

A Study On The Municipal Solid Waste Management Of Itanagar Capital Complex Of Arunachal Pradesh, India

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Abstract— This paper is an attempt made to study the management of municipal solid waste generated in the capital complex of Arunachal Pradesh. Due to rapid population growth and socio-economic development the management of municipal solid waste (MSW) is a major concern in the state. The municipal solid waste is predominantly managed by depositing it in the low lying areas, called dump or landfills. The MSW of Itanagar capital complex is dumped at the landfill site at Chimpu located in the outskirts of the capital complex. In this work we have tried to quantify the MSW generated and also the composition of MSW has been studied by segregation of MSW sample at the landfill site. The assessment and analysis of MSW generated leads us to realize that there is great potential for energy generation as well as composting due to high percentage of organic content in the MSW. The data given in this paper may be used for further study of MSW management in the Itanagar Capital complex.

Keywords— Municipal solid waste, Energy, Composting, MSWM, quartering method

I. INTRODUCTION

Municipal solid waste (MSW) management is considered as one of the herculean tasks faced by developing countries like India. Huge quantity of solid waste is generated during various activities in municipal areas. Municipal solid waste includes mainly commercial and residential wastes, in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes (MSW Rules, 2000). In simple words, MSW, which is more commonly known as trash or garbage, consists of everyday items we use and then throw away, such as product packaging, yard trimmings, furniture, textiles, bottles, food scraps, newspapers, appliances and metals. These wastes are to be stored, collected, transported, processed and disposed of in an environment friendly manner, so as to keep the city neat and clean. The most popular means of management of MSW still prevailing in our country is disposing the waste materials in low lying areas called landfill sites. MSW Rules, 2000, mandate “landfills should always be located away from habitation clusters and other places of social, economic or environmental importance”, which implies landfills be located outside the city, so the garbage does not harm the public health, or land, water, and air environment. The generation of MSW increases with socio-economic development of urban population. In an emerging economy like India, rapid population growth has further added to the intensity of waste generation. Similarly in the state of Arunachal Pradesh management of MSW has been of great concern due to population growth as well as socio-economic development of the state. The study area Itanagar is the capital of Arunachal Pradesh and lies between 27° 6' 0" N latitude and 93° 37' 12" E longitude. It is located at an average altitude of 750 m above sea level. Municipal solid waste of Itanagar city is managed by Itanagar Municipal Corporation (IMC) established in the year 2013. The City is divided into 28 wards, each ward has 3000 plus population. The total population of the city covered under these wards are around 94,562 (*Department of Town Planning, GoAP, 2012 [6]*). All the waste generated in the city are dumped into Chimpu landfill site in an uncontrolled manner, posing a threat to human health and environment.

II. METHODOLOGY

Sample Preparation

It is of utmost importance for all analysis that the samples be representative. Hence, in this study quartering method is followed. The cone and quartering is an effective method for homogenizing bulk solid sample, where about 20-30 g of waste sample are obtained from 8-10 different locations of landfill sites and are mixed thoroughly and divided into four equal parts as shown in the figure 1 below *Muhammad Safar Korai et al (2014) [12]*. Two parts are again mixed with each other whereas other two parts are discarded. This process of mixing is repeated till we get a mix sample of about 5-10 kg, which can be placed in plastic bag, sealed and shipped directly to the laboratory for tests and analysis. It may be noted that sample if stored for more than two days should be refrigerated at < 6° C.

