

SOLID WASTE MANAGEMENT PRACTICES OF SYLHET CITY

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ABSTRACT

Solid waste management has become a major issue all around the world. The amount of toxic waste is rapidly engulfing the environment. Sylhet City Corporation is one of the 12 existing city corporations in Bangladesh, with an area of 26.5 km² and the population currently estimated at 602,235 with a growth rate of 1.37%. The population is ever-increasing with each passing year. As like the other major cities, the amount of solid waste generated here is worrisome. The SW generation rate is significantly rising in several parts as a result of people drifting to the Sylhet City from the neighboring districts, as well as from all over the country. The rapid population growth and its unplanned progression are greatly attributed to per capita SW production and improper management tactics. Ergo, it became requisite now to study the SWM practices of Sylhet City. Therefore, this research was executed to explore the established Solid Waste Management system of Sylhet City, and to compute the quantity of overall Solid Waste that is being produced daily. The qualitative and quantitative data were accumulated through feedback assessment (e.g. questionnaire) forms. It was discovered that the Solid Waste generation rate is somewhere around 432 tons/day in the Sylhet City Corporation area, and it includes 2 tons/day of tea wastes produced by the tea gardens in Sylhet City which is burned and dumped by the concerning authority. Retracting that amount, and with an additional 20% incurring loss by City Corporation while collecting, the actual collection is almost 370 tons/day. The per capita SW generation rate is 0.71 kg/day/person. Each day Sylhet city also produces 1.3 tons of clinical waste. The recyclable amount and the reused amount are 65 tons/day and 2 tons/day respectively, while the disposed amount is almost 303 tons/day. This waste toxicity is becoming a problem for public health issues due to a lack of poor regulation, inappropriate management, and development theme. Better and necessary steps could be taken to properly manage the SWM system.

Keywords: SWM, SWM practices of Sylhet City, SW generation rate, 432 tons/day, inappropriate management.

1. INTRODUCTION

The unnecessary or worthless solid materials produced by human activity in residential, commercial, or industrial environments are referred to as solid waste. There are three possible categories for it. According to its:

- origin (domestic, industrial, commercial, construction or institutional)
- contents (organic material, glass, metal, plastic paper etc.)
- hazard potential (toxic, non-toxin, flammable, radioactive, infectious etc.).

Waste cannot be avoided because it is a byproduct of regular human activity such as domestic chores, business, industry, agriculture, natural and man-made disasters, and health care.

Waste is defined as "any solid, liquid, gaseous, radioactive substance, the release, disposal, and throwing away of which may cause deleterious changes to the environment". (The Bangladesh Environment Conservation Act, 1995)

The term "solid waste management" describes how solid wastes are stored and disposed off. The collection, transportation, treatment, and disposal of waste are all parts of waste management. Since waste is a major issue that affects every civilization, solid waste management is also a long-standing practice. Bangladesh has had a traditional waste management system since its independence in 1971. Early strategies for regulating trash in Bangladesh included indiscriminate open dumping, burning, disposal of waste into bodies of water, landfilling, and direct disposal into rural agricultural land. Bullock Cart was put to use to handle the gathering of night soil for solid waste. The nation transitioned from an outdated to a proficient waste management system as time passed on. (Md. Ashikuzzaman, 2019)

A significant barrier to sustainable development is the rapid growth in urban population and industrialisation, which are severely straining our natural resources. In most regions, including Sylhet City, disorganized waste management and dumping are a prominent factor to the deterioration of the environment.

The Sylhet city's population growth rate is particularly 1.37% from 2022. The primary challenges to solid waste management in Sylhet, a rapidly developing metropolis, are the city's quickly growing industry, a lack of financial resources, insufficient skilled workers, improper technology, and a lack of community awareness.

The management of home solid waste under SCC monitoring is the primary focus of this study. Industrial, demolition, and construction rubbish as well as hazardous waste aren't deemed to be part of municipal solid waste and are instead handled separately by Sylhet City Corporation.

1.1 Objectives of The Study

These are the precise objectives of this study:

- To compute the volume of total solid waste and recyclable solid waste and its generation rate.
- To investigate the existing SWM system of the city and to compute the per capita waste generation.
- To develop a mass balance of the SWM system in the city.

