

Assessment of the Present State and Economical Prospects of Solid Waste at Amin Bazar Waste Dumping Site, Dhaka, Bangladesh

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Abstract

The study was conducted to explore the current status and the economical prospect of the solid waste management at Amin Bazar waste dumping site, Dhaka. A total of 48 solid waste samples were collected in both dry and wet season to study the physical composition, pH and moisture content of discarded wastes. The wastes were comprised of plastics (6%), paper (3.5%), glass (0.23%), garden waste (8.5%), food stuffs (72.25%), metals (0.16%) and textile products (3.25%). The pH values of the samples ranged from 6.9 to 7.8 which indicated the neutral condition. Larger portion of the wastes was organic (72%). About 14.38% of wastes were recyclable but there was no recycling and composting facility. Proper recycling of the solid wastes at Amin Bazar can be a source of compost and useful metal resources which may contribute in safe and sustainable environmental management.

Keywords: Landfill; Solid waste; Waste management; Recycling; Composting.

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1. Introduction

Rapid urbanization is enlarging the size of cities like Dhaka City in terms of geographical area and population as a process of development. Urban population growth and economic development accelerate the consumption rates and as a result increase the waste generation in developing countries [1]. The increased municipal solid waste (MSW) is causing severe environmental degradation. Residences, commercial establishments, and

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institutions, industrial and agricultural activities are the principal sources of solid wastes. Different factors such as spiraling urban population, economic development, consumption pattern, climate, culture and institutional framework play significant role in MSW generation [2]. Solid waste consist highly heterogeneous mass of discarded materials from the urban community. MSW generation was identified as an inevitable consequence of production and consumption activities related to the level of income and urbanization [2]. Solid waste disposal in unscientific way can cause adverse impact on all components of the environment and human health [3,4]. Therefore, in order to ensure the longevity of environment the management of municipal solid waste needs to be revamped [5]. Open dumping; sanitary land filling, incineration and composting are the most prominent disposal methods in various parts of the world. Most of the industrialized countries dispose their solid waste in sanitary landfill but scenarios are different in the developing countries like Bangladesh as open dumping is very common here. In Bangladesh there is no ideal management plan for the proper management of huge quantity of solid wastes in most of the big cities. A minor amount of the generated wastes are collected by door-to-door collection system and the major portion of population does not get waste collection services. Nevertheless, MSW management system is still in developing stage due to lack of motivation, awareness, commitment, expertise as well as money and a considerable portion (40-60%) of wastes are not properly stored, collected or disposed [6,7]. In the major cities of the country, per capita solid waste generation is about 0.5 kg/day whereas only 0.2 kg/day of them is carried to the final disposal and rest is disposed-off locally due to the poor waste management system [8]. In response to the excessive growth in population and solid waste generation in developing countries like Bangladesh need an easily and economically feasible waste management system that can effectively address and manage solid wastes [9].

Dhaka, the capital city of Bangladesh is estimated to generate around 3500 to 4500 tons of MSW every day [10]. Most of the generated wastes are dumped on streets, water bodies and other public areas. The wastes dumped into the water bodies clogged the drainage system and contaminate the water. This improper dumping of solid wastes makes serious environmental degradation and public-health risk to the people living in this city. The Dhaka City Corporation (DCC) is the main responsible authority for solid waste management of Dhaka city. DCC, with its limited resources and a poor management plan is facing serious problems in providing a satisfactory service to the city dwellers. An inadequate information base (regarding quantity, type and characteristics of wastes), poor operation and maintenance of service facilities and above all lack of civic awareness on the part of a section of the population are adding up to the deteriorating environmental situation [11].

The aim of the present study was to investigate the solid waste generation, characteristics and management scenario at Amin Bazar waste dumping site, Dhaka. The study also investigated the economical prospects of these solid wastes with proper recycling and composting systems.

2. Experimental

2.1. Study area

The Amin Bazar waste dumping site (23°47'48"N and 90°17'50"E), one of the main dumping sites for Dhaka city wastes, is situated within the low-lying floodplain of the River Karanachhali in Savar upazilla under the district of Dhaka alongside Dhaka-Aricha highway. The area around the dumping site is mainly used for agricultural activities and by brick manufacturing industries except during the monsoon (June-October) when the areas are inundated by rain and flood. The area is used as a dumping site from 2007. Fig. 1 shows the study area.



Fig. 1. Location map of the study area. The green shaded area enclosed by circle indicates the waste dumping site.

2.2. Sample collection and preservation

The samples were collected in both dry (October to December) and wet season (May to July) in three shifts. Twenty four solid waste samples were collected from the landfill site in each season. The samples were collected from the surface level in clean dry polythene bag and preserved for laboratory analysis. Each of the samples contained approximately 2 Kg of solid wastes.

2.3. *Sample preparation*

Determination of organic and inorganic composition as well as the recyclable materials was the objectives and therefore the collected samples are prepared for composition analysis, pH measurement and moisture content. The collected solid waste samples were first dried under the sun for time as much as it needed to be fully dry after that the samples were kept in the laboratory at room temperature. These samples were then used to analyze the physical composition, pH and moisture content.

