

SOLID WASTE MANAGEMENT OF SYLHET CITY IN TERMS OF ENERGY

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Abstract - Civilization and industries are undoubtedly dependent on energy. The fossil fuel with very inadequate resources contributes this huge amount of energy requirement. As the nonrenewable energy sources are being scarce due to non-restricted urbanization and unplanned construction, renewable sources of energy need to be considered. Waste-to-energy by incinerating the waste are equipped with the latest in combustion and pollution control technologies to keep emissions and toxins below the hazard. Solid waste generation had reached to the value of 215 tons/day on the basis of per capita waste generation 0.430 kg/day in Sylhet city. With the aim of investigating the present scenario of solid waste management, adverse impacts of pollution and integration of viable energy technology to the management system, the study has been carried out. The existing policies have been analyzed with particular references to Sylhet as a case study to find out an effective and sustainable way of solid waste management. Waste minimization, segregation of waste, sound waste collection, participation of community based organizations (CBOs), composting and energy generation were integrated to manage an economical and ecological enrichment. This paper also focused on some guidelines towards appropriate solid waste management and feasible conversion to energy that can be suggested to concern authorities that would assist them to take comprehensive plan.

Key words: Solid waste, pollution, energy, management, and environment

1. INTRODUCTION

“Solid waste” (SW) management is one of the important problems in Bangladesh. Rapid urbanization, population growth, changes in the cities, social life and economic development, increasing speed and income levels in urban areas has increased the amount of solid waste per capita. In this case, an effective solid waste management in municipalities make inevitable. Though solid waste management is a very complex process, a lot of methods are considered here. But energy and materials recovery could be the best choice. The SW management in Bangladesh including collection, disposal, and recovery is difference with other countries in the world, due to the different type and quality of SW management. The concept of sustainable solid-waste management in term of energy is the application of the best basic principles of waste management, which is highly dependent on the natural resources of destination areas without creating any serious environmental and social problems as well as ensuring safety and cost effectiveness.

Sylhet, the edge of the river surma is the north eastern city of Bangladesh. It is located at 24°53' N latitude and 91°53' E longitude with an estimated population of 0.6 millions and a high migration rate especially a population growth rate of 4% per annum [1] in comparison to the annual average growth rate of 2.01% in Bangladesh [2]. This increasing population results rapid and mushrooming expansion of waste

products in the city that causes a long chain of hazardous problems. Now-a-days the waste generated per day throughout the city is approximately 190-215 tons.

Furthermore the illiteracy and ignorance of people is making the condition much more severe. This paper mainly focuses on the existing municipal solid waste management system followed by Sylhet City Corporation (SCC) and the problems associated with it. An improved and simple Municipal Solid Waste Management system also proposed for a clean Sylhet city.

2. RESEARCH METHODOLOGY

The study was an exploratory in nature. The main thrust was on primary data, which was based on the in-depth interviews and observations; a small survey was also conducted during data collection.

2.1 Steps of the Study

The study involved the following four steps:

1. Step-1: Selecting the site and scope the research problem.
2. Step-2: Conducting survey, collecting information / data on current energy development situation and perform situational analysis.
3. Step-3: Assessing the existing situation for generating strategies and action plans for sustainable

power development.

4. Step-4: Proposal for strategies and action plans for sustainable conversion of waste to energy.

2.2 Data Collection Methodology

The main intention of this research was designed to gather data, collect information and analyze the information to support the objectives to encourage sustainable waste conversion in Sylhet city. The methodology is shown on Figure 1.

