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Assessment of Municipal Solid Waste Management in Mymensingh City towards Sustainable and Profitable Waste Management

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Abstract

Waste generation is increasing with the increasing of population at Mymensingh city but the waste management practice of the Mymensingh city corporation is not well established. The present study was conducted to find out profitable opportunities for municipal solid waste (MSW) management of Mymensingh city. Both primary and secondary sources were used to collect data as fulfillment of the study. Twenty two different locations of 5 wards in the city were visited for collecting these data. In the city estimated amount of waste produce 150 tons/day where 40-50% biodegradable and 15-25% recyclable paper, plastic, glass, metal etc. Currently waste is not being collecting and disposing scientifically due to unavailability of facilities, thus creating environmental pollution as well as unable to earn profit. Resource recovery and recycling could be a good option to reduce waste and earn profit from recyclable materials such as plastic, paper, metal etc. Besides this composting could be useful to produce bio fertilizer and bio gas from biodegradable wastes. By selling bio-fertilizer and biogas city could also earn profit. Integrated waste management combination with reduce, recovery, recycling and composting would be better solution for managing waste in the city.

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Introduction

Municipal solid waste (MSW) becomes a serious problem in developing country, especially in urban areas where the large and rapid population growth occurs. As a developing country huge amount of solid waste generated in municipal areas but most of them are not managed properly in the cities of Bangladesh. Mymensingh which recently upgraded as City Corporation have an area of 91.315 square kilometers having a huge population of 471,858 in 2018 (Khan *et al.,* 2018). Population migration rate in newly formed Mymensingh city is also high-flying. As the population is increasing in this city waste production is also increasing day by day.

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Currently Mymensingh city producing around 150 tons of waste per day among them city authority collect 130-140 tons of waste which is almost 90% of total waste, and 10-20 tons of wastes remain in different street, drain in the city (Khan *et al.,* 2018). It is predicted that this waste generation will be double 280 tons/day and 0.40 kg/person/day (LGED, 2017).

Generally, MSW in Mymensingh is disposed of in low-lying areas without taking any precautions or operational controls. Therefore, MSW management is one of the major environmental problems of Mymensingh. It involves activities associated with generation, storage, collection, transfer and transport, processing and disposal of solid wastes (Sharholy *et al.,* 2008). But, in Mymensingh city, the MSW management system comprises only four activities, i.e., waste generation, collection, transportation, and disposal (Khan *et al.,* 2018).

The management of MSW requires proper infrastructure, maintenance and upgrade for all activities. This becomes increasingly expensive and complex due to the continuous and unplanned growth of the city. Life Cycle Assessment (LCA) is a holistic approach that quantifies all environmental burdens and therefore all environmental impacts throughout the life cycle of products or processes (Rebitzer *et al.,* 2004). It is increasingly utilized for solid waste management systems especially in the decision-making process and in strategy-planning. LCA has been utilized for sustainable MSW management since 1995 (Güereca *et al.,* 2006). LCA is an ideal tool for application in MSW management because geographic locations, characteristics of waste, energy sources, availability of some disposal options and size of markets for products derived from waste management differ widely (Abeliotis, 2011). Previous studies regarding waste management in Mymensingh focused mainly on waste generation, current management practice, and its impacts on human and environment etc. (Islam *et al.,* 2008; Mian *et al.,* 2010; Muhit *et al.,* 2011; Rahman *et al.,* 2015), but not showing profit earning opportunities. Therefore, a study which shows the profit earning opportunities from waste management in Mymensingh city was essential.

Objectives

Considering the above issue, the present research on Life Cycle Assessment of municipal solid waste management in Mymensingh City to find out better municipal solid waste management options was carried out.

Specific objectives of the study are -

a) To determine the amount of solid waste generated in the system area of concern, which are the city of Mymensingh.
b) To determine the most feasible system of Municipal Solid Waste management for Mymensingh City using LCA tool and
c) Find out profitable options for MSW management of Mymensingh city.

Materials and methods

Study area

Present study was conducted at Mymensingh City Corporation, which was upgraded to a city corporation, the country's 12th, on 2 April 2018 from Municipality. The city is located about 120 kilometres (75 mile) north of Dhaka, the capital of Bangladesh. Mymensingh City Corporation have an area of 91.315 square kilometres and a population of 4,71,858 in 2018.