2.4. *Sample analysis*

For physical composition analysis, a powerful magnifying glass was used in order to locate every individual particles present in the samples. After careful observations the different particles of the wastes were separated from the samples according to the size. Every element was carefully separated using forceps. Hand gloves were wore to avoid direct contact to skin. After that, the separated particles were weighed by an electronic balance and the measurements were recorded.

For pH measurement, the sun dried samples were grinded in a mortar and then the powdered samples were taken in a clean vessel and deionized water was added. A total of 40.0 g solid waste powder was added into 100 mL distilled water. The suspension was stirred several times for 30 min. Then the pH was measured by the pre-calibrated pH meter (SCHOTT instrument, model: lab 851) and recorded.

The moisture content of solid waste was determined by a microwave oven using the following formula.

$$\text{Moisture content, MC (\%)} = \frac{W_W \times 100}{W_{\text{DRY}}}$$

Where,

Weight of wet sample and tare (g) = $W_{\text{WET+C}}$

Weight of dry sample and tare (g) = $W_{\text{DRY+C}}$

Weight of tare (g) = W_C

Weight of water (g), $W_W = (W_{\text{WET+C}} - W_C) - (W_{\text{DRY+C}} - W_C)$

3. Results and Discussion

3.1. *Amount of incoming solid waste*

The dumping site received waste from the ward no. 9, 10, 11, 12, 14, 16, and 41 and belonged to the zones 6, 7, 8, 9 of DCC. The average incoming waste to disposal sites varied from 313 ton/day in dry season to 414 ton/day in wet season as shown in Table 1.

Table 1. Average incoming waste amount to disposal site in Amin Bazar.

Survey time	Waste amount carried (ton/day)	Annual Waste amount carried (ton/year)
Dry season	330	120450
Wet season	424	154760
Average	377	137605

Total amount of incoming waste is about 137605 ton/year. Around 72% of the incoming wastes are organic in composition and rests of them (28%) are inorganic. Waste that arises from living things, decomposes naturally was called organic waste e.g. vegetable, peel of fruits, leaves, flowers, fish and meat, paper, cloth etc. Waste that is not organic, does not decompose and can usually be reused was called inorganic waste. For example, plastic, glass products, metal/iron etc. Most of the organic waste can be reused through composting and the inorganic waste can be recycled.

3.2. Physical composition

One of the common features of collected samples was color and odor. All the samples had nauseating bad smell and were black in color. The percentages of the sample composition were varied in different seasons. In the following Table 2, the average percentages of the physical composition and the average amount of recyclability of incoming solid waste at the dumping site are given.

Table 2. Physical Composition and the amount of Recyclable and Non-Recyclable wastes.

Constituents	% of total waste			Recyclable/ Non-Recyclable	Recyclable waste (tons/year)	Non- recyclable waste (tons/year)
	Dry Season	Wet Season	Mean			
Plastics	5.00	7.00	6.00	Recyclable	8256	Nil
Paper	4.00	3.00	3.50	Recyclable	4816	Nil
Glass	0.25	0.20	0.23	Recyclable	344	Nil
Textile	3.00	3.50	3.25	Non-Recyclable	Nil	4472
Food and kitchen	70.00	75.00	72.25	Non-Recyclable	Nil	99763
Wood/grass	0.16	0.10	0.13	Non-Recyclable	Nil	179
Garden waste	11.0	6.00	8.50	Non-Recyclable	Nil	11696
Ash/Soil	1.46	1.00	1.23	Non-Recyclable	Nil	1692
Metals	0.13	0.20	0.16	Recyclable	196	Nil
Others	5.00	4.00	4.50	Recyclable	6192	Nil
Total	100	100			19804	117802

The domestic waste abounds in organic waste including food waste and its content becomes higher in rainy season than that in dry season. The food waste portion varied on average from 70% in dry season to 75% in wet season. The organic waste (paper, food waste, wood and grass) appears more than 80% in the domestic waste throughout the year.

The percentages of plastics increased upto 7% in wet season from 5% in dry season. The total percentages of recyclable and non-recyclable wastes were 14.38% and 85.62% respectively. Due to the rainfall the demand of plastics, polythene increases and at the same time paper products demand decreases. The percentages of garden waste decreases in the wet season.

3.3. *Moisture content*

Moisture content is the measure of the amount of water retained by the waste elements. It depends on the percent of pore space presents in the element. The elements with higher percentages of pore space contain more moisture. Most of the samples of rainy season show higher value than dry season as shown in Fig. 2.