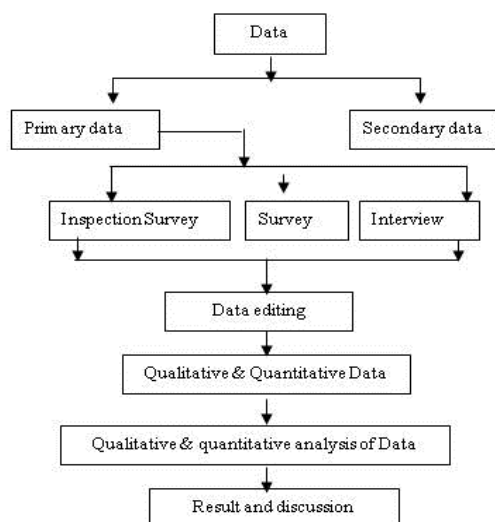


Fig. 1: Schematic view of types, sources, processing and analyzing of data

2.3 Analysis

2.3.1 Checklist for Interview

This checklist has been made for the persons who are engaged in government service, corporation, municipalities, engineering services, law associates and others. They are in any way connected with the township plan or aesthetic development of the town. The number of the interviewer was 40. The interview was descriptive in nature. There was ample opportunity to speak very open and frank. They opined on the policy, structure of institution, responsibility and on other important things. The responses were quantitative on one side; on the other hand some responses were qualitative.

2.3.2 Questionnaire for Survey

The questionnaire was made for the people who are the main stakeholder from primary to tertiary level to get a details and transparent view about existing management situation of the city. For collection of data some groups of people were selected. Target group are those people who involve and depend in solid waste recycling, work in solid waste management and poor community living in the vicinity of the dumping spot. Specific question focused on the source of waste, market value, the waste preferred by shop owner, selling area of waste and process of recycling in industry. There are also some people who services in the motel, hotel

and restaurant etc. The number of the interviewer was 100. The main reason of field survey was to calculate the amount of recyclable solid waste in SCC and to calculate the percentage of solid waste has been recycled and to observe the recycling process in factories.

2.4 Study Area

The important spots where the analyses have been conducted are presented in the Table 1. (Source- field survey and SCC)

Table 1: Different spots of study area

spot	location	Waste handling agency	Tons/day	population
CDS-1	Lalmatia	SCC and NGO	197.71	1,277
CDS-2	Rikavi bazar	SCC	28.47	60,317
SDS-1	Eidgah	SCC	15.91	30,672
SDS-2	Madina market	SCC	17.27	37,751
CODS	Bondor-bazar	SCC and CBO	13.65	20,117

CDS- City dumping spot

SDS- Secondary dumping spot

SCC- Sylhet City Corporation

CODS- Commercial dumping spot

3. RESULTS AND DISCUSSIONS

3.1 Characteristics of Solid Waste in Sylhet City

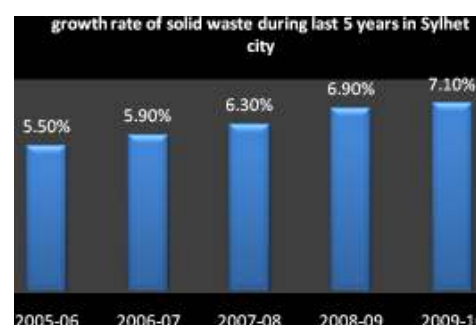


Fig. 2: Growth rate of solid wastes for last 5 years

A survey on solid waste generation rate and physical composition analysis found that per capita solid waste generation rate in Sylhet city was 0.430 kg/cap/day with the 215 tons/day of solid waste generation. The growth rate of solid waste materials over last 5 years in SCC area is shown on Figure 2 (According to SCC waste report).

It is evident from the above figure that average increase in solid waste was 7.1% during the last year, which was the maximum growth rate for last five years. The average growth rate was estimated as 6.34%. The

nature of the solid waste in Sylhet was low-calorific value, excessive moisture content with high quantity of non-combustible property.

The basic sources of solid waste were studied on the basis of industrial and residential purposes. The sources of solid waste are shown on the Figure 3 [3].