Sampling and data collection

After the selection of the study area sample were collected using LCA tools. Twenty two different locations of 5 wards in the city were visited for collecting these data. Data and sample were collected from November 2019 to June 2020. All types of waste like biodegradable, metal, electronic etc. data were collected. A survey work was carried out to find data regarding waste and its management options at Mymensingh City.

Sample analysis

The present study was undertaking to identification of waste categories at Mymensingh City and its management options. Based on the waste list, waste were categorized such as recycle waste, bio-degradable waste, non-biodegradable waste etc. An LCA was evaluated based on different waste data. The volume and composition of these waste were measured. Based on waste data, management options were compared with refereed works.

Results and discussion

Qualitative and quantitative analysis of MSW of mymensingh

There are many categories of MSW such as food waste, rubbish, commercial waste, institutional waste, street sweeping waste, industrial waste, construction and demolition waste, and sanitation waste (Sharholy *et al.,* 2008). Data on quantity variation and generation are useful in planning for collection and disposal systems. An estimated MSW generation in Mymensingh city has listed in Table 1. Presently, in Mymensingh City, around 150 tons of waste produce per day among them city authority collect 130-140 tons of waste which is almost 90% of total waste, and 10-20 tons of wastes remain in different street, drain in the city. MSW contains recyclables (paper, plastic, glass, metals, etc.), toxic substances (paints, pesticides, used batteries, medicines), compostable organic matter (fruit and vegetable peels, food waste) and soiled waste (blood-stained cotton, sanitary napkins, disposable syringes).

Characteristics and composition of MSW

In this study waste was categorized into five classes i.e. Biodegradable waste, Paper, Plastic, Polythene

Table 1. Estimated MSW generation at mymensingh city

Year	Population	Total waste generation (tons/day)	Average per capita waste generation (kg/person/day)
2015	296,107	89	0.30
2020	351,682	116	0.33
2025	417,688	138	0.33
2030	496,082	164	0.33
2035	589,190	236	0.40
2040	699,773	280	0.40

Source: LGED, 2017

and others. Other categories wastes are medical waste, clothes, electronic wastes, industrial waste, glass etc. Maximum waste in other categories comes from medical waste Medical College Hospital and many private clinic, pathology and pharmacy are situated in the city. The composition of MSW at generation sources and collection points was determined on volume basis and it consists mainly of a large organic biodegradable fraction (40–50%), Polythene (30–35%), paper (5–10%) and plastic (4–8%), glass and metals (each less than 1%). By weight and volume biodegradable waste which includes kitchen waste, food items etc. is large amount (Fig. 1).

