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Sustainable Municipal Solid Waste Management in Dhaka City: Challenges and Issues

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Abstract

Improvement of the current solid waste management system is one of the main challenges for most of the municipalities in Bangladesh, especially for Dhaka city. Currently, large quantities of solid waste in Dhaka city are being dumped in informal or formal but unsanitary dump sites that threaten the general public health and ecological environment. Since the current solid waste management system mainly depends upon landfilling and open dumping without any source separation at the household level, it is necessary to introduce a new integrated system that will take into account the current situation in the city as well as the obligations as set out by the legal framework for waste management in the country. The study is mainly done based on secondary data analysis and literature review and reveals that only an integrated solid waste management system developed considering the local situation and caracteristics of the waste generated in the city can be an effective solution starting from source segregation to composting of organic waste. Producing refuse-derived fuel (RDF) using non-compostable high calorific value waste can be useful to reduce a substantial amount of landfill load of the city.

Introduction

The problem of solid wastes in Dhaka, the capital city of Bangladesh, is worse compared to cities in other developing countries (DoE, 2013). Dhaka is the ninth-largest mega city in the world, with about 19.58 million people (UNDESA/PD, 2018) living in a small area of 302.92 sq. Km. with a density of 30,551 people per sq. Km (BBS, 2014). The growth rate of the city is very high which is over 4 percent during the last decade, and Dhaka is projected to move up in the position rank and will become by 2030 the fourth largest city in the world with over 28 million people after Delhi, Tokyo and Shanghai (UNDESA/PD, 2018). With the rapid growth of population and unplanned urbanisation, Dhaka faces enormous challenges of environmental degradation these days. Poor solid waste management further adds to the problem. With conventional waste management systems, the city authorities are not in a well-managed position to handle the total volume of wastes (DoE, 2013). The existing system for waste management has an average waste collection efficiency of 55% (DoE, 2013), and about 45% of the waste is unmanaged, subsequently, dumped in open spaces that poses health hazards to residents, clogs drainage systems and causes environmental pollution (Matter et al., 2015), which is a major concern for Dhaka City (DoE, 2013). On the contrary, if 100 percent waste is collected and reached the landfill, by 2025, it will require around 79.35 hectares, i.e., 196 acres of land (calculated from Waste Concern, 2015), whereas, the total land area of the present two landfill sites is only 60 hectares (Kabir, 2015). That means

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more land will be required shortly for new landfill sites, which will pose a severe burden to the densely populated land scared city. Besides, Bangladesh emits 86.38 kg of CO2e per capita per year from the waste sector (Waste Concern, 2015) that is also a severe climate change issue. Thus, the increasing problems of solid waste in Dhaka are not only posing increasing threats to the health of its residents, but also a global climate change issue.

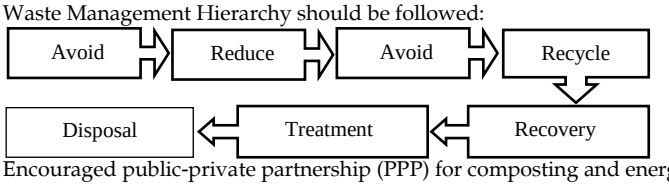
The main objectives of the present study are to analyse the current solid waste management system in Dhaka City with a view to provide some policy measures to be taken to ensure sustainable solid waste management in the city. The study is based on reviewing national plans, policies, reports and academic journal articles. Data are collected from national and international journal articles, conference proceedings, web materials from various national and international organisations, reports, and guideline.

Present Status of Municipal Solid Waste Management in Dhaka City

Legal Framework of Waste Management in Dhaka

The legal framework of municipal solid waste management in Dhaka is presented in Table 1.

Table 1: Legal framework of municipal solid waste management in Dhaka

Acts and Rules	Framework for Solid Waste Management
Dhaka City Corporation Ordinance, 1983	▪ Residents of the city are responsible for bringing their waste to Dhaka City Corporation's secondary waste collection points - dustbins/containers. ▪ Dhaka City Corporation held responsible for collecting waste from secondary waste collection points,i.e., its dustbins/ containers, and transport to final disposal sites.
Environment Conservation Rules, 1997	▪ Focused mainly the hazardous industrial waste ▪ Management responsibilities are given on respective industrial entities
City Corporation Act, 2009 (amendment, 2011)	▪ Responsibilities remains same as Dhaka City Corporation Ordinance, 1983
National 3R Strategy, 2010	▪ Promote Waste is a Resource; ▪ Targets reduce, reuse and recycling of solid waste including energy recovery
Solid Waste Management Rules, 2018 (Draft)	▪ Waste Management Hierarchy should be followed:  ▪ Encouraged public-private partnership (PPP) for composting and energy recovery

