

Seminar Paper on
Solid Waste Management In Dhaka City: Status and Challenges

Submitted To

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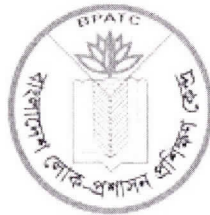
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Abstract

Waste is the object or substance that its holder requires and wants to discard and Waste Management is the collection, transportation, recovery and disposal of the same including the supervision of the total process. Solid Waste (SW) can be classified into two major components i.e. organic waste and inorganic waste. Waste is being created by different human activities like increasing population,

Now 4R method of waste management i.e. Reduction, Reuse, Recycling and Recovery is the best solution worldwide for waste management. Dhaka city is still struggling with its solid waste management scenario and modernization of that is a quick necessity. For finding out the challenges and way out of the solid waste management of Dhaka city, this research had been done where both the primary and secondary data had been used.

High rate of population growth, Rapid urbanization, Influx of people in urban areas, Lack of Appropriate Legislations, Lack of people's awareness, absence of waste segregation, Lack of coordination among the Government agencies are the major challenges of waste management of Dhaka city.

Decentralization of responsibility, Promoting 3R/4R method, Modernization of waste collection and transportation system, Creating awareness among the community, privatization of waste management, Enhancing public-private partnership can ameliorate the solid waste management of Dhaka city.

Key Words: Solid waste, DNCC, DSCC, Modernization, Collection, Transportation.

Chapter 1 Introduction

Background:

Waste is the object or substance that its holder requires and wants to discard and Waste Management is the collection, transportation, recovery and disposal of the same including the supervision of the total process (The Framework Directive 75/442/EEC).

In today's world, waste is considered as a raw material in the wrong place. Municipal solid waste is the garbage, refuse or any other solid, semi-solid or liquid substances generated from community activities (Chowdhury and Afza 2006).

Inappropriate and disorganized Solid waste (SW) disposal creates vital environmental degradation like air pollution, water pollution, wildlife habitat loss, destroying water bodies and reduce aesthetic values. All these are threats to the public and decline the quality of people's life (Warunasinghe and Yapa 2015).

The increasing volume and complexity of solid waste is bringing a very high risk to the human health as well as the ecosystems worldwide. An estimated 11.2 billion tonnes of solid waste is being created around the world which contributes about 5 percent of global greenhouse gas emissions (UNEP 2020).

In view of achieving sustainable development, the aim of today's waste management strategy is to work towards a zero waste economy. The modern waste management policy is being driven by the waste hierarchy i.e. Reduction, Reuse, Recycling, Recovery and finally Disposal to the landfill as the last option (Fei et al. 2016).

The city corporations in Dhaka are still lagging behind to follow the waste hierarchy in SW management. The SW disposal in Bangladesh is largely landfill based and initiative of recycling and composting is insignificant (Yasmin and Rahman 2017). Informal sector does some resource recovery and recycling of waste in Dhaka city. The poor people collect inorganic recyclable materials from solid waste and sell those to earn for their living. A large portion of organic matter which has the potential to be recycled or composted remains totally unutilized and disposed to landfills (Mukti 2013).

Objectives/Research Questions:

The objectives of the study are to find out the solutions of the following research questions:

- i) to assess the present scenario of solid waste management in Dhaka city ;
- ii) to find out the challenges;
- iii) to explore the best practices of solid waste management.

Justification of the Study

The population of Dhaka city is increasing and at the same time, the waste generation is also increasing. But the waste management practice of Dhaka city is not satisfactory and needs to have sufficient policy and modernized systems to ameliorate the waste management procedure of Dhaka city (Yasmin and Rahman 2017). So the research in this field is highly fruitful and the findings of this research will be helpful for the Dhaka City Corporations for better waste management and creating awareness among the city dwellers.

The research findings will also be beneficial for the Ministry of Environment, Forest and Climate Change (MoEFCC) in the decision making processes on solid waste management. Through conducting the research, this researcher has obtained the opportunity of improving different skills. This will also be helpful for other researchers who desire to conduct further research in this field.

Chapter 2 Literature Review

2.1 What is Waste?

Solid waste is the garbage, refuse or any other solid, semi-solid or liquid substances generated from community activities (Chowdhury and Afza 2006). Any waste generated from the domestic sources is termed as household waste and internationally a large portion of this waste ends up in the landfills (Inglezakis and Moustakes 2015). Waste materials (see figure 2.1) are generated by human activity and the consumer lifestyles of people and increased economic activity have led to increased waste production (UNEP 2020).



Figure 2.1 Solid Waste kept for disposal

Solid Waste (SW) in a broad sense can be classified into two major components, i.e. organic waste and inorganic waste. The organic part of waste can be subdivided into three major categories: putrescible, fermentable and non-fermentable. Putrescible wastes naturally decompose rapidly and if not carefully controlled creates objectionable odours during decomposition and produces visual unpleasantness. Fermentable wastes break down within short time, but without the unpleasant accompaniments of putrefaction. Non-fermentable wastes break down very slowly and prevent the decomposition. Preparation of food and human consumption is a principal source of putrescible waste. Thus the amount and nature of organic and inorganic

waste varies with the lifestyle, living standard of people and seasonality of food production (UNEP 2020).

2.2 Problems Created by Waste

Waste is not a waste rather it is a by-product of the process of consumption and resource that can be processed for obtaining necessary materials. Waste is not a problem if it is properly managed but it creates different environmental and health problems when there is a lack of management (Hettiarachchi 2014).

Solid waste poses problems in different ways. If the solid waste is disposed or dumped openly, then it can lead to land pollution. If it is dumped in low lands, then it may create water pollution and if burnt, then creates air pollution. If any waste is uncollected and remain on the streets and public places, then it creates serious environmental degradation and public health risk (Hai and Ali 2005).