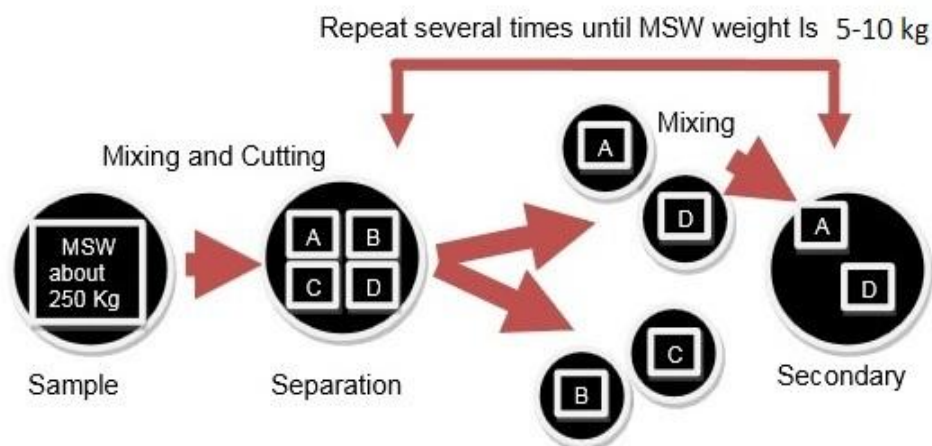


Figure 1: General Flow Chart Of Quartering Method

Quantification of Municipal Solid Waste

Total municipal solid waste generation from Itanagar city was calculated by observing the total amount of waste reaching the landfill site per day. This was done by observing the number of vehicles reaching the landfill site and the number of trips each of these vehicles being made per day. If the capacity or amount of waste each of these vehicles can carry is worked out then total solid waste generation can easily be found out *Kenli et al 2013[7]*.

Type of vehicle	No. of vehicle	Capacity	No. of trips per day
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MSW Composition Analysis

Composition of municipal solid waste from Itanagar city was analyzed by segregating a truckload of waste into different constituents like paper, plastic, food, glass etc. and weighing each of them as shown below.

Sl. No	Constituent	Weight in kg	% by weight
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Chemical Composition of Waste

Chemical composition of solid waste is important for processing and recovery of waste. The feasibility of combustion depends upon chemical composition of solid waste. Chemical characteristics of waste are determined by conducting :

1. Proximate analysis: This involves the determination of following parameters:
 - Moisture content
 - Volatile content
 - Fixed carbon and
 - Ash content
2. Ultimate analysis: This involves determination of following parameters:
 - Carbon %
 - Hydrogen %
 - Nitrogen %
 - Oxygen %
 - Sulfur % and
 - Ash %

III. RESULTS

QUANTIFICATION OF MUNICIPAL SOLID WASTE

Currently IMC has employed two types of vehicle viz. a truck of capacity approx. 2000 kg and a mini truck of capacity around 700 kg to carry out the transportation of municipal solid waste from Itanagar and Naharlagun area to the landfill site (Chimpu). The total quantification of waste from Itanagar and Naharlagun are made as follows:

Total Waste Generation from Itanagar:

Table 1: Type of vehicle employed at Itanagar with their capacity and no. of trips

Type of vehicle	No. of vehicle	Capacity	No. of trips per day	No. of trips per week
Truck	3	2000 kg	2	12 (2 x *6 days)
Mini truck	5	700 kg	2	12 (2 x *6 days)

*Sunday being rest day, only 6 working days are considered.

MSW availability from Itanagar:

- Total MSW from truck = $3 \times 2000 \times 2$
= 12000 kg or 12 tonne
- Total MSW from mini truck = $5 \times 700 \times 2$
= 7000 kg or 7 tonne
- Total quantity of MSW from Itanagar per day = $12000 + 7000$ kg
= **19000 kg or 19 tonne per day**
- Total quantity of MSW per week = 19000×6 days
= 1,14,000 kg or 114 tonne
- Total quantity of MSW per year = $1,14,000 \times 365/6$
= **69, 35,000 kg or 6,935 tonne per year**

Total waste generation from Naharlagun:

Table 2: Type of vehicle employed at Naharlagun with their capacity and no. of trips

Type of vehicle	No. of vehicle	Capacity	No. of trips per day	No. of trips per week
Truck	3	2000 kg	2	12 (2 x *6 days)
Mini truck	5	700 kg	2	12 (2 x *6 days)

* Sunday being rest day, only 6 working days are considered

MSW availability from Naharlagun:

- Total MSW from truck = $3 \times 2000 \times 2$
= 12000 kg or 12 ton
- Total MSW from mini truck = $5 \times 700 \times 2$
= 7000 kg or 7 ton
- Total quantity of MSW from Naharlagun per day = $12000 + 7000$ kg
= **19000 kg or 19 tonne per day**
- Total quantity of MSW per week = 19000×6 days
= 1,14,000 kg or 114 tonne
- Total quantity of MSW per year = $1,14,000 \times 365/6$
= **69, 35,000 kg or 6,935 tonne per year**

Hence, total Municipal solid waste from twin capital city viz. **Itanagar and Naharlagun** came out to be **38,000 kg or 38 tonne per day**.