2. METHODOLOGY

The overall methodology used in the study in order to reach the objectives of the study is as follows:

- i. Selection of Study Area
- ii. Structured Questionnaire Survey
 - Waste Collectors
 - Recycling Shops
 - House Holds
- iii. Data
- iv. Data Analysis
- v. Determination of Recycling Performance

2.1 Structured Questionnaire Survey

The facts and data of the current waste management system were collected through a series of questionnaires for waste collectors and recyclables companies.

2.1.1 Waste Collectors

Waste collectors were categorised based on their technique of waste collection, mode of transportation, gender, and age. To learn more about waste collectors' recycling efforts, including the type, amount, and selling prices of the waste they collected, as well as their collection and selling locations, questions were asked using a questionnaire form. The daily wages and living arrangements of the waste collectors were also stated. The following were some of the questions posed in indirect interviews:

- i. How are the recyclable waste materials collected?
- ii. How much does it cost to buy and sell the waste they collect?
- iii. Who do they sell to?
- iv. What is the average daily collection?

2.1.2 Recyclable Waste Collection Shops

Small, medium, and large categories were used to group the recycling waste collecting businesses. The type of recyclable solid waste (RSW) collected and processed served as the basis for the classification of recycling businesses. Through a field survey and direct calculating, the number of quantity shops was determined. The disposition of nine stores in the same category (medium) to participate in interviews, take photos, and provide feedback was evaluated. Information was collected regarding RSW's types, amounts, prices, and locations for buying and selling. The number of waste collectors in the category that supplied them with RSW and the number of employees involved in their collection activities were also disclosed. Averages of RSW collection/processing, buying and selling prices of RSW, and shopkeepers were computed using data based on the interviews. By estimating the averages of the collected data, the total amount of recycling and the total number of participants were determined. The following were some of the questions posed in indirect interviews:

- i. How much recyclable waste do they collect daily?
- ii. What types of waste do they collect?
- iii. What method do they use to gather recyclable waste?
- iv. What do they do with the wastes?
 - v. What is the cost of buying and selling?
 - vi. Where do they sell/send the recyclable waste to?
- vii. How much loss tends to happen during the collecting process?
- viii. Who is the recyclable solid waste supplier?
- ix. What do they do after they purchase RSW?
 - x. What is the average daily collection of various types of materials?
- xi. Is there a need for waste pre-processing?

2.1.3 Households

To find out household views on recycling and their actual participation, a household survey was carried out. A home survey was undertaken to get an overview of SWM system participation. 250 households in total were surveyed. The following were some of the questions posed in indirect interviews:

- i. What are the interviewee's name and address?
- ii. How many family members are there?
- iii. Which types of garbage do they usually generate?
- iv. How much garbage is generated every day?
- v. How do they get rid of the garbage?
- vi. Do they keep sellable solid recyclable garbage in storage?
- vii. Who do they sell to?
- viii. What is the selling price of the recyclable item?

2.2 Data

Data can be split into two categories for the purposes of this study: primary data and secondary data. A systematic questionnaire survey was used to collect primary data, including opinions and information about recycling programs from waste collectors, recycling shops, industry workers, and homes. The office of the Sylhet City Corporation was approached for secondary information.

2.2.1 Data Analysis

The collected data were initially categorised in accordance with the study's goals. A simple and straightforward analysis of the data was adopted. The most significant elements were documented, classified, and categorised from the information acquired from observation and interviews.

2.3 Socioeconomic Status

There are 27 wards in the area of study region, all of which have dense populations. The majority of participants were low-wage employees who frequently worked in recycling and waste management facilities. The temporary workforce was split between men and women, with 87% of males and 10% of women. Additionally, 3% of the labor force was made up of kids. Men's ages ranged from 20 to 65, women's ages from 20 to 40, and kids' ages ranged from 8 to 15 years old. Depending on working hours and job availability, the daily wages for males ranged from TK 450 to 500 (US \$4.1-4.56), for women from TK 350 to 400 (US \$3.19 to 3.65), and for children from TK 250 to TK 350 (US \$2.28 to 3.19). The amount of solid waste generation at present is reflected in the socioeconomic position of the dealer. Dealers' earnings ranged between TK 15000–20000 (US \$136.7–182.24) in terms of their ability to invest and gather waste. The education levels of the labor force and the owners were found to be elementary level and HSC level, respectively.