Waste is being created by different human activities like increasing population, urbanization, industrialization and improved living standards of people. The number of people and the industries are increasing rapidly in the urban areas which is putting heavy pressure on the natural resources and placing a big challenge for sustainable development. Lack of proper management of household waste is causing ruin of the environment of many cities in different countries (Tania 2014).

2.3 History of Waste Management

Humans have been mass-producing solid waste since around 10000BC when they constituted non-nomadic societies for the first time. Then small communities started to move and bury their wastes to the nearer place outside their homestead or settlement. The people also used to dispose their wastes at nearby rivers or water bodies (Seadon 2006). At that time exceptionally the people living in the ancient city of Mohenjo-Daro in the Indus Valley implemented the SWM practice by 2000BC. By 500BC, the Greeks banned waste disposed in the streets by issuing a decree and established the world's first 'Municipal dumps'. In 200BC Chinese cities deployed 'disposal police' who were responsible for enforcing waste disposal laws.

In Athens and Rome, one specific type of problem came in the forefront. At first the wastes were accumulated outside the city boundaries but it was envisaged that opponent could climb up the waste piles and over the city walls. So, the piles of waste relocated well outside the city boundary. Historically, health concern of people, security of human, the resource scarcity, value of waste and public awareness act as the driven for progress of solid waste management (Marshall and Farahbakhsh 2013).

2.4 Causes behind Increase of Waste Worldwide

2.4.1 The Growth of Population

The unbridled growth of population is the most important challenge for sustainable waste management. If drastic actions are not taken, the rapid growth of population will hamper all the initiatives of waste reduction. In the last century, the world population increased rapidly and the waste production grew tenfold (Hoornweget *al.* 2013). If the growth rate of population is not controlled, the waste generation may be doubled again in 2030. Unless the population growth is reduced, the globe will face more problems with disposal of its waste (Hoornweget *al.* 2013, Mukti 2013).

2.4.2 Urbanisation

The population in the urban area are increasing worldwide as the improved social facilities and more job opportunities in urban areas are attracting people. As every year some more areas are coming under urbanisation and being equipped with more infrastructural facilities, people are being attracted to shift to the urban areas (Tania 2014).

The huge number of urban population creates heavy pressure on the waste management in different countries. In Bangladesh the number of urban population is increasing at a sharp rate which is about 6%. The influx of people is very high in eight divisional cities in Bangladesh and the highest in Dhaka City which leads to the dramatic increase in waste generation and makes the waste management of Dhaka city very complex (Halder *et al.* 2014).

2.4.3 Economic Activities

Industrialisation, businesses and other economic activities are increasing. With the rapid technological innovation and growing demand of people, economic sectors are flourishing. More economic activities are creating more wastes which demand special attention to dispose (Farzana and Kabir 2004).

2.4.4 Changing Lifestyle of People

Different human activities produce waste and people's lifestyle has a major impact on waste production (Tania 2014). In one hand increased number of population are creating pressure on the natural resources and on the other hand because of urbanization and technological innovation people are obtaining different opportunities and devices which are changing their lifestyle. In different countries, people's food habit is also changing. In Bangladesh, urban people have been attracted to fast foods and different world renowned food chain shops have opened their branch in the cities. Changes in the lifestyle of people have effect in the ingredients of household waste (Zahur 2007).

2.5 Different Categories of Solid Waste

2.5.1 Municipal Solid Waste:

This waste consists of household waste, street waste, sanitation waste, construction waste and other residential waste. MSW can be divided into two groups i.e. organic and in-organic waste. Organic waste is biodegradable and can be turned into compost which is used as manure in the agricultural field. In-organic waste includes plastic shopping bags, plastic bottles, aluminum cans fall in this group and those are recyclable. In-organic waste can be used as raw materials for producing new products by recycling (UNEP 2020).

2.5.2 Industrial Waste or Hazardous Waste:

This type of waste is produced from the industrial units and those are dangerous to human, animals, plants and the environment. Any oil spill in the seas, poisonous gas or chemicals, industrial effluent can cause destruction to the living species and the environment if this waste are not treated or disposed scientifically (UNEP 2020).

2.5.3 Hospital Waste or Biomedical Waste:

This type of waste is generated in the hospitals, research centres, clinics and health care centres. This solid waste is infectious and can spread different diseases among human and animals. Disposal syringes, cotton swabs, bandages, expired medicines are included in this category which are hazardous and dangerous (UNEP 2020)

2.5.4 Covid 19 Waste

Corona virus was first detected on 28th December 2019 in Uhan of Hubai province of China but after that it had been spreaded in 213 country and areas of the world including Bangladesh. For saving the life from Corona virus people had been compelled to use Personal Protection Equipment (PPE), mask, Hand Gloves, Sanitizers etc. and those had evolved a new bunch of hospital waste which is more dangerous for human life and demand special type of disposal systems.

2.6 What can be done about it?

A properly organised and effective management of solid waste can enhance the environmental quality of a city and increases the health situation of population. People's awareness about the health and environmental hazards related to disorganised household waste management can help a lot in improving the waste management programmes (Warunasinghe and Yapa 2015).

The United Nations Environment Programme (UNEP) has focused on the waste as a resource and underscored the need of circular economy.

UNEP's report 'Global Waste Management Outlook' has made the foundation of these approaches. UNEP found that about 11.2 billion tons of urban waste is generated each year. The report emphasized two approaches for eradicating the waste. The approaches are the inclusion of informal recyclers in municipal waste management system and development of an academic consortium for preparing a waste management curriculum and developing the guidelines for a legislative framework on waste management (UNEP 2020).

