is threatening our health, environment and well-being (Chouhan and Reddy, 1996 Majumdar, 1994) Waste minimization is a methodology used to achieve waste reduction, primarily through reduction at source.

Solid waste may be defined as generation of undesirable substances which is left over after they are used. They can not be reused directly by the society for its welfare because some of them may be hazardous for human health. There are many categories of MSW such as food waste, rubbish, commercial waste, institutional waste, street sweeping waste, industrial waste, construction and demolition waste, and sanitation waste. MSW contains recyclables (paper, plastic, glass, metals, etc.), toxic substances (paints, pesticides, used batteries, medicines), compostable organic matter (fruit and vegetable peels, food waste) and soiled waste (blood stained cotton, sanitary napkins, disposable syringes) (Jha et al., 2003; Reddy and Galab, 1998; Khan, 1994). The quantity of MSW generated depends on a number of factors such as food habits, standard of living, degree of commercial activities and seasons. Data on quantity variation and generation are useful in planning for collection and disposal systems. With increasing urbanization and changing life styles, Indian cities now generate eight times more MSW than they did in 1947. Presently, about 90 million tons of solid waste are generated annually as byproducts of industrial, mining, municipal, agricultural and other processes. The amount of MSW generated per capita is estimated to increase at a rate of 1–1.33% annually (Pappu et al., 2007; Shekdar, 1999; Bhide and Shekdar, 1998).

TABLE I: Municipal Solid Waste Generation Rate in Different States of India (Source, CPCB, 2000)

S. N.	State	Per capita Waste generated(kg/day)	S. N.	State	Per capita Waste generated(kg/day)
1	Andhra Pradesh	0.364	12	Maharashtra	0.378
2	Assam	0.223	13	Manipur	0.201
3	Bihar	0.280	14	Meghalaya	0.157
4	Gujarat	0.451	15	Mizoram	0.296
5	Haryana	0.276	16	Orissa	0.336
6	West Bengal	0.321	17	Punjab	0.312
7	Delhi	0.475	18	Pondicherry	0.295
8	Himachal Pradesh	0.427	19	Madhya Pradesh	0.316
9	Karnataka	0.376	20	Rajasthan	0.355
10	Kerala	0.393	21	Tamil Nadu	0.467
11	Uttar Pradesh	0.381	22	Tripura	0.210

2. INTEGRAL UNIVERSITY CAMPUS, LUCKNOW

Integral University is a state private university in Lucknow, the capital of Uttar Pradesh, India.

The university is divided in blocks: Administrative block, Academic blocks 1, 2, 3, Civil Block, Medical and Hospital Block, Library Block and Architecture block. Besides this, the university has four boys' hostels (1, 2, 3, 4), three girls' hostels and Resident Hostel for Doctors and Nurses.

Integral Institute of Medical Sciences and Research (IIMS&R) which is a hi-tech 350 bedded hospital, fully furnished with advanced facilities and managed by highly qualified medical staff. It has 18 departments besides Emergency & Trauma Care Unit.IIMS&R , have 23 departments to provide training and patient care. There are numbers of PG and UG courses are running and imparting medical education and dedicated social services to the local and off course regional human kind too at very nominal cost.

2.1 OBJECTIVE OF STUDY

There is following different objectives of my study on solid waste management in the IU Campus.

1) To evaluate the Solid Waste generation, quantification and categorization in IU Campus

2) To identify the present solid waste management practices existing in campus.

3) To provide some different alternatives for better management of solid waste management in IU Campus

2.2 LAYOUT OF SURVEY STRATEGY

1. Identify the waste origin areas in the IU Campus.

(From Google Map)

2. Data Collection for

a. Different sections of campus (from institute administration)

b. Their location and size (by visiting)

Visited the campus

3. Divided the campus in to different zone according to my study purpose

a. Academic and departmental area

b. Residential area, and Hostels and messes

4. Collect the information about the staff for SWM (by questioner)

5. Collect information about the solid waste management activities in campus through

a. Questionnaire with staff for SWM

b. Questionnaire with residing peoples, and

c. Individual field visit

6. Sample collection and examine the waste buy

a. Visual method

b. Sort and weigh method

c. Grid method

7. Analysis of observation

8. Result and discussion

9. Conclusion and suggestions

2.3. SAMPLE COLLECTION AND ANALYSIS

The solid waste from the different sites were randomly collected from bins provided by existing system of waste

management. For the purpose of sample collection wastes obtained from different zones and examine by taking weight of that samples. Then the waste is taken out and sorted in to different categories and weighted for measurement of composition of particular type of waste. And for the measurement of the amount of road side waste a survey of the area of waste deposition and calculate the area where the waste was spread. Then some sample collection sites were selected and randomly collect the sample of waste form these areas with the measurement of one meter of one meter sample area size. Then calculate for whole area with the mean of the sample collected.