2.4 Waste Quantification

A given area's current SW generating situation is reflected in waste quantification. It is the most accurate way for figuring out how much waste is produced generally from the perspective of the stuff that the categorised waste shop gathers each day. According to the City Corporation, the waste collector and feriwala are responsible for collecting the majority of the waste in the neighborhood. It was found that waste collectors in Sylhet were particularly interested in collecting demand-based waste, such as plastic, metal, polythene, rubber, tin, glass, and paper, from roadside trash cans, near market garbage bins, bus and truck stops, and other locations.

There are various kinds of recycling waste collecting shops in Sylhet City. There are more than 100 recyclable waste collection shops in the city. To collect data, 10 of the largest stores were located and surveyed. About 15 tons of plastic, 8.6 tons of metal, 1.1 tons of paper, and 1.15 tons of glass are collected daily by these ten stores. The average amount of recyclable waste was found to be high in more than 100 other collecting stores. The majority of waste collectors claim that plastic waste

collecting is more efficient and convenient than other types of waste collection. Additionally, because metal waste sells for a high price, it is an important concern in the waste management sector. A number of businesses were found to be gathering scrap steel and iron. They collected about 1.5 tons every day.

2.4.1 Waste Collecting Approach

Due to socioeconomic activity and population growth in the study area, the rate at which solid waste is produced has grown. A person's lifestyle determines how much they earn and how much they consume, which could result in a higher rate of waste generation. A few waste products, including paper, have decomposed into several parts in the presence of biodegradation processes at the source as a result of inadequate management at the waste collecting shop. Additionally, some of them have been lost for a number of reasons. The categorical component of waste generation rate gradually increases to its highest peak when compared to developed nations. Based on market demands, different types of solid waste are collected from garbage collectors and other sources at various costs.

2.5 Medical Waste Processing

An average of 1.3 tons of clinical waste gets generated each day. A different organization other than the City Corporation is in charge of collecting these garbages. Medical wastes must be treated carefully while being disposed of since they are highly dangerous and contagious. The responsible authority collects trash from 160 clinics located around the city, making sure the waste is handled very carefully. For efficient collecting, they follow a few processes. They are as follows:

- i. They instruct the clinics to collect waste using 4 distinct containers, each of which is colored differently.
- ii. The bins are coloured as Blue, Yellow, Red and Black.
- iii. Liquid wastes (blood, bodily fluids, etc.) are collected in the Blue bin, hazardous wastes (worn gloves, catheters, etc.) are collected in the Yellow bin, sharp objects (needles, blades, scissors, etc.) are collected in the Red bin, and regular waste (food, polythene, paper, etc.) is collected in the Black bin.

2.5.1 Medical Waste Dumping

The relevant authorities make sure that the medical waste is disposed of safely. They follow the following strict procedures:

- i. **Red Bin:** A machine with an incinerator burns the contents of the Red bin at a temperature of 800° to 1200°.
- ii. **Yellow Bin:**
 - i. An autoclave machine boils the damp trash in this bin to a temperature of 135° before it is properly discharged.
 - ii. After being incinerated by an incinerator, the dry wastes are dumped.
 - iii. The waste, which includes body wastes from people, is buried underground.
- iii. **Green Bin:**
 - i. Three chambers with chlorine are used to wash the contents of this bin. To ensure that the waste is not reused, it is broken into numerous little pieces after being washed.
 - ii. This bin's liquid waste is disposed of through effluent treatment.

The concerning authority collects the clinical wastes throughout the city, between 8 am to 2:30 pm. It was observed that Sylhet MAG Osmani Medical College provides the most clinical waste, followed by Ragib-Rabeya Medical College and IBN-Sina Hospital.