2.7 Agenda 21 at Rio Convention

The Rio Convention held at Rio de Janeiro from 3 to 14 June 1992 fixed up a target for environmentally sound management of solid wastes and sewage related issues which has been mentioned in chapter 21, section 3 of Agenda 21 (Rio Declaration 1992).

2.8 Best Practice Options for Waste Management

2.8.1 Hierarchy of Waste Management

In the modern waste management practice, solid waste management hierarchy is being considered as a key element and is being used in different countries in formulating their national and regional waste management policy. The waste hierarchy gives a framework by which waste management could be made more sustainable. In the hierarchy table, the most favourable option is the reduction of waste and least favoured option is the disposal to landfills. Reduction, Reuse, Recycle, Recovery and Disposal are the preferred steps for the sustainable waste management (UNEP 2020, see figure 2.2).

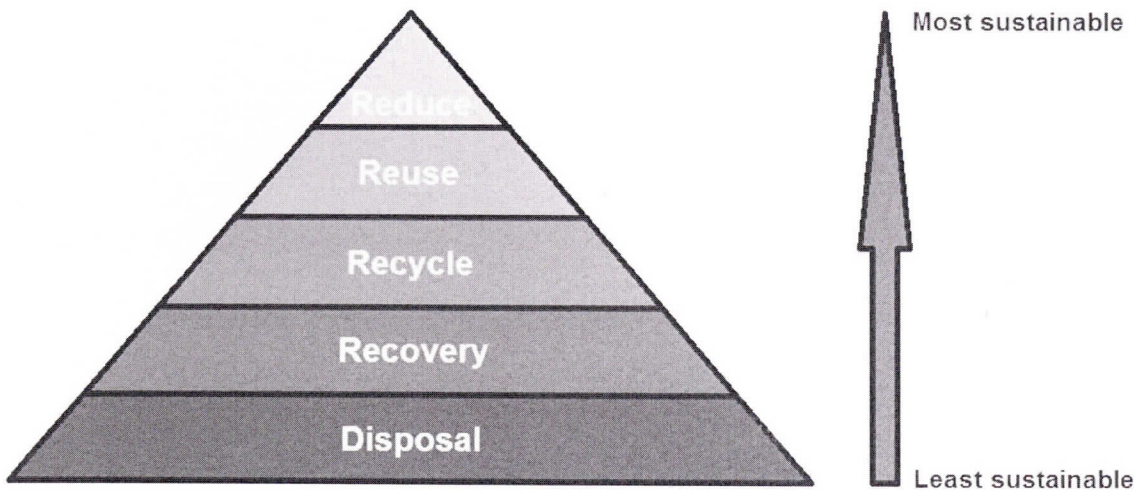


Figure 2.2: Waste hierarchy

The waste management hierarchy can make the waste management process economically beneficial and environmentally sound. The hierarchy is a major policy tool in many countries for

conservation of resources and protection of public health and safety. The hierarchy also reduces water and air pollution and dependence on landfill for waste disposal (UNEP 2020).

2.8.2 Reduction of Waste

Reduction of waste means taking any measure before the product, material or the substance has become the waste. This is the best option for managing the waste and should be considered first. For this reason, reduction of waste has been placed at the top position of waste hierarchy (UNEP 2020). Reduction of waste has been placed before all these stages as this can reduce the cost of all other stages (Menon 2010). In the National Waste Management Policy of any country, waste reduction can be the thrust number one and this will encourage people to minimize waste generation (Ng *et al.* 2015).

2.8.3 Reuse of Waste

Reuse is an action by which products, materials or substances can be used again for the same or different purpose by cleaning or by repairing. A material which is a waste for one can be useful for others. Most of the used material can be reused if it could be sent to the right person and that will decrease the amount of waste disposal. Reuse of plastic products can help the society in many ways. Plastic production uses 4-8% of global oil production. By reusing plastic products, a portion of fossil fuels can be saved which results reduction of Carbon-dioxide (CO₂), Nitrogen-oxides (NO_x) and Sulphur-dioxide (SO₂) in the environment (Al-Salem *et al.* 2009).

2.8.4 Recycling of Waste

Recycling is the processing operation by which the waste products or substances are reprocessed into a new product for the original or different use. Composting of organic material is also included in recycling.

In the waste management strategy, recycling of waste is obtaining preference and the authorities are trying to motivate people to segregate the recyclable waste at the production point. The success of recycling depends on the participation of the residents and the efficiency of the infrastructure and equipment (Guerrero *et al.* 2013).

2.8.5 Recovery of Energy

Recovery means to use the waste for serving any useful purpose by replacing other substances which was required to be used to perform the particular function. Harnessing energy from the waste is a suitable method of recovery (UNEP 2020). Solid waste can be a source of energy and the calorific value of waste can be used for electricity generation and producing heat. Solid waste can solve a part of the necessity of electricity and at the same time can improve the quality of environment (Haldaret *al.* 2014). For recovering energy, the waste materials are partially or completely oxidized for producing heat, power and gaseous fuels. For this, developing infrastructure and viable market is necessary (Al-Salem *et al.* 2009).

2.8.6 Disposal to Landfill

The modern management system targets to use landfills as the last resort of waste disposal. Pollutants can be migrated to the soils and groundwater in and around landfill areas (Kasassiet *al.* 2008). Irrespective of the global move towards zero waste, the number of landfills is increasing in the underdeveloped and developing countries and their argument is that the modern landfills are capable to save the environment from the pollutants (Kiddeeet *al.* 2013).