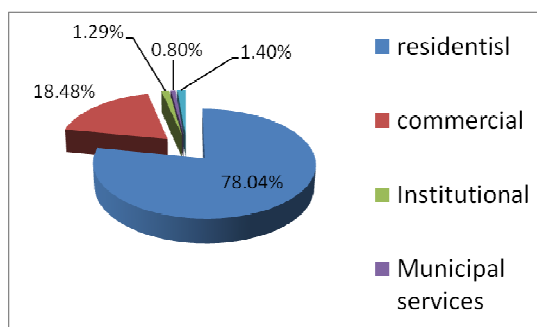


Fig. 3: Different sources of solid waste materials

There is an insignificant variation of composition in MSW at six major cities of Bangladesh. The evident shows that Sylhet is the 2nd largest waste producing city according to MSW generation rate. A comparison based on solid waste is shown at Table 2.

The rapidly biodegradable portion is normally very high compared to other portions, essentially due to the use of fresh vegetables and in absence of food processing industries as revealed in Table (3a, b) [3]. Average Composition of Solid Waste Collected from Different Locations of sylhet is shown on Table (3a, b) (In wet weight %).

Table 2: Comparison of solid waste [3]

MSW Generation	Dhaka	Chittagong	Khulna	Rajshahi	Barisal	Sylhet
Population (Millions)	11	3.65	1.5	0.45	0.40	0.50
MSW Generation (T/D)	5340	1315	520	170	130	215
MSW Generation rate Kg/capita/day	0.48	0.36	0.34	0.37	0.32	0.43

Table 3a: Average solid waste from different locations

Area type	Food and vegetable-s	Paper and paper products	Polythene and plasti-es	Textile and woods	Rubber and leathers
CA	64.27	11.33	2.12	4.53	1.90
IA	55.53	19.97	4.43	0.35	1.70
HIG-R	76.22	10.08	3.32	0.95	0.08
UMIG-R	79.72	4.30	6.42	2.64	0.30
LMIG-R	82.01	7.06	3.32	1.55	0.50
LIG-R	89.25	1.86	1.39	1.38	0.32

Table 3b: Average solid waste from different locations

Area type	Metal and tins	Glass and ceramics	Brick, concrete and stone	Dust, ash and mud products	Others
CA	0.91	1.03	3.05	9.80	1.06
IA	2.04	1.27	2.03	11.61	1.07
HIG-R	0.76	0.56	0.70	4.39	2.94
UMIG-R	3.10	0.84	0.30	1.20	1.18
LMIG-R	1.09	0.67	0.80	1.26	1.74
LIG-R	0.50	0.43	0.90	2.34	1.63

CA: Commercial area

IA: Industrial area

UMIGR: Upper medium income group residential

HIGR: High income group residential

LIGR: Low income group residential

LMIGR: Low medium income group residential

An average physical composition of solid waste in Sylhet is shown on the Figure 4 (According to SCC and field survey).

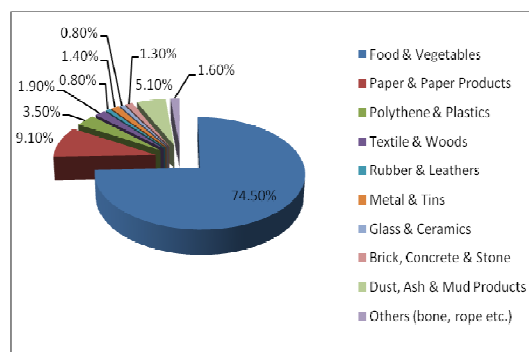


Fig. 4: Average waste composition of Sylhet city

3.2 Scenarios of MSW Management through Recycling and Treatment

Phase 1:

Primary collector → Barterer, van-driver
(From house to house)

Phase 2:

Secondary collector → SCC collector, bin-tokay
(From roads and dustbin)

Phase 3:

Tertiary collector → Dump Tokay
(From final disposal)

Here, phase one is the source separation, where the collectors separate refused of higher market value such as papers and paper products, bottles, fresh containers, plastic materials, tin, glass, metal, old clothes, shoes etc. and sell it to street hawkers.

In the second phase, the poor children of slum dwellers or street children known as “Tokai” collect

different items of low market value from on-site storage bins/containers and open storage spaces. The items include broken glass, cans, cardboard, waste papers, polythene, rags, pet bottles, coconut shells, metals and miscellaneous commercial waste discarded by householders.