It should be noted that the North-East Medical College is not within their control because they opt to manage their own garbage. The medical college administration gave us an estimate of roughly 40 kilograms every day.

2.6 Standing Landfill Condition

The one and only landfill site used by the SCC is situated in Lalmatia, Mogla bazar, Sylhet. Lalmatia site is about 1-15 ft. below the existing road level, fully marshy and located about 5 Km away from the city center. Here, some of the scavengers stealthily collect some types of waste and sell those to make their livelihood. But this kind of waste sorting is not allowed by the authority. A noticeable thing is that in the landfill, wastes are openly burnt either partially or completely to reduce the volume which is very detrimental to the environment.

It is worth mentioning that, there is a separate space in Lalmatia landfill for the dumping of medical waste and some of the wastes are segregated by the workers. (Ara S., 2021)

3. ILLUSTRATIONS

3.1 Figures and Graphs

3.1.1 Selection of Study Location

The SCC is currently divided into 42 wards, with the addition of 15 new wards to the existing 27 wards. The newly added wards, on the other hand, were quite rural, and the city corporation has yet to begin collecting their waste. They now have jurisdiction over only 27 wards. Nonetheless, they have stated that they will begin waste collection in the newly selected wards as soon as possible.

Therefore, this study is based on the 27 pre-existing wards.

Preliminary surveys were carried out to locate stores that collect recyclable material. It was discovered that the distribution of the city's collecting shops and businesses is not uniform. Several large companies gather all of the city's plastic, metal, etc. The location of the study is shown on a map of Sylhet City Corporation in Figure 1.