Fig.2 (a) Regular Bin   Fig.2 (b) Trash Bin

2.4. OBSERVATIONS

The management of solid waste generated in the IU Campus, it has been divided in to four zones Administrative block, Academic blocks 1, 2, 3, Civil Block, Medical and Hospital Block, Library Block and Architecture block. Besides this, the university has four boys hostels (1, 2, 3, 4), three girls hostels and Resident Hostel for Doctors and Nurses. In this campus there is different source area that generates the waste of different type such as Food waste, Plastics, Paper, Tin, Rubber, Metal, Glass, Dust, Textile, Leather, and Garden Trimming shown in Table II.

TABLE .II: Major Sources of Solid Waste Generation in IU Campus.

S.N.	Source	Type of Waste
1	Canteens	Food and Vegetable Waste, Paper, Plastic and Dust
2	Employee Residences	Food Waste, Plastics, Paper, Tin, Rubber, Metal, Glass, Dust, Textile, Leather, Yard Trimmings
3	Academic Blocks	Paper, Plastic, Card Board, Dust, Garden Trimmings
4	Hostels	Glass, Paper, Tin, Plastic, Leather, Dust, Card Board
5	Street Sweepings	Glass, Plastic, Paper, Wood, Dust, Tree Leaves

2.5. COLLECTION SYSTEM

The solid waste is collected from different sources/establishment by various methods. The solid waste management activity in IU consists of wastes generator throwing the waste into the different types of bins provided by the IU waste management system at different locations. The sweepers sweep the road and drain and transfer the waste into the bins and hand carts. There are 185 regular dust bins of different types 125 small plastic rectangular, 50 big plastic cylindrical are placed in IU. Three types of dust bins are used. These are Large Plastic Rectangular Bins of volume 0.339 m3 Fig. 2(b), and Small Plastic Cylindrical Bins of volume 0.243 m3 Fig.3. The collection of waste from these dust bins is planned in accordance with frequency of container becoming full by the by sweepers to the larger bricked wall mounted bins constructed at different places which his finally dumped by the IU sweepers on every second day.

Fig.3: Cemented Bin in IU Campus

In the IU campus one administrative officer, 4 supervisors and 70 sweepers currently working for the Purpose of solid waste management and cleaning. Senior supervisor for Academic and Residential area Supervisor for Girls Hostel Supervisor for boys hostel no. 1 to 4.

2.6. TRANSPORTATION

Transportation of solid waste collected to larger bins by sweepers is carried out properly by a tractor at each second day Lifting of garbage is done manually. The waste collected from the roads and bins is directly transported to the final dumping site. Most often workers are not provided with protective hand gloves and shoes so they are directly expose to the waste. Protective measures are necessary to avoid contracting skin allergies and respiratory diseases .The loading and unloading of waste is done through mechanical system reducing direct contact of worker with the wastes.

3. RESULTS AND DISCUSSION

Waste generation rates works out to be 0.140 Kg per capita per day. Approximately 120 kg/day waste is generated from the Employee residential area, 300 kg. From mess activities, 250 kg from hostel and130 kg from academic region and on average 110kg/day from regular street sweeping which contribute to the total 910 kg solid waste per day shown in Table III. Waste generated in IIMS&R, University Polytechnic and Pharmacy blocks are not included in this case study.

TABLE III: The Various Waste Generating Places in Campus

S.N.	Sample Sources	Amount of Waste (Kg/day)
1	Canteens	300 kg
2	Employee Residences	120 kg
3	Academic Blocks	130 kg
4	Hostels	250 kg
5	Street Sweepings	110 kg
	TOTAL	**910 kg**

4. CHARACTERISTICS OF SOLID WASTE:

The quantity and characteristics of solid waste vary from place to place. Factors that influence the quantity and Compositions are the different activity areas for waste materials. The typical composition of solid waste of IU. is given in Table IV, V, VI and VII &Figure 4, 5, 6, 7 and 8.