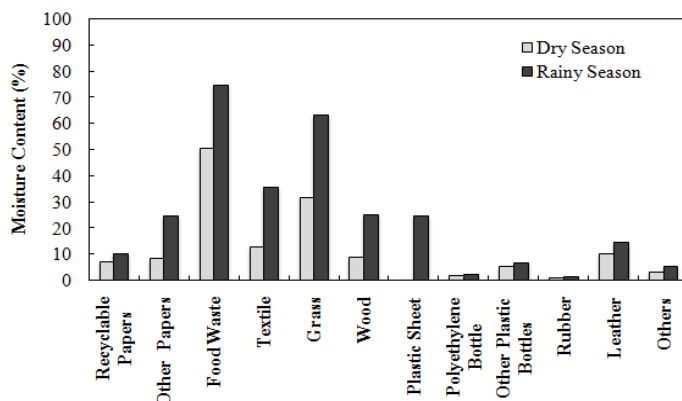


Fig. 2. Moisture contents of the constituents of incoming solid wastes at Amin Bazar waste dumping site.

Heating values of solid wastes depend on the types of wastes and moisture contents of the wastes. Themelis *et al.* [12] reported that the heating values of the different types of wastes decrease as the moisture content increases. Based on the moisture contents, the calorific value of the solid waste generated in Dhaka city was estimated 8.0 MJ/kg [13]. So, there is a huge prospect of producing electricity from the waste.

3.4. *pH*

pH is a term used universally to express the intensity of the acidity or alkalinity. It is a measure of hydrogen ion concentration or more precisely the hydrogen ion activity. The collected samples were analyzed for pH determination. The following Table 3 represents the pH values of the samples. The range of pH of the samples was from 6.9 to 7.8 with an average 7.47 which indicates the neutral condition.

Table 3. The pH value of the wastes at Amin Bazar waste dumping site.

pH			
Sample 1	Sample 2	Sample 3	Average
7.5	7.5	7.8	7.6
7.6	7.6	7.8	7.7
6.9	7.2	7.8	7.3
7.2	7.4	7.3	7.3
7.1	7.5	7.6	7.4
7.3	7.5	7.4	7.4
7.8	7.6	7.5	7.6
7.5	7.7	7.5	7.6

3.5. Economic prospects of the waste management

3.5.1. Recycling of wastes

Recycling is the most important practice of solid waste management. Materials recovered from solid waste can be used as resources or as raw materials for the new production. The main recyclable wastes and recycled products are aluminum, ferrous metals, paper and cardboard, glasses and plastics. The Amin Bazar waste dumping site annually received 196 tons of aluminum and ferrous metals, 4816 tons of paper and cardboard, 8256 tons of plastics and 344 tons of glass materials. These can be used as resources. The proper recycling process of them can provide a large income source. The Table 4 indicated the economical payback of wastes from recycling processes.

Table 4. The economic benefits of recycling of waste materials.

Recyclable Commodity	Annually Generated Amount (Tons)	Price per Ton (BDT)*	Total price (BDT)
Metals	196	20000	3920000
Papers and Cardboard	4816	12000	57792000
Glass	344	5000	1720000
Plastics	8256	6000	49536000
Total	13612		112968000

* From the local market

Waste recycling has some significant advantages. If the waste can be recycled properly, it will be possible to earn around Bangladeshi Taka (BDT) 112.9 million in every year. Now a day these commodities are collected by the waste pickers and sell in the local market. The polythene or plastic products are recycled by a group of people and sell in the local market.

3.5.2. *Composting of waste*

Compost is organic material that can be used as a soil amendment or as a medium to grow plants. Mature compost is a stable material with content called humus that is dark brown or black and has a soil-like, earthy smell. It is created by: combining organic wastes (e.g., yard trimmings, food wastes, manures) in proper ratios into piles, rows, or vessels; adding bulking agents (e.g., wood chips) as necessary to accelerate the breakdown of organic materials; and allowing the finished material to fully stabilize and mature through a curing process. Three types of composting are typical and can produce 0.25 tons of compost from 1.0 tons of organic waste [14]. The total amount of organic wastes (99075 ton) received by Amin Bazar dumping site in one year can produce 24768 tons of composts. The price of per kilogram compost is minimum BDT 3.5 in the local market and therefore it is possible to make BDT 86.7 million every year if the organic wastes of the incoming site are properly composted.

4. Conclusion

The amount of solid waste generation is large in Dhaka. The present solid waste dumping system is neither environment friendly nor sustainable. Unplanned dumping of solid waste poses severe health hazard as they often contain pathogenic microorganisms. The runoff pollutes aquatic ecosystems. The solid waste management system of DCC is not sufficient to manage the up growing problem of solid waste. So, government should take some necessary steps in this regard by providing proper management authority and effective action plans. Importance should be given in recycling and composting which is a source of income as well as sustainable environmental management.

The solid waste is a solid resource if the wastes are managed properly. Annually 112.9 million BDT can be earned from the waste of the site if the wastes are recycled properly and annually 86.7 million BDT can be earned from the organic waste if the wastes are composted properly. The total amount of income will be 200 million BDT if the wastes are properly managed. There should be more emphasis on recycling and composting of the wastes. Through these processes it is possible to get economical benefits as well as sustainable environmental management. By ensuring the availability of skills, knowledge, and capacity to implement waste management programs effectively, especially at the local level, it is possible to turn the solid waste into the solid gold.

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