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Municipal solid waste (MSW) management in Dhaka City, Bangladesh

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Abstract : *Dhaka is the capital city of Bangladesh, with the highest population density (129,501 people/square km) in the world. Municipal solid waste (MSW) generation in the city is 4634.52 tons/day. This study aims to explore current MSW management scenario which is found one of the most underestimated sectors of Dhaka City Corporation (DCC) – the responsible authority for MSW management. Overall operational and collection efficiency of DCC MSW management is 45% and 60%, respectively. Vehicle fleet for waste transport showed considerably low efficiency in terms of load carrying capacity and fuel consumption. Residential waste is found potential source of composting. At present, a 500 tons/day compost plant has been operating since September 1998. Worth of recoverable recyclable material is found US$ 82,428,449.9989. Open dumping is a pressing problem leading to groundwater pollution, environmental contamination and emission of greenhouse gases (GHGs). Each day, approximately, 1800 tons of MSW is dumped in the only official landfill site – Matuail. DCC spends 1.5% (601,350 Bangladesh Taka (BDT)/day) of the total budget for landfilling operation and management. Land required for disposal of MSW in Dhaka is estimated to be 110 ha per year. Clean Development Mechanism (CDM) projects in waste sector in Bangladesh are found promising. This study urge to prepare a detailed plan for sustainable MSW management in Dhaka for source separation, large scale investment on composting and Waste to Energy (WTE) projects, recycling, state of the art landfill development, and optimized reverse logistic operation*

Keywords: *MSW; Composting, Recycling; Electricity, GHGs, CDM, Dhaka, Bangladesh*

I. INTRODUCTION

Not only developing countries but also globally, municipal solid waste management (MSWM) is a critical and multifaceted problem (Barton et al., 2008, Chen et al., 2010, Manaf et al., 2009). Globally, municipal solid waste (MSW) generation was estimated about 1.6 billion tons in 2002 (Pappu et al., 2007), and it is predicted that, by year 2025 and 2050, solid waste generation will reach 2.2 and 4.2 billion tons/year, respectively; faster than rate of urbanization in large metropolis (Council, 2013). In recent years, developing countries started improving municipal solid waste management (MSWM) practices. Increasing urban solid waste is neither properly managed nor appropriately disposed. Major inhibitors for MSWM for developing countries, includes low level of technical know-how knowledge, financing MSW management, particularly in collection, transport and disposal mechanism, considering resource recovery (Henry et al., 2006, Imam et al., 2008, Shekdar, 2009). Several researchers from developing countries discussed improper MSWM in their respective cities (Alavi Moghadam et al., 2009, Henry et al., 2006, Manaf et al., 2009, Pokhrel and Viraraghavan, 2005, Sharholy et al., 2008, Troschinetz and Mihelcic, 2009, Zhen-Shan et al., 2009). Human health and biological degradation is affected by improper management of MSW that leads to socio-economic degradation (Abu Qdais, 2007, El-Fadel et al., 2002, Shekdar, 2009).

Dhaka is the capital city of Bangladesh, with a population over 7 million and the highest population density (129,501 people/square km) in the world. The city is located on latitude 23° 42′ 0″ north and longitude 90° 22′ 30″east. The population growth rate of Dhaka city in the last decade was 56.5% which is among the highest in the world (Hossain, 2008). With current pace of urbanization, waste generation is increasing exponentially. It is found that MSW generation in the city is 4634.52 tons/day (Alamgir and Ahsan, 2007a, Concern, 2009). Socio-economic condition, standard of living and rate of urbanization are some of the influencing factors for exponential growth of MSW, especially in the urban and semi-urban areas of developing countries (Rathi, 2006).

Dhaka City Corporation (DCC) – North and South is responsible for MSWM that is found ill-fated and malfunctioned for many years. However, it is now trying to improve the situation with the help of financial incentives from different donor agencies and development partners such as United Nation Development Programme (UNDP), Swiss Development Cooperation (SDC), United Nations Children's Fund (UNICEF) and non – government organizations (NGOs) and notable social business enterprise - Waste Concern (Zurbrügg et al., 2005).

This paper presents an overview of current MSWM in Dhaka city, and identifying constrains providing several recommendations for system improvement. Possible sustainable resource recovery technique through clean development mechanism (CDM) under Kyoto Protocol is also discussed. This study may be beneficial for municipal authorities and researchers to work towards redefining present MSWM system.