Chapter 3 Methodology

3.1 Desk study

In the pursuit of commencing this study, the first endeavor was to conduct a desk study for gathering information about municipal solid waste, its different aspects and the present solid waste management system of Dhaka City. The solid waste management system of some other countries was also studied during the desk study for having an in-depth idea of waste management of those countries which could be helpful for Dhaka city. For collecting the information, books written on waste Management and articles published in different journals were studied for delving into the research matter.

3.2 Data collection

For this research project, data were collected from both the primary and secondary sources. Secondary information were collected from different books, bulletins, research papers and journals published in Bangladesh as well as other countries.

Some waste collection spots of Dhaka city were visited and discussions were held with the executives, employees and litter pickers of DSCC and DNCC for obtaining in-depth idea about the solid waste management system of Dhaka. Some residents were consulted to obtain the information about how the households segregate the waste at the source point. To obtain the information about the solid waste management situation in Dhaka, discussions were held with the DNCC and DSCC people, waste collectors and residents of different areas of Dhaka city.

3.3 Compilation and Analysis of gathered information

The information found from different sources were analyzed and compiled to understand the present waste management procedures of Dhaka city, the challenges and the way out from this situation.

Qualitative analysis of the data were done for finding out the solutions of the research questions. The compilation and analysis of data were furnished an opportunity to find out the best practices of solid waste management in Dhaka city.

3.4 Report Preparation

At the end of the data analysis and data compilation, a consolidated report was prepared which present the solid waste management system and the challenges of solid waste management in Dhaka city and presents some recommendations for the improvement of the solid waste management of Dhaka city.

Chapter 4 Solid Waste Management in Dhaka

4.1 Background

Dhaka, the capital of Bangladesh is one of the most contaminated cities in the world and solid wastemanagement is a major issue in reducing this environmental pollution (Bhuiya 2007). The area of Dhaka city (see figure 4.1) is 360 km² and population is 15 million in the city area (Parvin and Begum 2018). As Dhaka is the centre of most of the administrative, commercial and educational institutions, around one million commuters visit the city area every day. The population is increasing rapidly and yearly population growth rate of Dhaka city is 3.72% (Parvin and Begum 2018, Bhuiya 2007).



Figure 4.1: Map of Dhaka city

(Source: www.google.com)

Dhaka city is facing numerous problems regarding the solid waste management and at the same time, increasing population is creating more household wastes (see figure 4.2). On the other hand, availability of landfill sites is decreasing. So, Dhaka North City Corporation (DNCC) and Dhaka South City Corporation (DSCC) need to reduce solid waste generation and introduce modern solid waste management system (Haque *et al.* 2013). In Dhaka city, there is an illegal practice of disposing of household waste, commercial waste and industrial wastes in the rivers, canals and wetlands. The river Buriganga which has encircled Dhaka is now in a deplorable condition because of the waste disposal (Uddin *et al.* 2018, Chakraborty *et al.* 2013).

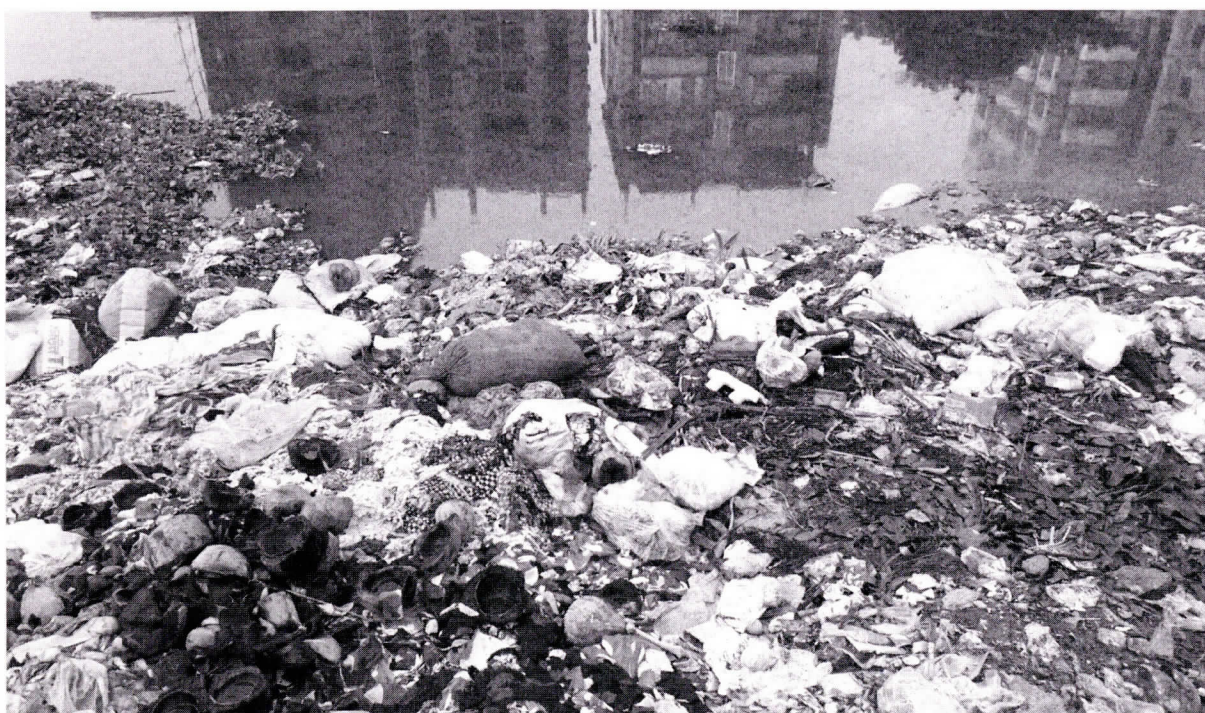


Figure 4.2: SW remains scattered at an undesignated place in Dhaka city

The Dhaka City Corporations collect, transport and dispose the solid waste to the specific sites. The government allocates funds to the City Corporations which are also financed from local taxes, municipality holding licenses and trade licenses. Other than paying the municipality holding tax to the City Corporation, householders need not pay for waste disposal. In the present time and situation, NGOs and CBOs are playing an important role in managing and disposing of household waste. CBOs mainly collect wastes from the households of different areas of the

Dhaka city. NGOs are taking part in composting and recycling organic and inorganic waste respectively and ensuring people's participation in these activities (Parvin and Begum 2018).