The final phase is the recovering of reusable and recyclable materials from final disposal spots (FDS). Scavengers/Tokais are salvaging recyclable wastes mainly when collection vehicles are being unloading at FDS. The present waste management and recycling system is shown in the Figure 5.

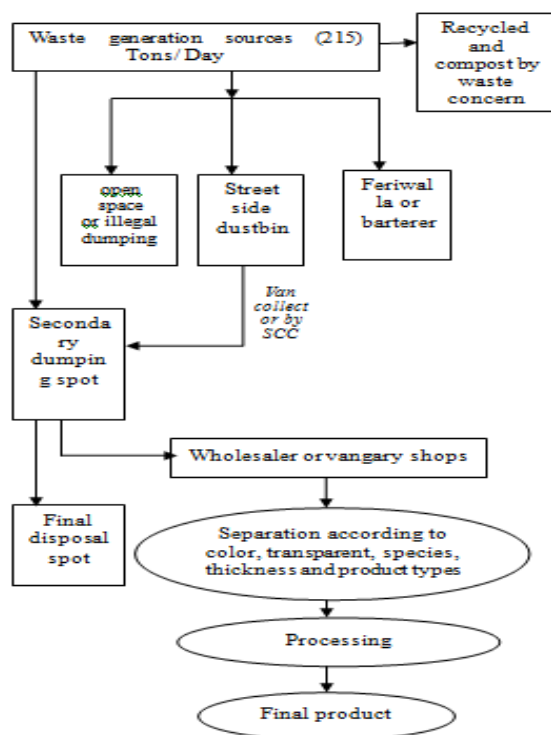


Fig. 5: Present solid waste management and treatment

There is never a permanent solution for solid waste management system [3]. The situation should be handled separately as the situation varies city by city, within different regions of the city and even within different parts of the region. Therefore, SCC is encouraging community based organizations and local NGOs to organize and carryout community waste management program (mainly house to house collection and disposal). It was found in the survey that, if the recyclable materials including organic waste for composting was separated out then the final waste could be reduced by 60% to 80%.

3.3 Situation of Crucial Discarding Site

Despite source reduction, reuse, recycling and composting divert significant portions of MSW, large amount of wastes still need to be placed in landfills. There is no controlled/engineered/sanitary landfill in Bangladesh. The sites are situated in and around the city areas of low-lying open spaces, unclaimed land,

riverbanks and roadsides [4].

Especially in Lalmatia under SCC, crude open dumping sites are always incompatible with the surroundings. Wastes spreads all over the site are unsightly as no proper system maintain for filling the area. Wind blows litter and indiscriminate the waste outside the dumping site and on the surrounding surface water. The study also revealed that every site poses high threat to health and environment as shown in Table 4.

Table 4: Potential threat to health and environment caused by the FDS of MSW in Sylhet [5]

Hazard Point Factors	Lalmatia dumping Spot (LLM)
Waste contents	30
Rainfall	4
Distance to drinking water aquifer	10
Site Drainage	8
Potential to create leachate at site	4
Distance to domestic water source	4
Site accessibility	2
Frequency of burning	2
Site exposure to public & vector	4
Public concern over site esthetics	4
Total points	72

According to Indian Health Service (HIS 1998), the hazard point of LLM was 72 while they classified the hazard level as point 13 for low hazard, 14-29 for moderate hazard and 30 or more for high hazard [3].

Table 5: Physical properties of solid waste in Sylhet city [3]

Physical properties	Properties	Range
	Volatile solids	43 to 71%
	Ash residue	29-57%
	Moisture content	56 to 70%
	bulk density	550 to 1125 kg/m ³
	grain size	2 to 200mm
Chemical chemical properties	pH	7.7 to 8.7
	carbon,	11.50%
	nitrogen	0.91%
	potassium	0.76%
	phosphorous	0.33%

3.4 Scenarios of Existing Solid Waste Management Practice and its Limitations

There is no independent law in Bangladesh to address the problems of solid waste. In Sylhet, the city authorities generally manage MSW through recycling. But the authorities do not support for reusing and reducing the city waste. Even the composting, a great potential sector of waste treatment and minimization considering the nature of solid waste in city, fails to reach desired target due to improper planning [6-8]. During the field survey, it was found that the composting activities have been initiated as organized base (Pilot-scale type) in Sylhet by different organizations like NGOs including a waste concern group associated with SCC and another private group EPCT. But this composting of night soils and other organic wastes in Bangladesh is very trace in amount [9]. This poor treatment of solid waste is

represented by the following Figure 6 (According to SCC and field survey).