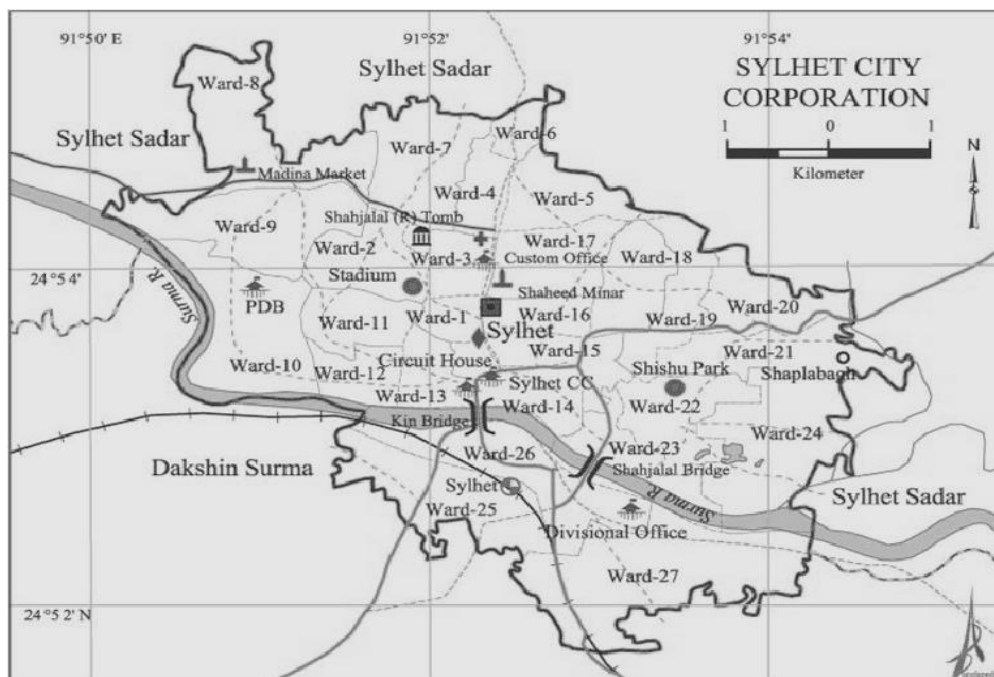


Figure 1: The study area

3.1.2 Solid Waste Generation in Sylhet City

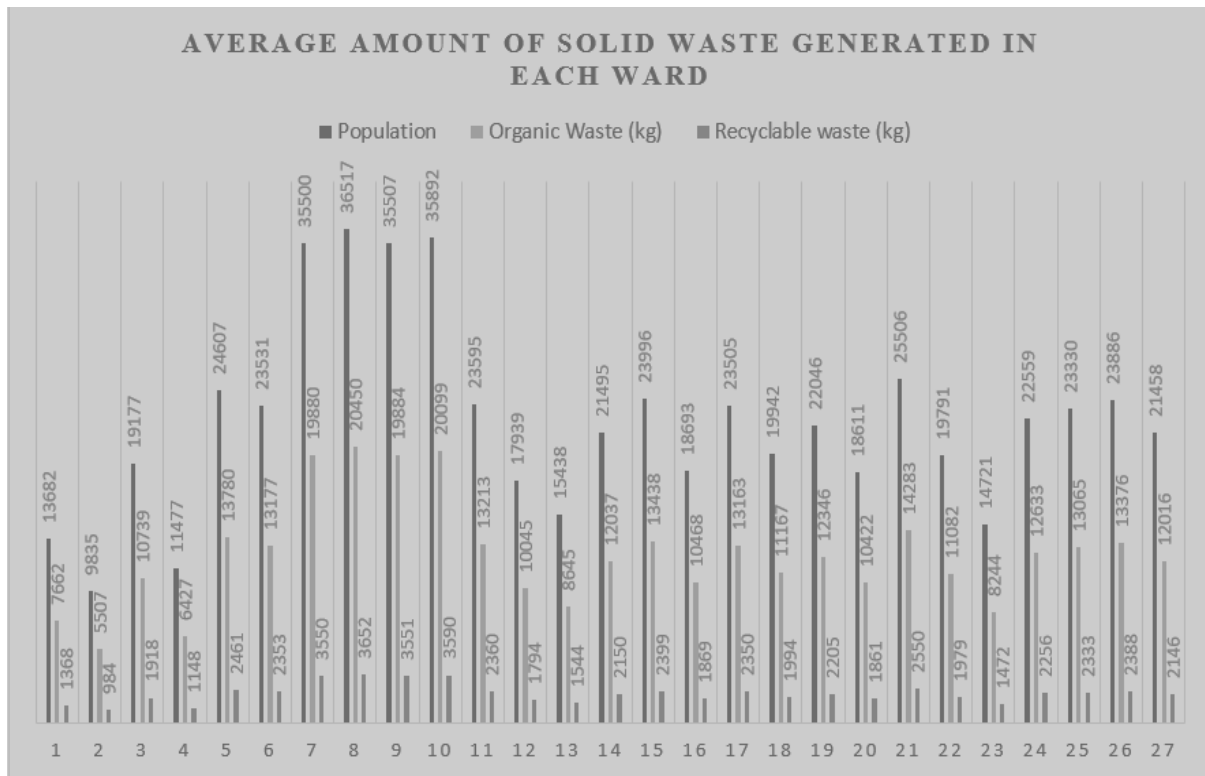


Figure 2: Percentage of waste generation of different types in Sylhet City

3.1.3 Different Types of Waste Generation in Sylhet City

The production of solid waste was calculated to be 432 tons per day. With 78.7% coming from food and vegetables, 9.25% from plastics, 2.3% from metals, 1.15% from paper, 2.3% from a combination of glass, textiles, and wood, 0.3% from clinical waste, and 0.45% from tea waste.