4.2 Overview of Waste Management in Dhaka

In Bangladesh, on behalf of the government, SW is managed by the city corporations. In Dhaka city, Dhaka North City Corporation (DNCC) and Dhaka South City Corporation (DSCC) are responsible to perform that job. DNCC and DSCC are doing the job centrally and have not decentralized the waste management activities to the city wards (Haque *et al.* 2013). Every day the residents are producing about 4500 tons of solid waste and the city corporations have the capacity to collect about 50% of total waste. Rest of the SW remains scattered on the roads, ditches and open fields which create nuisance and place adverse impact on human health and environment (Roy and Roy 2013).

4.3 Legal Framework

In Bangladesh, the existing policies, law and regulations for solid waste management and monitoring are inadequate. According to the act 'The Local Government (City Corporation) Act 2009, Dhaka City Corporations are responsible for waste management of city corporation area. DNCC and DSCC have Waste Management Division to execute the management of solid waste. The following acts and regulations are being used for solid waste management in the country including Dhaka.

- i) The Local Government (City Corporation) Act 2009
- ii) The National Environment policy 2018
- iii) The Environment Conservation Regulation 1997 (Revised)
- iii) The Environment Conservation Act 1995 (Revised)
- iv) Medical Waste (Management and Processing) Regulation 2008
- v) National 3R Strategy for Waste Management 2010

4.4 Generation of Waste and Composition

In Dhaka city, wastes come from residential areas, commercial areas, street sweepings and some other sources (refer to table 4.1). Annually 1.70 million tons of SW is produced and the waste stream contains substances like food waste, clothes, cardboard, papers, metals, agricultural wastes and broken home appliances (refer to table 4.2). Around 80% of the waste is organic waste which varies in the fruit producing and rainy seasons (Parvin and Begum 2018).

Table 4.1: Generation of SW in Dhaka city

(Source: Al Faruq *et al.* 2013)

Sl.	Sources of generation	Total generation (tons/day)
1	Residential areas	4500.00
2	Commercial areas	1177.61
3	Institution areas	62.45
4	Street sweeps	28.30
5	Others	20.00
6	Total	5788.36

Table 4.2: Composition of waste in Dhaka city

(Source: SAARC 2004)

Waste Composition	Percentage by weight
Food and vegetable waste	70
Paper and cardboard	4
Plastics	5
Metals	0.13
Glass and ceramics	0.25
Wood	0.16
Garden waste	11
Other (stones, dirt)	5
Moisture	65

4.5 Collection of Waste

There are no sufficient waste collection services in most of the areas in Dhaka city. There is insufficiency of bins in the community which instigates people to drop wastes here and there (Yasmin and Rahman 2017). Still in Dhaka, most of the collection bins are open (see figure 4.3 and 4.4) and collection of waste from the slum areas is very limited. Slum areas are the living place of poor people who have many children and very little awareness about waste management, environment conservation and health related issues (Tania 2014).



Figure 4.3: Open top waste collection bin placed by DSCC



Figure 4.4: Waste bin placed by City Corporations

Table 4.3: Chronological development of SW management in Dhaka

(Source: DNCC and DSCC 2020)

Year	Activity
1864	Waste collection at night by Bullock cart. Dhaka Water Supply and Sewage Authority (WASA) collects the liquid waste.
1963	Municipality collects the waste
1982	Waste collection by bullock cart is stopped.
1987	House to House collection of waste was introduced at Kalabagan, a part of Dhaka city.
1993	Demountable container system was introduced.
2002	System of permission for primary collection.
2003	JICA commenced the Development study.
2005	The Clean Dhaka Master Plan was formulated.
2007	Technical Cooperation Project by JICA started.
2008	Waste Management Department was created in Dhaka City Corporation (DCC).
2010	DCC introduced low emission Compactor and 7 ton capacity containers.
2011	Technical cooperation project by JICA obtains extension up to 2013.
2016	DSCC and DNCC are trying to modernize the SW management system

4.6 Transportation of Waste

The DNCC and DSCC have the fleet of vehicles for carrying the refuse from the city waste bins to the landfills. City Corporation have engaged private organisations for collecting waste from the households and transport at the Secondary Transfer Stations (STS) or the roadside bins. Moreover, city dwellers also carry their waste and dispose of it to the road side bins. In some areas community management has been developed and community associations have employed people to collect waste from house to house by rickshaw vans and dispose of at the waste bins (see figure 4.5).



Figure 4.5: House to house waste collection by the community employed person

From the waste bins, DNCC and DSCC trucks carry the waste to the landfills (see figure 4.6). DSCC has its disposal at Matuail(see figure 4.7) and DNCC at Amin Bazar.



Figure 4.6: Transportation of SW by covered truck in Dhaka



Figure 4.7 Matuail landfill in Dhaka city, the destination of Dhaka waste

4.7 Best Practice Method of Waste Management

4.7.1 Reduction of Waste

Initiatives for reduction of waste are not very visible in Dhaka city though it is highly helpful for waste management. Some social organisations have recently started work to build awareness among the city people regarding the reduction of waste (Parvin and Begum 2018) .