II. MATERIALS AND METHODS

Document analysis or desk research generally forms part of policy research (Ritchie and Spencer, 2002). Functional data were embedded through interviews based on the data found from the questionnaires distributed to city dwellers, urban planning officer, municipal authorities related to waste management. Secondary data were collected from various government and non-governmental reports, published articles, books, policy paper and conference proceedings. Study conducted by Japan International Cooperation Agency (JICA), and subsequent reporting of ‘’Clean Dhaka Master plan’’ is only up to date source that provided major part of the quantitative data for this article.

III. RESULTS AND DISCUSSION

In this section, current state of Dhaka city MSWM., its challenges and recommendations are discussed.

3.1 STATUS QUO OF DHAKA MSW MANAGEMENT

Several factors are involved in MSWM including waste generation, collection and handling, disposal, transport and transfer of waste (Kumar et al., 2009). In this section, the status quo of MSWM in Dhaka city is discussed.

3.1.1 MSW GENERATION AND CHARACTERISTICS

Waste generation in city areas is largely influenced by many of the factors such as geographical condition, waste collection frequency, stages of socio-economic development and climatic condition (Keser et al., 2012, Weng and Fujiwara, 2011). Quality generation is valuable information for future waste management planning (Beigl et al., 2008, Sharholy et al., 2007). Total MSW generation in DCC area is 4634.52 tons/day, with a per capita waste generation is 0.41kg/day (Concern, 2009). Among the other three metropolises of Bangladesh, waste generation varies from 172.83 tons/day to 1548.09 tons/day (Concern, 2009).

A percentage variation of the waste generation is shown in Table.1

Table 1: MSW composition (in %) at Dhaka between 1992 and 2005(Concern, 2009)

Sl no.	Parameters	1992 (in %)	2005 (in %)
1.	Glass/metal/Construction	6.38	8.17
2.	Plastics	1.74	4.1
3.	Textile	1.83	4.57
4.	Paper/cardboard	5.68	4.29
5.	Food waste (organic)	84.37	78.87

As shown, the percentage of organic food waste (FW) comprises as the highest in the MSW of Dhaka city. This generally happens due to lack of consumption of unprocessed foods. However, fraction of organic waste decreased from 84% in year 1992 to 78% in year 2005. The presence of large organic fraction in MSW is reported for many other developing countries such as India (40-60%) (Sharholy et al., 2008), Turkey (43-64%) (Keser et al., 2012), China (57-62%) (Chen et al., 2010), Nigeria (52-65%) , Nepal (60-70%) (Pokhrel and Viraraghavan, 2005). Physical and chemical composition of MSW in Dhaka is presented in Fig. 1 and Fig. 2. In recent times, percentage of plastics as packaging waste is changing due to large scale process food production in Bangladesh. Moreover, fast food culture that spreads widely throughout the city is making changes in food habit as well as the composition of waste items.

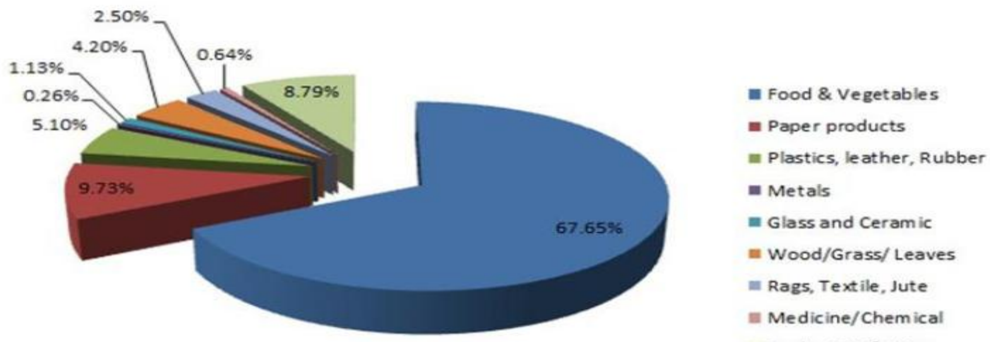

Fig. 1: Average Physical Composition of MSW in Dhaka (Concern, 2009)