Source: DoE, 2013, BIGD, 2015, updated by the author

Characteristics of the Solid Waste Generated in Dhaka

According to the Bangladesh Waste Database 2014, the total amount of municipal solid waste generated every day in the country has been gradually increasing since1991, which was approximately 6,493 tons per day in 1991, turned to be double within fifteen years

reaching 13,330 tons per day in 2005 (Waste Concern, 2014). The same report also estimated that Bangladesh generated 23,688 tons of urban solid waste per day in 2014 and Dhaka generated 25.44% of the country's urban waste, that means, Dhaka City generates about 6,026 tons of solid waste per day. Table 2 shows the composition of solid waste generated in Dhaka. Food/organic waste makes up the significant portion of waste ending up at the landfill at 54.92% of total waste generated followed by plastic waste 14.70% and paper 12.60% (Kabir, 2015).

Table 2: Composition of solid waste generated in Dhaka

Component of Waste	Amount (in %)
Organic	54.92
Plastic Products	14.70
Paper	12.60
Textile and Wood	4.73
Leather and Rubber	1.54
Metal	1.56
Glass	1.14
Others	8.81

Source: Kabir, 2015

The moisture content of the waste generated in the city is about 50% (Enayetullah et al., 2006). The most important feature of the solid waste generated in Dhaka is the calorific value of the waste, which is about 8 MJ/kg (Sufianet al., 2006).

Collection and Transportation of Solid Waste in Dhaka

Dhaka Metropolitan Area is divided into Dhaka South City Corporation (DSCC) and Dhaka North City Corporation (DNCC), and there is Waste Management Department under each corporation responsible for solid waste management (Kabir, 2015). The waste collection systems of the DNCC and DSCC are not in a position of handling the large volumes of solid waste produced by the ever-growing numbers of city dwellers, and that only 55% of the solid waste produced is being collected (DoE, 2013) and dumped to its two landfill sites. The private sector initiative by NGOs and CBOs provide primary collection services of waste from door-to-door and carry the waste to the secondary collection points (containers or designated sites by the corporations) and even sometimes to vacant lands, by rickshaw-vans. The city corporations then transport the waste from secondary stations to final disposal sites by various sizes of trucks (Matter et al., 2013; Kabir, 2015).

Disposal of Solid Waste in Dhaka City

Dhaka city is facing severe environmental imbalance because of the poorly managed solid waste disposal system. The two landfill sites - Aminbazar under DNCC and Matuail under DSCC are not managed as sanitary landfills (Scheinberg et al., 2010). Though the two landfill sites have some modern waste management facilities, those cannot be classified as a sanitary landfill, but the controlled landfill. Waste segregation,

waste compaction with daily soil cover are not used in these dump sites. However, dozer, chain dozer, scraper are being used to spread the waste regularly (Kabir, 2015).

The cases are even worse in areas, where there is no specific dump site. The collected solid waste is disposed of through simple dumping in low-lying areas, flood-plains, water bodies or open spaces. Major portion of the uncollected waste is also disposed of in the same manner (JICA, 2005). The haphazard crude dumping of solid waste in public places causes severe environmental hazards and public health risks. Poorly managed wastes cause pollution of air, land, and water, damage of ecosystems, decrease of soil fertility, loss of aesthetic value and increase the incidence of diseases, like malaria, dengue and respiratory problems (DoE, 2013). The whole municipal solid waste disposal system in Dhaka city is unsanitary and hence needs urgent improvement. Open dumping of municipal solid wastes need to be stopped and the landfills need to be operated and maintained through available and affordable modern techniques scientifically.