The Life cycle inventory of MSW management in mymensingh

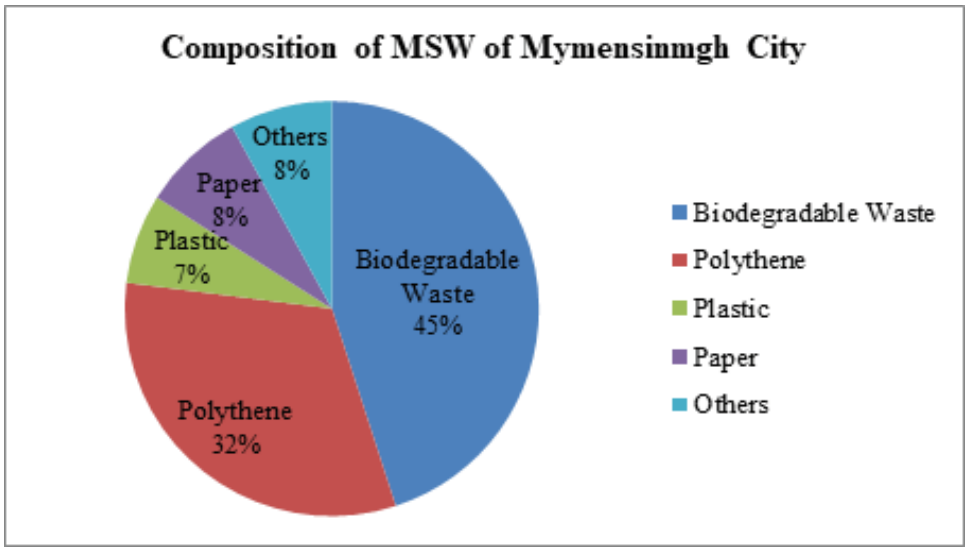

Fig. 1. Percentage (by volume) of total solid waste in mymensingh city

The LCA assesses the use of resources and the release of emissions to air, water, land and the generation of useful products. In the following sections, the most important LCI components of each management stage are identified and presented for the Mymensingh city. a) collection and transport of MSW, b) mechanical and biological treatment, c) thermal treatment, d) biological treatment, and e) landfilling.

Collection and transport of MSW

The MSW collected from the dustbins and collection points. Then transported to the processing or disposal sites using a variety of vehicles. Dustbins of the city are not hygienic though some new pair bins are setup in different locations, one is green color for biodegradable waste and another is yellow color for non-biodegradable waste (Fig. 2-a). In the city, vans, demountable container carrier trucks, tractor-trailers, tricycles etc. are mainly used for the transportation of MSW.

Fig. 2. (a) Waste collection bins at mymensingh city, (b) Open burning of waste beside railway station, (c) Open dumping of waste near China bridge

Mechanical and biological treatment

Mechanical and biological treatment is a process that generates many useful products (Abeliotis, 2011). In this study we did not find any facility of Mechanical and biological treatment in Mymensingh city.

Thermal treatment

There is no scientific or modern thermal treatment facility in the city, but we found open burning during. When accumulated waste turn into huge amount, the workers burn these either completely or incompletely in open places (Fig. 2-b). These activities pollute environment as well as serious threat to human health.

Biological treatment

There are two processes included under the term "biological treatment" in MSW management: composting and anaerobic digestion (Abeliotis, 2011). The degradable organic carbon in the MSW is converted into CO_2. No biological treatment facilities have been established yet, but it has a big opportunity in the city.

Landfilling

Landfilling is the first and oldest MSW treatment option. The types of landfilling facilities, all over the world, range from uncontrolled dumpsites to highly engineered facilities with leachate and lanfill gas (LFG) management. Study found that there are no modern facilities for landfill in the city. It dumps wastes near the China bridge of the city (Fig. 2-c).

Profitable management opportunities of MSW

For managing MSW it needs large amount of money. Collection and transportation activities constitute approximately 50–60% of the total budget of MSWM (Khan *et al.,* 2018); hence, it forms a key component in determining the economics of the entire MSWM system. Therefore, authority should search profitable ways to manage this waste. A flowchart shows the way to earn profit from managing waste in Mymensingh city (Fig. 3).

Recovery and recycle of recyclable materials

Recycling refers to the removal of items from the waste stream to be used as raw materials in the manufacture of new products. Recycling can prevent the waste of potentially useful materials and reduce the consumption of fresh raw materials, thereby reducing: energy usage, air pollution (from incineration), and water pollution (from landfilling). Plastic, paper, electronic waste of the city could be selling as raw materials. These raw materials are then used in the production of new products. A number of recyclable materials, for example paper, glass, plastic, rubber, ferrous and non-ferrous metals present in the MSW are suitable for recovery and reuse. It has been estimated that the recyclable content varies from 15% to 25%. In India, about 40–80% of plastic waste is recycled (Sharholy *et al.,* 2008), but in Mymensingh, this recycling practice is not well developed. It is predict that recycling practice could have a great role to earn profit in Mymensingh.