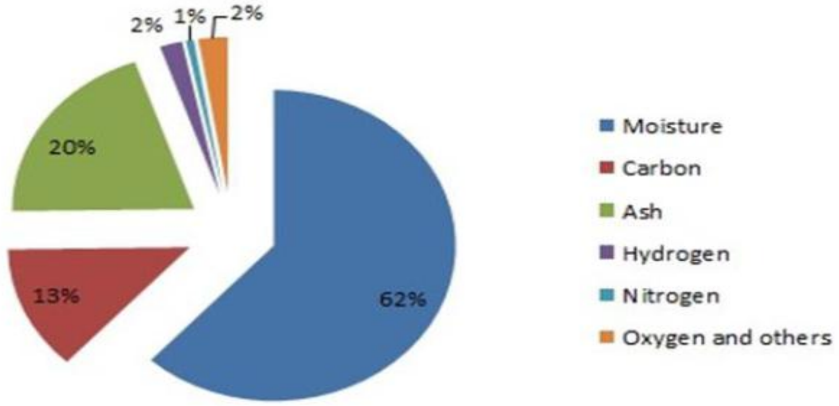

Fig. 2: Chemical composition in municipal solid waste in Dhaka city (Hamid Khan and Fayyaz Khan, 2009)

3.1.2 WASTE HANDLING AND PROCESSING IN DHAKA CITY

The method of waste handling and processing has direct effect on public health, collection efficiency, resource recovery of a MSWM system (Talyan et al., 2008). Like other developing countries, though unorganized and informal, MSW in Dhaka is generally handled and processed by large informal sector. Implementing source separation scheme at source is an important practice as part of sustainable MSW management and planning (Troschinetz and Mihelcic, 2009). However, there is no separation scheme is currently available in Dhaka city. Even, it is unfortunate that there is no hazardous waste collection and disposal scheme is present in Dhaka city. Separation of waste is an effective and sustainable practice from the view point of resource recovery and/or reuse of materials. Fig. 3. shows waste handling and processing flow, typically practiced in Dhaka

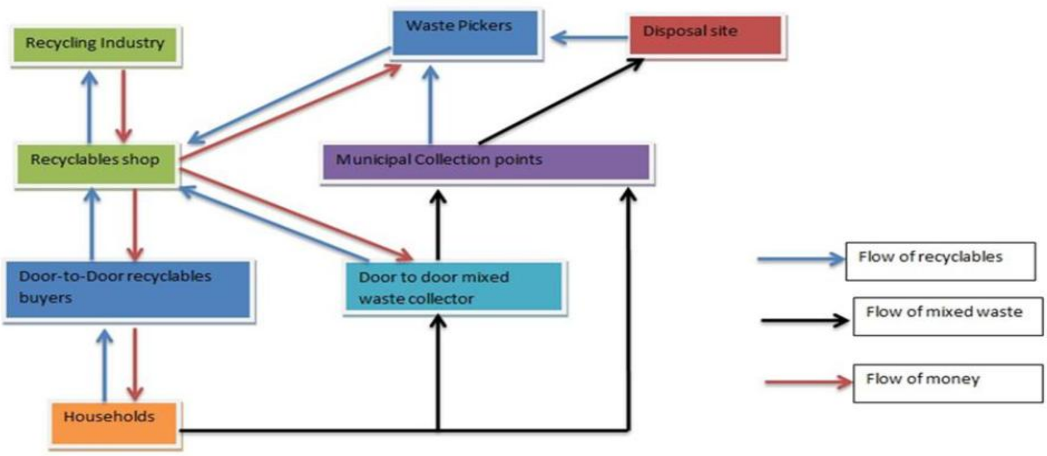

Fig. 3: Flow of waste, recyclables and money in MSW management in Dhaka (adopted from Matter et al. (2013))