Statuson Waste Recycling and Recovery

Informal Sector

Dhaka city has historically depended on the informal recycling sector (e.g., waste pickers) for the recovery of non-organic materials (Chowdhury et al., 2014). The waste pickers search for the recyclable items from the secondary station's dustbins/containers and even from open dumping landfill sites. rickshaw-van men directly collect recyclable items from the waste bin of households or containers (BIGD, 2015). Moreover, the housewives also separate the refuse of higher market value such as papers, bottles, fresh containers, old cloth and shoes, and sell them to street hawkers (Zahur and Otoma, 2013). A JICA report of 2005 shows that 83% total of plastic waste, 65% of paper waste, 52% of glass waste, 0.2% of compostable waste and 95% of other waste are being recycled or recovered (JICA, 2005). However, the total generated solid waste being recycled by the informal sector range from 4%to 15% (MoEF, 2010).

Project on Municipal Solid Waste to Compost

Earlier the city took a project on municipal solid waste to compost with a private firm named, Waste Concern through public-private partnership (PPP) in 2006 with an initial capacity of 100 tons of waste per day which increased up to 700 tons of waste per day within a year. As the project becomes a financial loss for the firm, the project was abundant in 2014 (Enayetullah and Sinha, 2016).

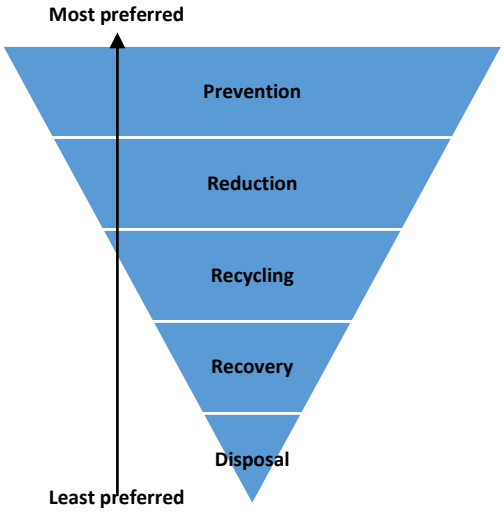
Earlier Initiatives on MSW to Energy in Dhaka

The Local Government Division signed a contract with Management Environment Finance, SRL, an Italian company in 2013 to produce 48MW electricity daily from the waste in Dhaka city with a plan to increase the generation to 100MW gradually. However, the project was cancelled after the company declared itself bankrupt. Later the government tried to produce electricity from waste again in 2017 and called for proposal three times, but due to overstating cost quoted by the bidders, the initiative was cancelled (Shitu, 2017; UNB, 2018).

Available Policy Options to Improve the Situation

Preferred Waste Management Hierarchy

For guiding waste management decision-making, the waste management hierarchy needs to be considered that shows an order of preferences of actions for reducing and managing solid waste as presented diagrammatically in Figure 1(UNEP, 2011). The waste management hierarchy is presented as an inverted pyramid, because the critical thrust of policy is to take action on preventing the waste generation first. The next preferred action is to reduce the generation of waste (for example, through reuse).



Source: UNEP, 2011

Figure 1: Waste management hierarchy

Recycling, including an aerobic digestion and composting, is the next preferred action followed by waste-to-energy and materials recovery. If energy is recovered through combustion and pyrolysis, or from sanitary landfill, it also belongs at this level of the hierarchy. The least preferred action is disposal in sanitary landfills or through incineration without energy recovery that is the last option for waste which has not been able to be prevented, diverted, recycled, or recovered in the previous steps.

Volume Based Waste Management

In order to reduce waste generation at the source and maximise waste recycling, the Korean government introduced the Volume-Based Waste Fee (VBWF) system in 1995 (Park et al., 2015). The VWF system imposes fees in proportion to the amount of food waste generated; hence, it is also called a "pay-as-you-throw" system. In South Korea, the government conducted a pilot test of VWF in 1994 in several municipalities, and after the pilot program's success, VWF was implemented nationwide as of January 1, 1995 (MOE, 2011, cited in Park et al., 2015). The target groups for VWF are mainly households and small businesses (e.g., markets, shopping arcades) that produce less than 300 kg of waste per day. According to MOE (2011) as cited by Park et al. (2015), the basic principles of VWF are as follows:

- households (or small businesses) are required to purchase standardised plastic waste bags produced and sold by local governments;
- wastes are to be put into the plastic bag and left for collection;
- recyclables such as paper, plastic, and cans are collected from containers or bins placed near residences at no charge.