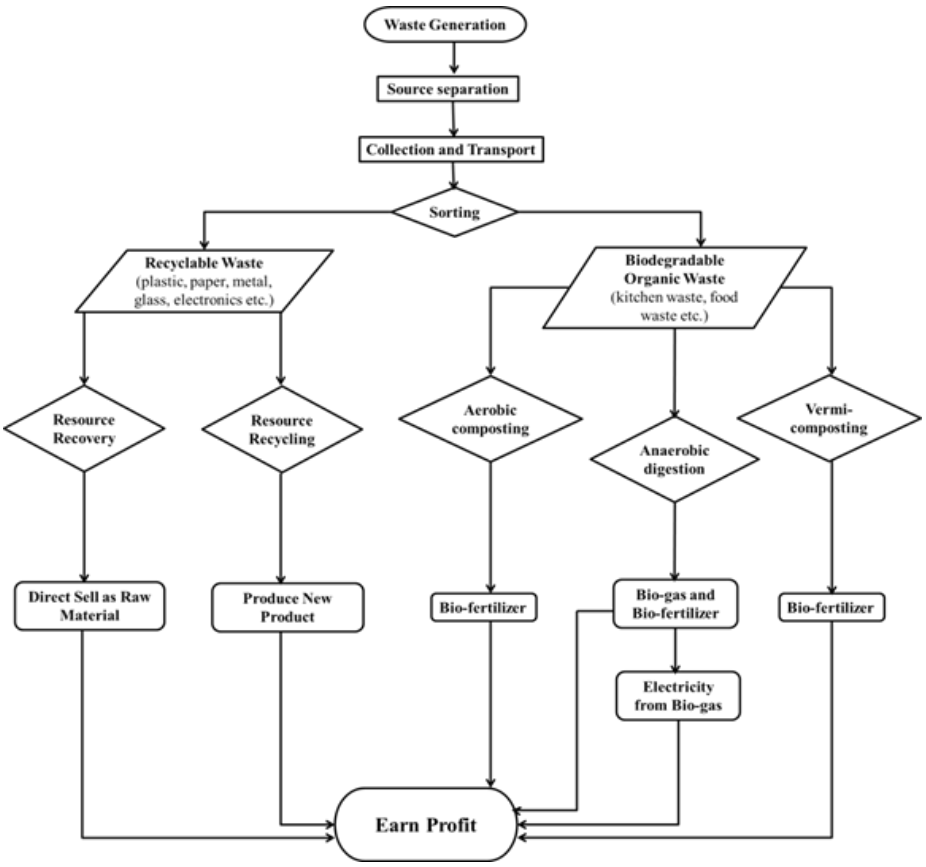

Fig. 3. Flowchart showing earning profit from waste (Khan *et al.*, 2018)

Fertilizer and energy production through composting

The bacterial conversion of the organics present in MSW in the presence of air under hot and moist conditions is called composting, and the final product obtained after bacterial activity is called compost (humus), which has very high agricultural value (Sharholy *et al.,* 2008). It is used as fertilizer, and it is

nonodorous and free of pathogens (Ahsan, 1999; RR Khan, 1994). As a result of the composting process, the waste volume can be reduced to 50–85% (Khan *et al.,* 2018). Recently about 9% of MSW in India is treated by composting and in Mumbi 300 t/day capacity plant is being composting and the compost produced is being sold at the rate of 2 Rs./kg (US$0.046/kg) (Sharholy *et al.,* 2008). Therefore, Mymensingh city has the potentiality to compost its biodegradable waste and earn revenue by selling compost fertilizer to farmers of the adjacent areas of the city.

Average biogas production at an anaerobic digestion facility falls between 0.2 and 0.3 standard cubic meter per wet kilogram of waste (Rana, 2016), and the amount of gas typically ranges between 50–70% (Klinkner, 2014). The biogas, which has 55–60% methane, can be used directly as a fuel or for power generation (Sharholy *et al.,* 2008). The Mymensingh city also have the opportunity to produce biogas estimated 5300 m3 from its 57 tons of biodegradable waste per day. And this biogas could be sell to rural areas as well as could be produce electricity.

Conclusion

Waste is resources if it manages in profitable manners and it could earn revenue. The present waste management system of Mymensingh City is very unscientific. For the safe of the health of citizen as well as protect environmental pollution of the city need immediate steps to manage solid waste properly. The study reveals that composting is the better option because reduces the pressure on the landfills. It has a good opportunity to produce bio-gas and bio-fertilizer from the solid waste of the city and profit could be earned from selling biogas and biofertilizer byproduct. But integrated management system including recovery, recycling would be better options for waste management of the city.

Following steps could be taken for better and profitable SWM for Mymensingh city-

a) Plastics, paper etc. should be recycle
b) Biogas and bio-fertilizer should be produced from biodegradable waste
c) Government should allocate money for such profitable SWM
d) Further research will be needed before starting any options for the management

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