MSW COMPOSITION ANALYSIS

The observed weight of different constituents of municipal solid waste from Itanagar and Naharlagun are computed below.

Composition of waste from Itanagar:

Compositions of municipal solid waste from Itanagar are as follows:

Table 3: Composition of MSW of Itanagar

Sl. No	Constituent	Weight in kg	% by weight
1	Food waste	1525.56	76.86
2	Paper/cardboard	68.87	3.47
3	Plastics	218.93	11.03
4	Textile	36.12	1.82
5	Leather/Rubber	16.08	0.81
6	Wood	9.13	0.46
	In-organics		
7	Glass	15.48	0.78
8	Metals	8.13	0.41
9	Others	86.53	4.36
	Total	1984.83	100

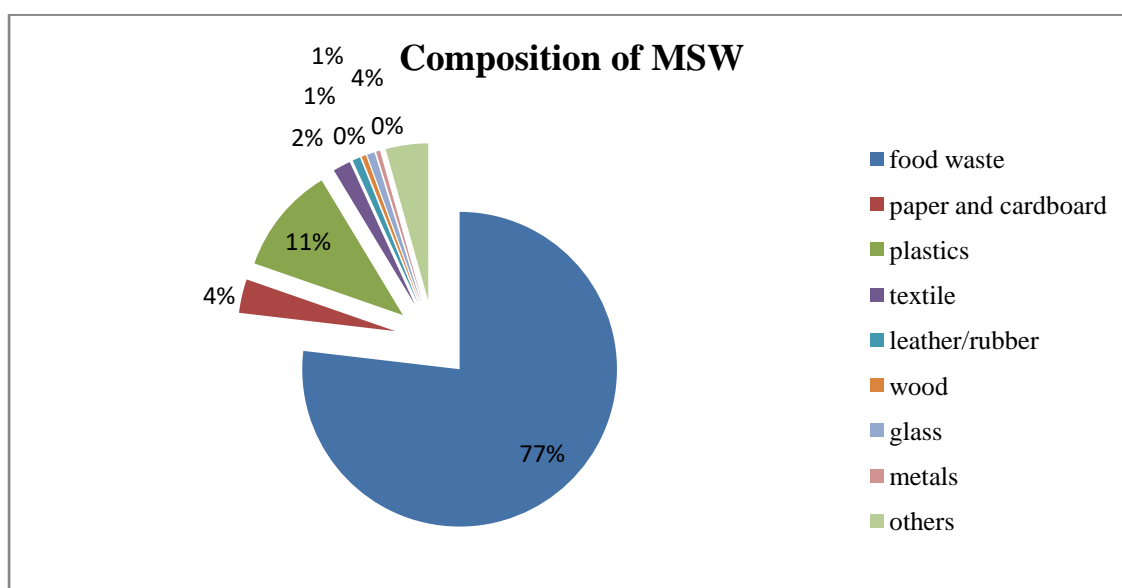


Figure 2: Pie chart showing composition of MSW from Itanagar

Composition of waste from Naharlagun

Compositions of municipal solid waste from Naharlagun are as follows:

Table 4: Composition of MSW of Naharlagun

Sl. No	Constituent	Weight in kg	% by weight
1	Food waste	1577.26	75.74
2	Paper/cardboard	109.75	5.27
3	Plastics	212.41	10.2
4	Textile	41.86	2.01
5	Leather/Rubber	32.07	1.54
6	Wood	5.83	0.28
	Inorganics		
7	Glass	19.58	0.94
8	Metals	5.00	0.24
9	Others	78.72	3.78
	Total	2082.48	100