TABLE IV: Composition of Solid Waste Generated in IU Canteen 300kg per Day

S.N.	Type of Waste	Wt. of Sample	Percentage
1	Food Waste	237.00 kg	79%
2	Plastic	9.00 kg	3%
3	Paper	15.00 kg	5.00%
4	Glass	6.00 kg	2.00%
5	Card Board	3.00 kg	1.00%
6	Leather	3.00 kg	1.00%
7	Dust	24.00 kg	8.00%
8	Garden/Yard Trimming	0.00 kg	0.00%
9	Tin	3.00 kg	1.00%
10	Wood	0.00 kg	0.00%
11	Metal	0.00 kg	0.00%
	TOTAL	**300.00 kg**	**100.00%**

TABLE V: Composition of Solid Waste Generated in Employee Residential Area of IU Campus per Day

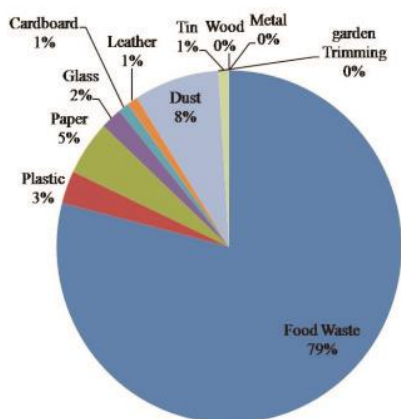| S.N.	Type of Waste	Wt. of Sample	Percentage
1	Food Waste	42.00 kg	35.00%
2	Plastic	10.80 kg	9.00%
3	Paper	14.40 kg	12.00%
4	Glass	8.40 kg	7.00%
5	Card Board	8.40 kg	7.00%
6	Leather	3.60 kg	3.00%
7	Dust	12.00 kg	10.00%
8	Garden/Yard Trimming	7.20 kg	6%
9	Tin	4.80 kg	4.00%
10	Wood	3.60 kg	3.00%
11	Metal	4.80 kg	4.00%
	TOTAL	**120.00 kg**	**100.00%**

Fig 4: Composition of Waste in Mess and canteen

Fig. 7: Waste Generated In Hostels of IU per Day

TABLE VI: Composition of Solid Waste Generated in IU Academic Area 130 kg per Day

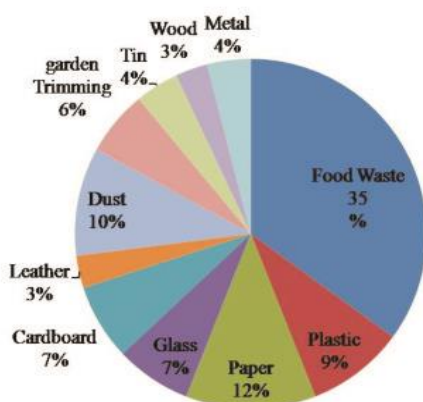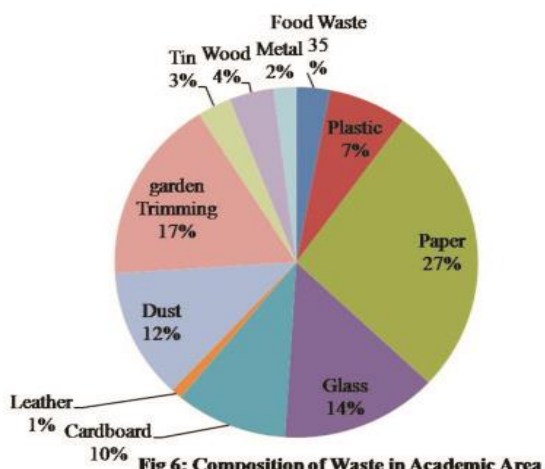| S. N.	Type of Waste	Wt. of Sample	Percentage
1	Food Waste	3.90 kg	3.00%
2	Plastic	9.10 kg	7.00%
3	Paper	35.10 kg	27.00%
4	Glass	18.20 kg	14.00%
5	Card Board	13.00 kg	10.00%
6	Leather	1.30 kg	1.00%
7	Dust	15.60 kg	12.00%
8	Garden/Yard Trimming	22.10 kg	17.00%
9	Tin	3.90 kg	3.00%
10	Wood	5.20 kg	4.00%
11	Metal	2.60 kg	2.00%
	TOTAL	**130.00 kg**	**100.00%**
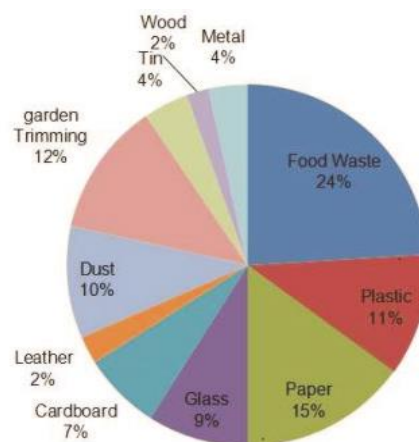
Fig 5: Composition of Waste in Residential Area