4.7.2 Reuse of Waste

In Dhaka city, reuse of waste is very prominent though there is no formal initiative from the city corporations or other charities. It is the spontaneous initiatives of the households and city dwellers. In Dhaka city there live many poor people. Most of the high and middle income households have a maidservant for doing necessary housework. The householders donate their old cloths and utensils to their maidservants and those are reused. DNCC and DSCC have no formal campaign programme to intensify reuse of waste (Tania 2014, Zahur 2007). Many people in the country use the waste as fire wood for their cooking (see figure 4.8).



Figure 4.8: Reusing of waste as fuel wood

In the winter season, many poor people suffer from scarcity of warm cloths. During this time, many voluntary organisations mainly operated by the students and alumni of the universities collect old clothes from the houses and donate those to the helpless poor people (Halder *et al.* 2014).

4.7.3 Recycling of Waste

DNCC and DSCC have no formal plan or target for waste recycling but recycling is being done in three stages in Dhaka city. In the first stage, the housewives segregate the valuable materials from the wastes. Old clothes, shoes, plastic bottles, fresh bottles, iron materials, aluminum materials have a resale value in Dhaka city and hawkers come to the houses to purchase those. Sometimes the hawkers give other new products like crokaries in exchange of these valuable wastes. Thus separating the valuables from waste is popular among the housewives and the first stage segregation is performed inside the houses. When the wastes are discarded in the waste bins placed by the city corporations, then the second stage of salvaging is done by the tokais (very poor street children). These people collect broken glasses, different metals, cans, paper, cardboard or any other valuable things which are saleable to the hawkers (see figure 4.9, refer table 4.5). In some cases, this salvaging is the main income source for the tokais and their families (Tania 2014, DNCC and DSCC 2020).



Figure 4.9: Poor people searching for the recyclable materials in waste

The third stage or final stage separation is performed by more tokais when the waste is deposited at the landfill site. As it is openly dumped, at the very onset of unloading the waste carrying truck at landfill, tokais start to look for the valuable material inside the refuse. All these materials salvaged by the households and tokais reach to the old materials shop through the hawkers. From these shops, materials are sent to the factories for recycling or other use after necessary processing (DNCC and DSCC 2020).

Table 4.5: Estimated volume of recycled waste in Dhaka city
(Source: Mili 2010)

Material	Generation of recyclable waste (ton/day)	Quantity of recycled waste (ton/day)	Recycling rate
Plastic	124	103	83%
Paper	260	168	65%
Glass	46	24	52%
Metal	27	26	96%
Compostable	2,211	6	1%
Others	99	94	95%
Total	2,767	436	15.75%

4.7.4 Composting of Waste

Composting is the controlled biological decomposition of organic wastes which produces natural fertilizer for the agricultural sector. The SW of Dhaka city is suitable for composting due to high moisture and organic components. Waste Concern, an NGO in Bangladesh first started composting in 1994 (See Figure 4.10). It is mainly the NGO that is working in this sector in

Bangladesh. In Dhaka, some compost plants have been set up with the technical support from the NGO's and financial support from donor agencies (Parvin and Begum 2018, Ahsan *et al.* 2014).

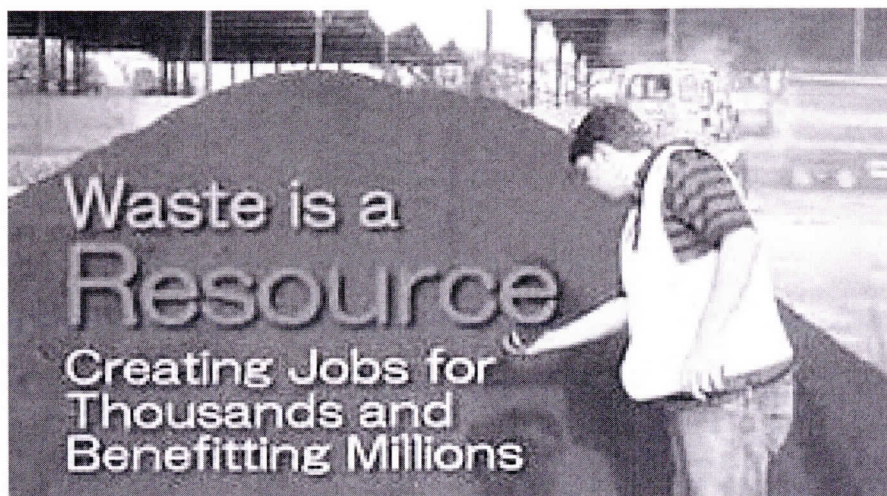


Figure 4.10: Fertilizer produced by composting in Dhaka

4.7.5 Recovery of Energy from Waste

The waste of Dhaka city has a high percentage of organic matter and right moisture content. So, the composition of SW in Dhaka city is suitable for composting (Hai and Ali 2005). It is estimated that about 50-60% moisture content is suitable for energy recovery from the waste. More than 70% of organic component is present in the SW of Dhaka city. So, DNCC and DSCC are in an advantageous position to harness energy from waste (Halder *et al.* 2014). In Dhaka city, there is no large scale initiative for recovery of energy from waste although there are some community scale biogas plants (Das *et al.* 2015).

4.7.6 Disposal to Landfill

The SW disposal in Dhaka is largely landfill based and initiative of recycling and composting is not very significant (Hasan *et al.* 2009). A large portion of organic matter which has the potential to be composted is disposed to landfills (Mukti 2013). DNCC and DSCC send the waste to landfills without any treatment which emits approximately 1 million tons of Green House Gas (GHG) annually (Chowdhury *et al.* 2014).