The volume-based waste fee system can be implemented by choosing one of three billing systems: a designated standard bag system, radio-frequency identification (RFID) system, and a chip or sticker system (MOE, 2017). In the standard bag system, the waste producer buys a standard plastic bag for disposing of food waste. The fees are collected in proportion to the amount of food waste through the cost of purchasing the bags. The costs of collecting and handling the waste, producing the bags and paying commissions to the stores are all included in the price of the bags, making them a kind of marketable security. The typical price of the waste bags in Seoul, which is the largest city in Korea, ranges from 0.05 U.S. dollars (52 KRW) for a 2-litre bag to 1.8 U.S. dollars (1840 KRW) for a 100-litre bag (SMG, 2013 cited in Park et al., 2015). The chip or sticker system requires a waste discharger to buy a payment chip or sticker and attach it to a waste container to be picked up. In Seoul, with bulky waste such as home appliances and furniture, residents are required to discard the waste by attaching appropriate stickers, and these stickers can be purchased from the local administrative office or a haulier who collects bulky wastes (Park et al., 2015). The RFID system allows the information on discharge to be checked through an electronic tag, where fees are charged according to the volume of the waste (MOE, 2017). South Korea has been ranked first for more than a decade among the OECD (Organization for Economic Cooperation and Development) member countries in their municipal solid waste recycling rate. One of the key contributing factors for its outstanding municipal solid waste recycling performance is the application of volume-based waste fee (VWF) system (Park et al., 2015).

Using the Informal Sector for Recycling

In developing countries, a well-established informal sector can be found in municipal solid waste management in the collection and recycling of valuable materials (Gunsilius et al., 2011; Matter et al., 2013). Employing the informal sector for waste recycling creates jobs, save municipalities' money and protects the environment. Over 200 cities around the world have already increased their recycling rates from 40 per cent to 80 per cent by integrating waste pickers, making a direct impact on nine million people, where waste pickers' monthly incomes have doubled up to between USD 180 and USD 260 per month (UN-Habitat, 2013).

In Dhaka, the existing informal waste recycling system is not scientific and systematic to secure a maximum value creation from the recycled waste. There is great scope for improvement, where households can play a predominant role by segregating recyclable clean materials like plastic, paper, metal instead of mixing them with organic kitchen waste decreasing their potential recycling value (Enayetullah et al., 2006). Source segregation at the household level improves the quality of recyclables and increases their monetary value (Matter, 2013). For example, recycled plastic materials are very competitive and meet high demand in the industrial market. A study, using a scenario of

a 100% plastic recycling rate and producing recycled pellets, estimates of potential foreign income at USD 29.42 million per year (Enayetullah et al., 2006). As opportunities for recycling of waste exist, actions need to be taken to make the sector scientific, systematic and health-conscious. A necessary policy measure to increase recycling rates is to allocate defined space systematically in each neighbourhood for sanitary storage, and transfer of waste and source segregated recyclables that will allow source segregation initiatives to work efficiently and reliably

Integrated Sustainable Solid Waste Management System in Dhaka City

Implementation of a feasible sustainable solid waste management system in developing countries is especially a challenging process. A review of the related literature indicates that there is no one perfect model that can be functional to all cities in all situations. Hence, the sustainable solid waste management system for each city requires an individual solution that is fitting to its own specific history, socio-economic conditions, demography, and local culture following the city's unique institutional settings and financial resources. Integrated Sustainable Solid Waste Management (ISWM) requires this approach allowing studies of complex and multi-dimensional systems of the specific city in an integrated way combining waste generations, collection, treatment, and disposal methods, to achieve environmental benefits, economic optimisation and societal acceptability (UN-Habitat, 2010; Topić et al., 2015).