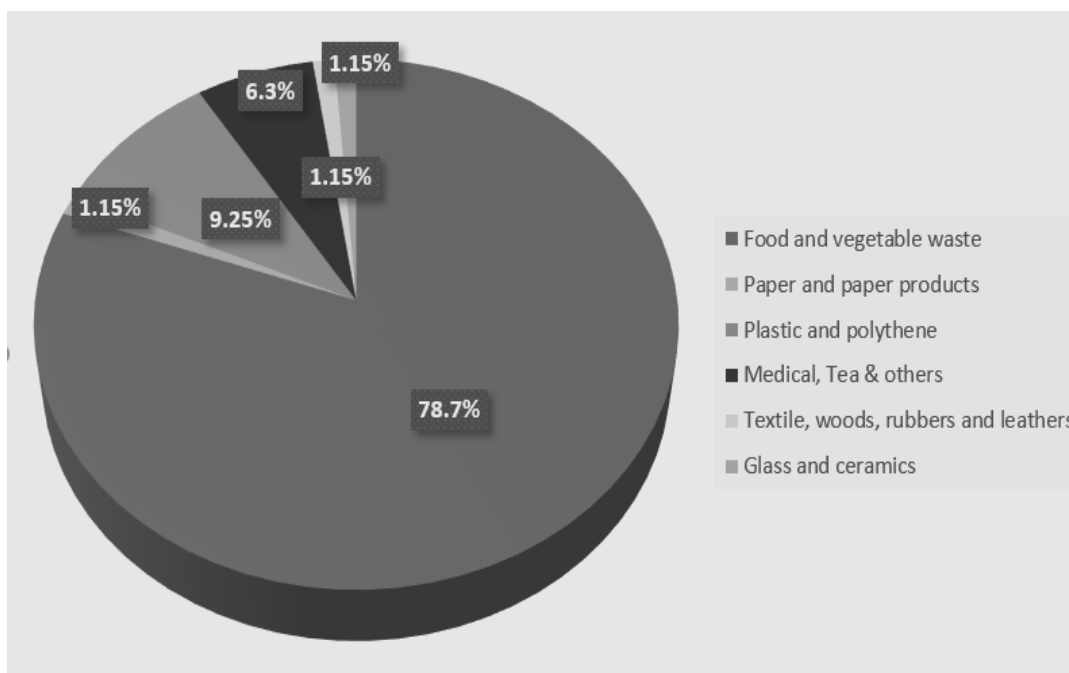


Figure 3: Percentage of waste generation of different types in Sylhet City

3.1.4 Waste Management and Recycling Approach

Waste is prepared for reuse or transformation into a different shape at recycling waste collection facilities around the study area. 2 tons of products are collected daily to be reused. There are 1200 kg, 400 kg, 200 kg, 50 kg, and 150 kg of plastic, metal, glass, textile and wood every day respectively. Recycling and ultimate use of garbage instead of disposal may aid in restoring the environment's natural equilibrium. The majority of shops collect recyclable waste directly from waste collectors. Mostly, they collect recyclable and non-biodegradable waste, which is afterwards shipped to Dhaka and foreign to be recycled into new items. While the majority of recycling is done in Dhaka and abroad, most local recycling waste collection stores focus on washing, drying, and cutting garbage.

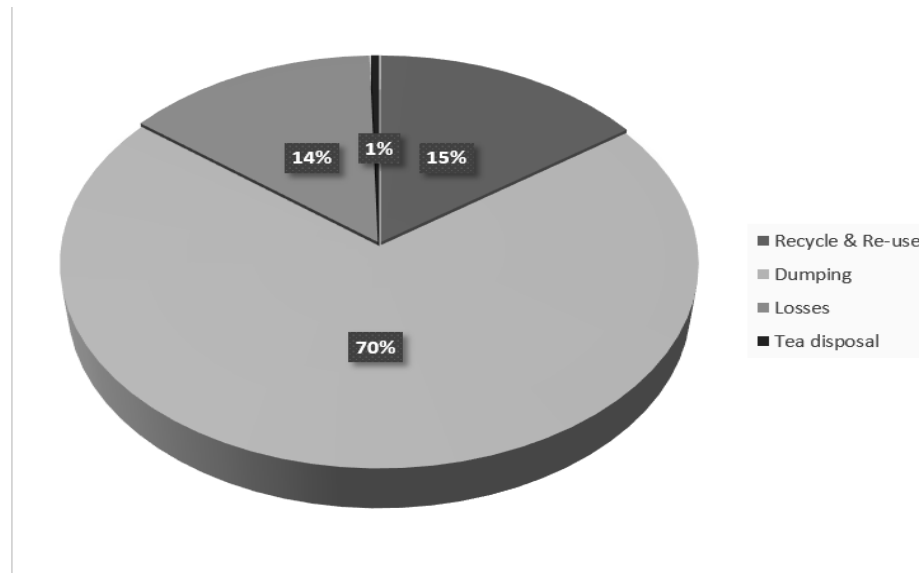


Figure 4: Management scenario (in percentage) of existing SW in Sylhet City

3.1.5 Mass Balance

Sylhet City Corporation generates 432 tons of total solid waste each day. On a daily basis, 303 tons of waste are disposed of directly to the Lalmatia dumping center, while 65 tons of waste (plastic, paper, metal components, glass, textile, and others) are collected for recycling. And the amount of re-used product is approximately 2 tons every day. Every day, 60 tons of waste are lost in this SWM system.