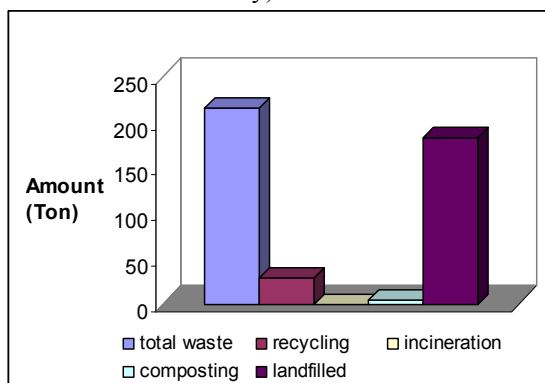


Fig. 6: proportion of various waste treatments

The main problems and limitations of present solid waste management system are analyzed below:

- Tremendous expansion of waste
- Shortage of land for waste disposal
- Inadequate waste collection
- Pollution of surface and ground water
- Unutilized organic waste
- Lack of awareness among citizens
- Lack of partnership between stakeholders
- Lack of institutional arrangement
- Insufficient financial resources
- Inefficient management of land field, manpower, equipment, other resources, unscientific collection
- Absence of by-laws and standards
- And lack of public private partnership (PPP) for waste management

3.5 Health Hazard Involvement

Health risk is involved for both solid waste collector and re-cycler, such as,

Infections

1. Skin and blood infection resulting from direct contact,
2. Eye and respiratory problem resulting from exposure to infected dust
3. Different diseases results from animal biting on the waste ground

Chronic diseases

Incineration operators are at risk of chronic respiratory diseases.

Accident

1. Bones and muscles disorders resulting from the handling of heavy containers.
2. Infecting wounds resulting from contact with sharp objects
3. Poisoning and chemical burn from mixture of chemical hazardous waste with general waste
4. Burns or other injury resulting from occupational accident at waste disposal sites [10].

During manufacturing plastic waste are washed away, it may results wear and tear, breast & uterine cancer and risk of decreasing testosterone level [11]. The chemical poisons in hospital waste can affect different parts of the body.

3.6.1 Proposed flow chart of Municipal Solid Waste Management System

A survey based solid waste management skeleton has been proposed in Figure 7.