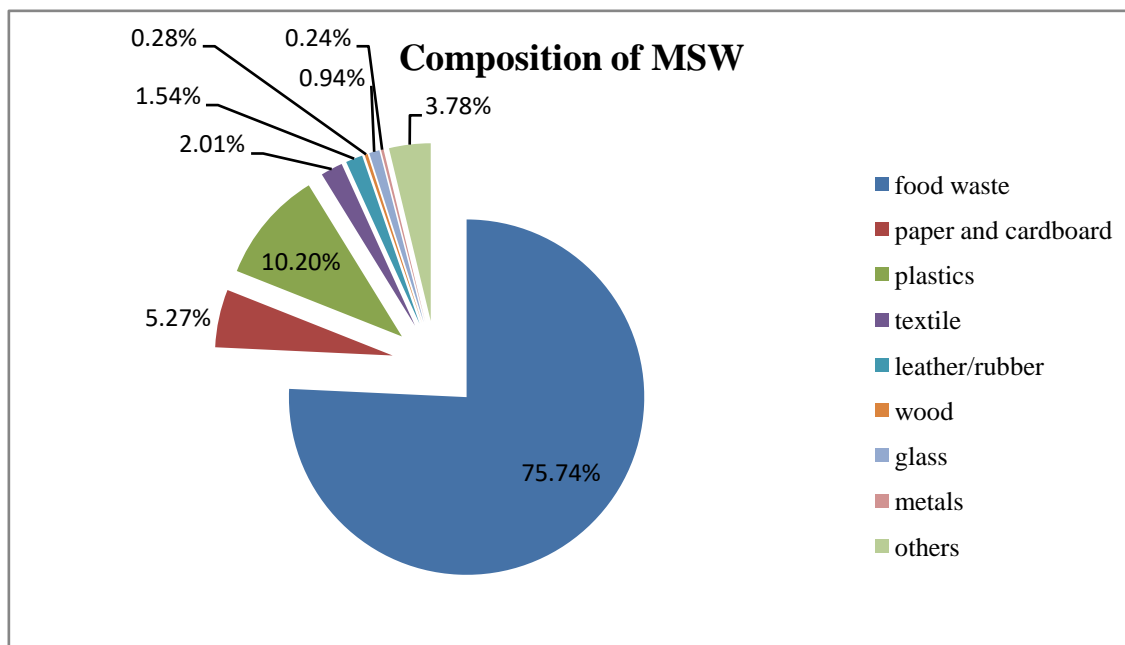


Figure 3: Pie chart showing composition of MSW from Naharlagun



Figure 4: Segregation of MSW at Chimpu landfill site

IV. DISCUSSIONS AND CONCLUSIONS

MSW composition and quantity

It has been found out from our study that about 38 tonnes per day of MSW is being generated and landfilled from Itanagar city every day. About 19 tonnes per day of waste from each Itanagar and Naharlagun area. The waste from the city mostly comprised of organic part. The average composition of waste is being tabulated in table 5. The waste includes 76.3% food waste, 4.37% paper and cardboard, 10.62% plastics, 1.92% textile, 1.18% leather, 0.37% wood, 0.86% glass, 0.33% metals, and 4.07% others including inert materials.

Table 5: Average composition of MSW of Itanagar and Naharlagun

Sl. No	Constituent	% by weight
1	Food waste	76.3
2	Paper/cardboard	4.37
3	Plastics	10.62
4	Textile	1.92
5	Leather/Rubber	1.18
6	Wood	0.37
	In-organics	
7	Glass	0.86
8	Metals	0.33
9	Others	4.07
	Total	100

As municipal solid waste is a heterogeneous mix its generation rates and composition may vary from time to time according to local economy, industrial development and local conditions. The field work for the study on MSW of Itanagar was conducted during the months of January and February 2016. From composition analysis of MSW it is seen that MSW of Itanagar capital complex contains organic waste as the major component and therefore, best means for MSW management is composting of MSW and recovery of energy from MSW. But other parameters such as moisture content, net calorific value etc. will have to be considered for deciding the best solution for the management of MSW.

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