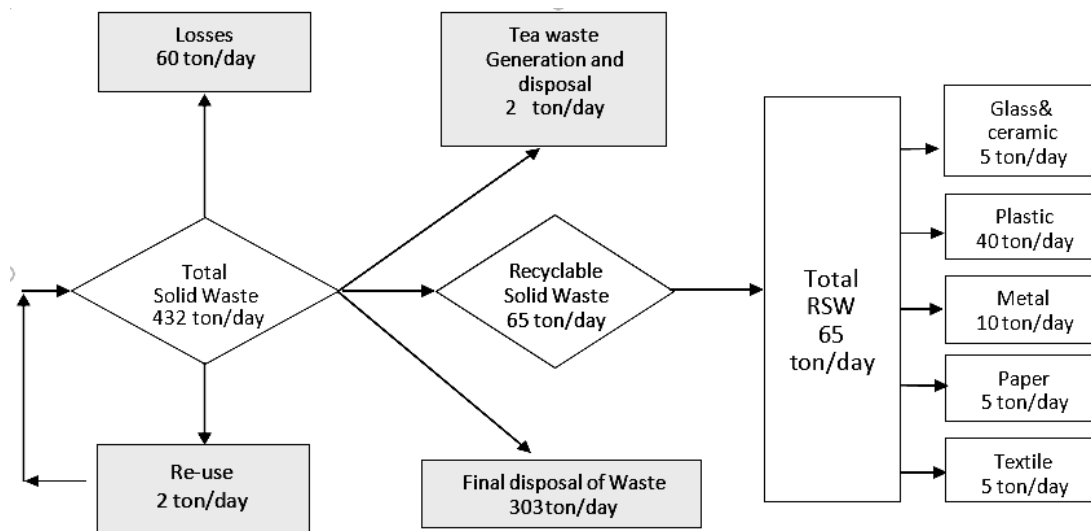


Figure 5: Schematic mass balance of recycling activities of Sylhet City

3.2 Tables

3.2.1 Waste Composition in Sylhet City Corporation

Several studies have been conducted to determine the waste composition of Sylhet. Table 1 shows the percentages of different solid waste compositions based on kg & percentage of total weight.

Table 1: Physical composition of solid waste generated in Sylhet City per day

Waste types	Amount (kg)	Weight (%)
Food & Vegetable waste	340,000	78.7
Paper & Paper products	5000	1.15
Plastic & Polythene	40,000	9.25
Medical	1300	0.30
Tea	2000	0.45
Metal	10,000	1.15
Glass & Ceramics	5000	2.30
Textile & Woods	5000	1.15
Others	24000	5.55

3.2.2 Various Recyclable Products collected in Different Stores

Sylhet City has a wide range of recycling waste collection shops. The city has more than 100 recyclable waste collection sites. To gather data, ten of the largest stores were selected and surveyed.

Table 2: Amount of various collected recyclable products in different 10 stores (daily)

Stores	Plastic (kg)	Buying price (tk)	Selling price (tk)	Glass (kg)	Buying Price (tk)	Selling Price (tk)	Metal (kg)	Buying price (tk)	Selling price (tk)	Paper (kg)	Buying price (tk)	Selling price (tk)
1	10000						5000					
2	3000											
3	1000			150			2000			250		
4	500			200			1500			150		
5	1200	15	20		6	7	1800	35	40	200	12	15
6	800			150								
7	1000			300			1000			150		
8	1000			200			1500					
9	500						800			150		
10	1000			150			5000			200		

3.2.3 Solid Waste Generation in Each Ward

An attempt was taken to compute the average solid waste generation in the 27 wards. These are the average amount of solid waste generated from each wards.