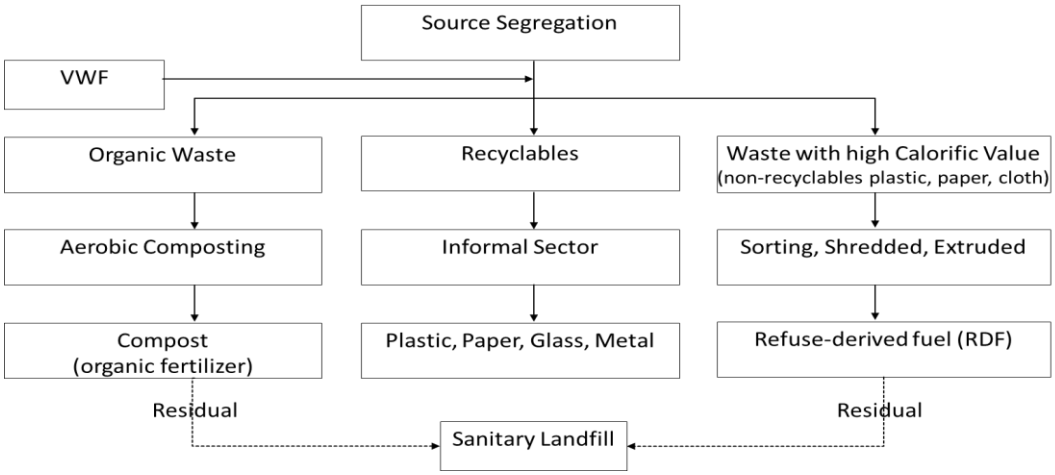
The calorific value (CV) of the waste generated in Dhaka is only 8.00 MJ/kg (Sufianet al., 2006), whereas, the desired CV for waste to energy using incineration technology needs to be more than 10.00 MJ/kg (Alam et al., 2001). The moisture content of the waste generated in Dhaka is higher, i.e., more than 50% (Enayetullah et al., 2006). Therefore, waste to energy (through incineration method) is not a sustainable option for Dhaka.

A substantial portion of urban solid waste in Dhaka is compostable, which is 74% of the total waste with the remaining 26% being non-compostable (Enayetullahet al., 2005). Reducing this organic content through composting would have a substantial impact on reducing the volume of waste to be collected and disposed of in landfills (Matter et al., 2013). Composting has numerous benefits, such as the production of organic fertiliser, reduction of waste quantity for final disposal, reduced air pollution and ground-water leachate and also creates employment and income. Composting is the most suitable option for developing countries, like Bangladesh due to low technology, low costing, low pollution effect, and it has more environmental and economic benefits compared to the disposal of organic waste into landfills (Harir et al., 2015).

For treating the non-compostable waste with high calorific value, i.e., mixed waste with non-recyclable paper, plastic, clothes, wood, a plant for refuse-derived fuel (RDF) need to be introduced. The brick manufacturing sector is one of the big consumers of energy mainly dependent on imported coal, which is typically used as the primary fuel in brick kilns (Begum et al., 2018). RDF can be used in those brick kilns in the country as a substitute for coal (Waste Concern, n.d.). Disposal in sanitary landfills is the last option for waste, which has not been able to be prevented, diverted, recycled or recovered in the previous steps. Additionally, Volume-based Waste Fee (VWF) can also be introduced in the city gradually in the long run to encourage reduced waste generation.

After analysing the waste composition and characteristics, an integrated approach of solid waste management comprising source segregation, recycling, composting, and resource recovery from non-compostable waste as RDF can be a sustainable solution for Dhaka as presented in Figure 2.

Financing waste management systems is often one of the most significant concerns for municipalities (Kazaet al., 2018). Cost recovery is essential to avoid reliance on subsidies from own-source revenues or national or external sources. Operational expenditures typically require a robust cost-recovery system for long-term sustainability. Revenue from compost and refuse-derived fuel (RDF) and standard user fee in terms of volume-based waste fee (VWF) system can be effective options for solid cost recovery system for ensuring long-term sustainability.



Source: Developed by author.

Figure 2: Proposed integrated Solid Waste Management system for Dhaka city.

Way Forward and Conclusion

This study highlights that sustainable waste management has a huge potential of development in Dhaka city. There is a strong need to introduce an integrated solid waste management system based on resource recovery, which would strictly follow the waste management hierarchy. Waste to energy through incineration is not a sustainable option for Dhaka. Proper use of recyclable and compostable waste can reduce the solid waste management problem substantially. An integrated, holistic approach of waste management starting from source segregation at the household level, followed by composting of organic waste, and producing RDF using non-compostable and non-recyclable high calorific value waste can reduce a substantial amount of landfill load. As stated earlier, disposal in sanitary landfills is the last option for those waste only which has not been able to be barred, diverted, recycled or recovered in the previous steps.

Waste can be prevented only by involving the residents since the citizens should be encouraged to separate kitchen waste from inorganic waste for recycling or composting. Therefore, it is essential to take a comprehensive education program both for the public

and the governmental institutions about the benefits of diverting waste from landfilling as a current situation. Introducing a volume-based fee system can also be instrumental in reducing waste generation and increasing revenue from waste management for long term sustainability.

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