4.8 Challenges of Solid Waste Management in Dhaka

4.8.1 High Rate of Population Growth

The growth rate of population is very high in Bangladesh and the increasing population is generating more waste (Halder *et al.* 2014). The rate of increase of urban population in Bangladesh is about 6% and most of the urban population is concentrating in 8 (Eight) major cities which constitute nearly 13% of total population of the country (Chowdhury *et al.* 2014).

4.8.2 Rapid Urbanisation

The rate of urbanisation in Bangladesh is very high. Most of the administrative, educational and health facilities are centred in Dhaka and many adjacent parts of Dhaka city are coming under urbanisation (Tania 2014, JICA 2005).

4.8.3 Influx of People in Urban Areas

As Dhaka is the capital, there is a continuous influx of people. Affluent people want to settle in Dhaka for obtaining better social and administrative facilities and poor people come to search the jobs (JICA 2005).

4.8.4 Increase of Slum Dwellers

In Dhaka city there are job opportunities like day labouring, rickshaw pulling and construction work. These poor people live in the slums because of their scanty income. The slum dwellers make the waste management situation more challenging and vulnerable (Chowdhury *et al.* 2014, Tania 2014).

4.8.5 Lack of Appropriate Legislation

There is shortage of appropriate legislations for proper waste management in Dhaka city and there is the lack of law which can punish the people for disposing of waste here and there without following the instruction. Enforcement of existing laws is also not very strong (Islam 2016, Bahauddin and Uddin 2012).

4.8.6 Scarcity of Waste Management Infrastructure

Dhaka city is lagging behind in having infrastructural facilities. Some plans of city corporations are not being successful because of the absence of appropriate structural facilities (Mukti 2013, Zahur 2007).

4.8.7 Lack of People's Awareness

People of Dhaka city are poor and are not aware of waste management. The educated people of the city also have indifference or lack of awareness about putting household waste in the specified place or bin. Lack of awareness of residents is a vital challenge for sustainable waste management in Dhaka city (Yasmin and Rahman 2017, Tania 2014).

4.8.8 Absence of Segregation of Different Types of Wastes

There is very limited segregation of waste in the source of waste production i.e. in the households. All the general waste, recycling waste and hazardous waste are being mixed together. So far the city corporations have no initiative of segregation of different types of waste (Parvinand Begum 2018, Ahsan *et al.* 2014).

4.8.9 Lack of Coordination among the Government Agencies

Lack of coordination among the government agencies hinders the waste management activities in Dhaka city. Lack of coordination among government agencies like different Ministries, Water Supply and Sewage Authority, Food Department and the City corporations are also liable for absence of time-befitting waste management of the city (DNCC and DSCC 2020, Zahur 2007).

4.8.10 Scarcity of Land

Availability of land for establishing landfill is in a crucial situation in Dhaka as day by day land is being scarce in the city. In the Matuail landfill site, there is the scope of expansion and it is being expanded in another 81 acres of land with existing 100 acres but there is no scope of expansion at the Amin Bazar landfill site (Parvin and Begum 2018, Ahsan *et al.* 2014).

Chapter 5 Discussion

5.1 Discussion

In this study, the waste generation and the management of solid waste in Dhaka city has been analysed. The solid waste management system of Dhaka is still disorganised and lacking a well organised plan. The analysis of the waste management of Dhaka city reveals various aspects which has the opportunity to improve. Following points reveals the pros and cons of waste management system of Dhaka.

5.1.1 Waste Hierarchy

Today's waste management hierarchy is Reduction, Reuse, Recycling and Recovery of energy and Disposing to landfill is the last resort. In Dhaka, the hierarchy is not followed formally. DNCC and DSCC have no institutional initiative to follow the hierarchy till now. Only in a very small area, DNCC and DSCC have started to follow waste hierarchy by the private sector. Informal sector and poor people collect valuables from waste which in turn acts as waste hierarchy implementation. DNCC and DSCC should take strong and planned approach to follow the waste hierarchy for better waste management.

5.1.2 Waste Collection

DNCC and DSCC collect around 50% of the total waste. Other 50% remains uncollected and scattered on the roads, low lands, fields which creates nuisance. DNCC and DSCC need to plan and manage 100% of waste generated. If 50% of waste is uncollected and remains scattered, it never can give a healthy and congenial atmosphere for the city people.

5.1.3 Disposal Bins

Now a days, many cities of the world set up sufficient number of waste bins. In the road side, people can find waste bin within a reasonable distance. In Dhaka, there are not enough waste bins and they are not well placed. It is not very easy for people to find out bins for waste disposal. Lack of waste bins triggers people to dispose of waste here and there. DNCC and DSCC need to increase number of waste bins and set up those in the strategic locations.

5.1.4 Supplying Bins to Householders

In some cities, there is a great initiative to supply different types of bins to the householders. Residents get brown wheelie bins, black bags and white bags from the authorities which encourage householders to store different types of waste in separate bags. In Dhaka, there are no such initiatives at all. DNCC and DSCC can take this type of initiatives which will inspire source segregation of waste.

5.1.5 Source Segregation

Segregation of waste at the producer's point should obtain utmost priority in the waste management strategy. DNCC and DSCC have no initiative to segregate waste in the generation place.

5.1.6 Decentralization of Work

It is being very difficult for the City Corporations to manage the work of a very large area. DNCC and DSCC can get better result if they decentralize the work and bestow this responsibility to the ward councilors.

5.1.7 Privatization of SW Management Services

Rendering some responsibilities to the private organizations would help amelioration of waste management. Dhaka has not privatised the waste management work. DNCC and DSCC have appointed NGOs and CBO's only for the collection of wastes of very small area.