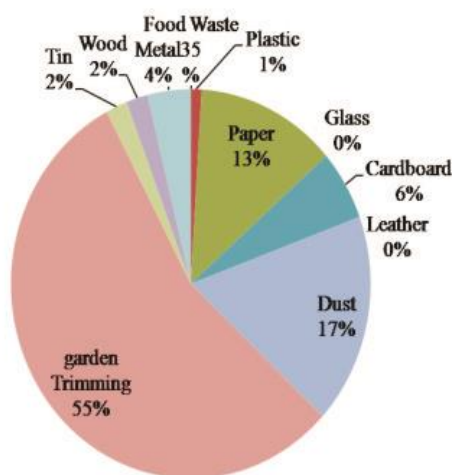Fig 6: Composition of Waste in Academic Area

Fig 8: Composition of Waste in Street Sweeping

TABLE VII: Composition of Solid Waste Generated In Hostels of IU per Day

S. N.	Type of Waste	Wt. of Sample	Percentage
1	Food Waste	60.00 kg	24.00%
2	Plastic	27.50 kg	11.00%
3	Paper	37.50 kg	15.00%
4	Glass	22.50 kg	9.00%
5	Card Board	17.50 kg	7.00%
6	Leather	6.25 kg	2.00%%
7	Dust	25.00 kg	10.00%
8	Garden/Yard Trimming	30.00 kg	12.00%
9	Tin	10.00 kg	4.00%
10	Wood	5.00 kg	2.00%
11	Metal	8.75 kg	4.00%
	TOTAL	**250 kg**	**100.00%**

TABLE VIII: Composition of Solid Waste Generated In Street Sweeping of IU Campus per Day

S. N.	Type of Waste	Wt. of Sample	Percentage
1	Food Waste	0.00 kg	0.00%
2	Plastic	1.10 kg	1.00%
3	Paper	14.30 kg	13.00%
4	Glass	0.00 kg	0.00%
5	Card Board	6.60 kg	6.00%
6	Leather	0.00 kg	0.00%
7	Dust	19.80 kg	18.00%
8	Trimmings and dry leaves	62.70 kg	57.00%
9	Tin	2.75 kg	2.00%
10	Wood	2.20 kg	2.00%
11	Metal	0.55 kg	1.00%
	TOTAL	**110.00 kg**	**100.00%**

5. CONCLUSION

The solid waste management in IU Campus appears to be inadequate and needs up gradation. The solid waste has to be disposed of scientifically through sanitary landfill and recyclable portion of the waste should be salvaged. Segregation of recyclable material would also leads to reduction in quantity of solid waste for final disposal. A system approach needs to be adopted for optimizing the entire operation of SWM encompassing segregation at source, timely and proper collection, transportation and segregation. More emphasis needs to be laid on segregation and collection of waste at door step from employee residences and hostels. Segregation of recyclable material from mixed waste not only is Tedious but also wasteful, therefore the residents should be sensitized towards the importance of segregation of wastes at source. Rather than considering the solid waste simply as residue to be thrown away, it should be recognized as resource materials for the production of energy, compost and fuel depending upon the techno-economic viability, local condition and sustainability of the project on long term basis. A better management for recyclable and biodegradable waste utilization provides the

facility to reduce the waste disposal up to 60-70 % of the total waste dispose at present.

6. SUGGESTIONS

1) To use Three bin system different for biodegradable waste, recyclable waste and deposition waste.

2) To use covered Trolleys/ handcarts for the collection of road side waste and collection of residential waste.

3) Provide more dustbins at different locations along side of road to collect the road side waste.

4) To use the biodegradable waste for producing vermi composting in the IU Campus.

5) To create three partitions in large masonaried partitioned bins for separated disposal of different types of waste at the source level.

6) To suggested the sweepers to segregate the different type of waste at the collection site before final transfer for the disposal.

7) To make awareness es about waste minimization, cleanses, healthy habits to protect the flora and fauna of the natural environment.

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