Table 3: Average amount of solid waste generated from each wards

Ward No.	Population	Organic Waste (kg)	Recyclable waste (kg)
01	13682	7662	1368
02	9835	5507	984
03	19177	10739	1918
04	11477	6427	1148
05	24607	13780	2461
06	23531	13177	2353
07	35500	19880	3550
08	36517	20450	3652
09	35507	19884	3551
10	35892	20099	3590
11	23595	13213	2360
12	17939	10045	1794
13	15438	8645	1544
14	21495	12037	2150
15	23996	13438	2399
16	18693	10468	1869
17	23505	13163	2350
18	19942	11167	1994
19	22046	12346	2205
20	18611	10422	1861
21	25506	14283	2550
22	19790	11082	1979
23	14721	8244	1472
24	22559	12633	2256
25	23330	13065	2333
26	23886	13376	2388
27	21458	12016	2146

3.2.4 Solid Waste Generation in Restaurants

Restaurants are a great source of solid waste generation as they produce a lot of different types of waste on a daily basis; such as foods, scraps, leftovers, tissues, plastics etc.

Table 4: Solid waste generated by 5 of the top restaurants (daily)

Restaurant Name	Organic Waste (kg)	Plastic (kg)	Paper (kg)	Glass (kg)	Total Amount (kg)
Panshi (Zindabazar)	873	20	5	2	900
Panshi (Kodomtoli)	290.5	7	2	0.5	300
Panch Bhai	776.5	18	4	1.5	800
Rajbari	384.5	12	2	1.5	400
Palki	282.5	7	10	0.5	300

3.2.5 Energy Generation Opportunity

Untreated municipal solid waste is being viewed as a valuable commodity to meet the energy requirements of the upcoming generations. Shashank Mathur et. al., showed with the anticipated global shortage of the non-renewable resources and the increasing demand for the renewable resources solid wastes are ripe for exploitation. WTE applications are being implemented worldwide and extracting energy from the waste. Approximately 130 million tons of municipal solid waste are being treated annually in more than 600 waste to are operating which are fueled by 27 million tons of municipal solid waste annually energy (WTE) facilities around the world to produce electricity to produce heated steam for district heating. Table 5 provides a range of electricity produced (expressed on a kWhr per ton basis) observed in operating facilities using a range of technologies. Energy output from the WTE facilities is generally a consistent source of power because of the regular and consistent supply of waste feedstock.

Table 5: Reported Electricity Production Ranges for various WTE Technologies

Technology	Electricity Production Range (kWhr/ton)
Conventional - Older	500 – 600
Conventional - Newer	750 – 850
Gasification	400 – 800
Plasma Arc Gasification	300 – 600
Pyrolysis	500 – 800

For the organic fraction of municipal solid waste in an anaerobic digestion system biogas yields of 80-200 m³ per ton (Mes, 2003) and this is the most environmentally friendly technology that produce energy as well as fertilizer for the plant and less carbon emission also. (Md. Ashraful Islam, 2017) (Mathur S.)

Sylhet city corporation dispose more than 300 tons of solid wastes daily. That amount of waste could be turned into renewable energy, which will benefit the people and the city greatly. The authority

must look at this as an opportunity and grab it soon. A huge amount of potential energy shouldn't be overlooked.

4. CONCLUSIONS

The study can be concluded as the following:

- i. Total quantity of waste generated in Sylhet City is found to be 432 tons/day.
- ii. The per capita waste generation rate is 0.71 kg/day/person.
- iii. The amount of total recyclable solid waste collected is 65 tons/day.
- iv. The percentage of recyclable solid waste is 15% of total solid waste.
- v. The percentage of reusable solid waste is about 0.5% of total solid waste.
- vi. The amount of clinical waste generated is 1.3 tons/day.
- vii. The tea garden waste generation rate is 2 tons/day.
- viii. The loss of waste during collection is about 20%, which amounts to roughly 60 tons of everyday collection.

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