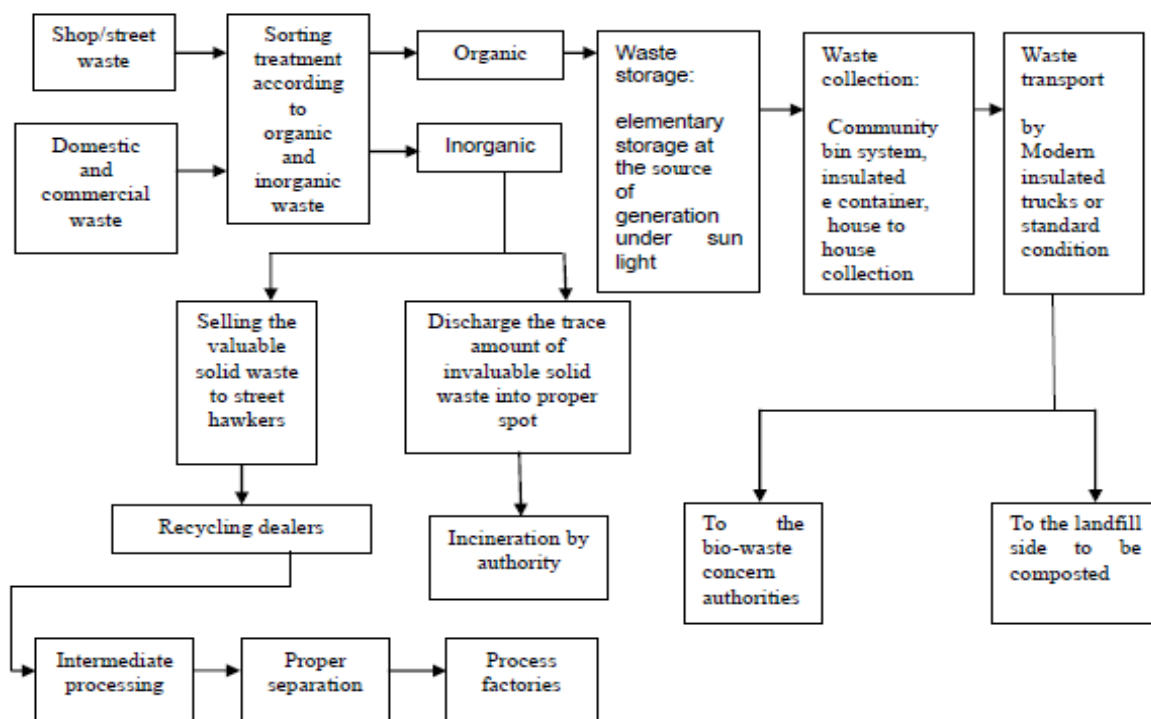


Fig. 7: Proposed diagram of solid waste management of sylhet city

3.6.2 Proposal of waste derived energy system

It is found that nearly 79% of waste in Sylhet City is residential waste; some proposals need to be developed for a better efficient and economic Municipal Solid Waste management system. Municipal Solid Waste (MSW) contains organic as well as inorganic matter and the latent energy present in its organic fraction can be recovered for gainful utilization through adoption of suitable waste processing and treatment technologies. Figure 8 shows the overview of the waste to energy (WTE) process which offers technology to convert MSW into various usable forms of energy [12].

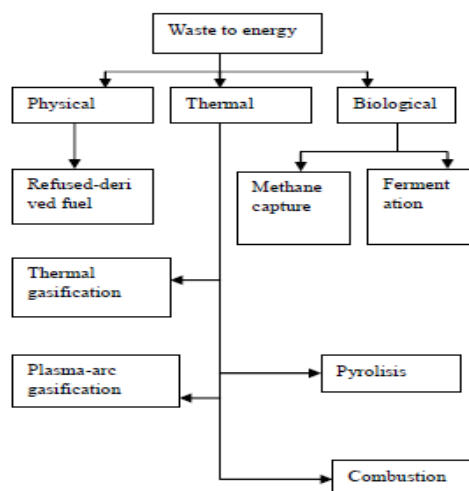


Fig.8: Waste to energy (WTE) process [10].

4. CONCLUSION

The present condition of solid waste management in Sylhet city is below the optimum level. Identifying the collection routes is the most vital work in solid waste management system. Solid waste generation data from this study will help the municipality to divide the total municipal area into different zone according to amount of waste generation and provide easier way to get the basic routes. The study has covered residential solid waste of Sylhet municipality as the main source of the solid waste. The disposal system of wastes and knowledge on health and hygiene, are informing the community about health, hygiene, diseases and impacts on environments. Private-public partnership (PPP) projects may run an effective role in this regard. A sufficient number of dustbins should be constructed and the dustbin site should be selected in such a way that is well distributed throughout the city. A proper sanitary landfill should be designed and used for solid waste dumping rather than open dumping which is being practiced presently. Along with conversion of energy from solid waste can be done through various thermal and biological processes such as pyrolysis, thermal cracking, catalytic cracking, fermentation and complete combustion. Due to the easy installation process and cost-effectiveness, bioconversion of degradable waste should be considered. It will help to achieve an almost zero waste with proper power development.

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