5.1.8 Legal Instruments

The legal framework for waste management is not adequate. DNCC and DSCC have different laws for SW management and each authority is working according to its law. New law befitting with the present time will be more effective for waste management of Dhaka city.

5.1.9 Enforcement of Law

In Dhaka, enforcement of law in waste management is very weak. Bangladesh needs to introduce reasonable penalty for violating the waste management rules and requires strict enforcement of waste management instructions.

5.1.10 Transportation of Waste

In Dhaka, all the wastes are carried in the same truck. Waste carrying trucks must be covered truck so that there will be no scope of environmental pollution during transportation of wastes. In Dhaka city, open trucks are also used beside the covered trucks for SW transportation and in that case bad smell or odour of waste contaminate the environment.

5.1.11 Reduction and Reuse of Waste

Following waste hierarchy and take various programmes for reducing and reusing the waste could be very useful for creating awareness among the residents for reducing waste. Dhaka City Corporations have no campaigning program to enhance reusing of waste materials.

5.1.12 Recycling of Waste

In Dhaka city, the recycling is fully informal and done by the poor people. There is no formal programme from DNCC and DSCC to enhance recycling. The existing informal recycling activities also can be enhanced if the city corporations offer voluntary training to the tokais. The health risk of those poor people will also be reduced. DNCC and DSCC should take different programmes to increase recycling of waste and to encourage segregation of recyclable wastes at the source.

Chapter 6 Recommendations

6.1 Recommendations

Based on the discussion and analysis, the study makes following recommendations for the improvement of the SW management of Dhaka city:

6.1.1 Enact Effective Legislations

There is lack of sufficient legislations in Bangladesh for effective waste management. The existing legislations need necessary amendments and new legislations are required to make the SW management of Dhaka city modernise, effective and time befitting. The country can take initiative to enact a new law for waste management which could be applicable for the whole country.

6.1.2 Decentralise the Responsibility

DNCC and DSCC are executing the SW management of Dhaka and they are not being capable to accomplish the waste management of this vast area effectively. As Dhaka is a large area and it has a huge population, DNCC and DSCC can decentralise the job among the wards and the responsibility can be delegated to the ward commissioners. Then each ward will be responsible for SW management of its own area and better management could be obtained.

6.1.3 Promote '3Rs' or '4Rs'

4R is the modern waste management hierarchy and many countries of the world are using this method. The UK, USA, the Netherlands etc. are following this method effectively and having effective waste management activities.

Dhaka city has the plan to follow 4R method in waste management but the City Corporations are not practising the hierarchy. DNCC and DSCC can practice and pay more attention to reduce, reuse, recycle and recovery of energy from the waste and can improve the waste management procedure.

6.1.4 Enhance Waste Collection

Dhaka city is lagging behind in collection of waste and a large portion of Dhaka city's waste is remaining uncollected. It is highly necessary to increase the waste collection rate of DNCC and DSCC. The present waste collection system should be upgraded and modernised.

6.1.5 Modernize Waste Transportation System

DNCC and DSCC are still transporting the waste by the open trucks which is a very backdated system and highly unsatisfactory in respect of environmental pollution and health hazards. DNCC and DSCC need to modernise their waste transportation facilities.

6.1.6 Establish Secondary Transfer Station (STS)

Secondary Transfer Station (STS) is effective and necessary for modern waste management. DNCC and DSCC have established a few STSs for accumulating waste from the nearer places and loading on trucks from the STS's. DNCC and DSCC need to establish more STSs for the better collection and management of SW in Dhaka city.

6.1.7 Create Awareness among the Community

In Dhaka city, lack of awareness among the residents is impeding the waste management system. The dwellers are not habituated to put the refuse in the specified bins rather a large number of people leave the waste here and there. As a result, source segregation is totally absent and wastes are seen scattered beside the city bins. So, massive programme is required to create awareness and DNCC and DSCC should chalk out awareness building programmes.

6.1.8 Enhance Public Private Partnership (PPP)

DNCC and DSCC are doing very small work in composting and energy recovery under public private partnership (PPP). DNCC and DSCC can expand the purview of PPP for promoting 4Rs method.

6.1.9 Privatize SW Management

DNCC and DSCC have privatised waste collection work of some areas of Dhaka city. DNCC and DSCC can privatise other activities like transportation, recycling and energy recovery from waste in more areas.

6.1.10 Introduce Waste Treatment Facilities

In Dhaka city, there is no waste treatment facility. The wastes are sent to the landfill directly from the waste collection bins. Waste treatment can reduce the load on the landfills and DNCC and DSCC need to introduce waste treatment facilities.

6.1.11. Enforce the Legislations

In Dhaka, there is the lack of necessary legislations for municipal solid waste management but the main problem is that existing laws are not being enforced properly. For effective SW management enforcement of legislation is highly important to reduce the mismanagement.

6.1.12 Ensure Infrastructural Facilities

DNCC and DSCC have lack of infrastructural facilities for waste management. The City Corporations have insufficiency of waste bins, trucks and bulldozers. DNCC and DSCC need to increase their infrastructural facilities.

6.1.13 Introduce Rewards and Incentives

For encouraging the residents in reduction, reuse, source segregation of recyclables, rewards and incentives can be introduced. DNCC and DSCC can declare rebate on holding taxes or other financial benefits for encouraging the city dwellers.

6.1.14 Introduce Penalizing for Offence

Besides the reward for the good work, penalising for misconduct should be introduced. Dhaka city can introduce penalty for violating the instructions.

Chapter 7 Conclusion

The research identified the challenges faced by Dhaka in managing solid waste and based on different aspects of the SW management of DNCC and DSCC, the research made some recommendations which can be applicable to improve the SW management system of Dhaka city.

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