3.1.3 COLLECTION OF SOLID WASTE

Collection, storage and transportation of large amount of generated MSW is a complex task that require attention considering contextual setting, constrain and opportunities (Ahsan et al., 2014). Organic fraction of the waste can degrade easily creating invasive odors, and leachate in open container those are placed haphazardly (even in the bus stop) beside the road sides may cause serious health impact on the city dwellers. In recent times, demountable containers are being used for onsite storage of MSW in some areas in Dhaka city. Numbers of containers for disposal are less. In Dhaka, 45% to 55% (2,200 ton/day) of the total waste is unmanaged and dumped in open space (SMS Rahman, 2009). However, The collection target for the year 2015 is about 3054 tons/day at present, which is higher than 218% as of 2004 (JICA, 2005). In Dhaka, DCC is primarily responsible for MSW collection and transport. Besides, there are total 47 non-government organizations (NGOs)/ Community based organizations (CBOs), currently working for household MSW collection. However, activities are limited to a small number of organizations (JICA, 2005). No community based participation has been developed and/or in action for MSWM, except small scale composting plant (A, 2000, Hai and Ali, 2005, TB, 1996). Manual waste collection method is generally practiced to collect household waste to transfer it to the containers. DCC waste collection vehicles collect the waste from open containers, transfer stations; and transport them to official landfilling site – Matuail. Each day, approximately, 1800 tons of MSW is dumped at the site (Yousuf and Rahman, 2007).

3.1.4 TRANSPORT AND TRANSFER

At present, transport system concerning MSW is managed both by private and city corporation vehicles – open trucks (OT), container carrier (CC) and Trailer trucks (TT) (JICA, 2005). Private organizations have three wheeler manual vans to collect household waste to disposal points/open container, situated at anonymous locations in different parts of the city, as primary collection point. Transfer station decreases operational cost of MSW transfer and handling (Alavi Moghadam et al., 2009). However, there are only 14 transfer stations in Dhaka (FE, 2014) . Collection and transportation has become a primary issue in MSWM in Dhaka city (JICA, 2009). Transport sector infrastructural development is found critical to achieve such target. As of 2009, DCC has 297 collection and transport vehicles that have carrying capacity of 1619 tons/day (JICA, 2009). It is clearly visible that collection efficiency (around 60%) with existing DCC vehicle fleet is very poor (JICA, 2005). Moreover, many of waste collection vehicles are too old and/or lack of repair and maintenance leading to vehicles malfunctioned

3.1.5 FINAL DISPOSAL

It is estimated that about 95% of MSW generated in the world is dumped either in land, rivers or even in sea without considering the subsequent environmental damages (Castaldi, 2014). Landfilling is found one of the most suitable options from the economic stand point for developing countries (Kumar and Sharma, 2014). Other popular methods of final disposal are incineration and composting. Even though, landfilling is cost effective, it is also responsible for ground water contamination (Peng et al., 2014). Like other developing countries, open dumping and landfilling, is the most common practice for MSW disposal in Dhaka. In several occasion, it was found that insinuation of leachate from open dumping cause contamination of land and ground water, and the surrounding environment (Aziz et al., 2014). Fig. 4. shows the MSW dumping at Matuail landfill site.

Fig. 4: Dumping of MSW at Matuail landfill site (Yousuf and Rahman, 2009)

Composting is found the most viable alternative option for disposal of MSW in Dhaka city. Typical organic waste contains high moisture about 62%. Decentralized composting projects found promising if composting plants are located at the proximity of waste generation. Low cost manual source separation, and adoptable technology along with socio-economic condition of the waste treatment workers is also vital implementing such

projects. Community based decentralized waste treatment, especially in case of composting, several developing countries, especially in the urban areas, showed tremendous success, mainly in the low income countries (i.e. Pakistan, Sri Lanka, India, Nepal, Bangladesh) (Zurbrugg, 2002). In Bangladesh, the first decentralized community based composting plant was established at Section-2, Mirpur, Dhaka, Bangladesh; by social business enterprise - Waste Concern in 1995. The capacity of the composting plant is about 3 tons/day, out of which maximum composting capacity is currently 2.52 tons/day (Zurbrügg et al., 2005). The plant is still continuing its operation and four more replications are about to proceed in other parts of the country.
Fig 5 shows the construction, installation and usage of barrel composting technology developed by Waste Concern with the technical and financial cooperation of United Nations International Children's Emergency Fund (UNICEF) and Department of Public Health Engineering (DPHE), Government of Bangladesh. The primary objective of such project is to encourage people to set up composting plant under private ownership and managing the waste by community participation (Concern, 2005a). Besides, barrel type composting; aerator and box type composting methods are also being used by waste concern (Iftekhar Enayetullah and Hashmi, 2006).

Fig. 5: Construction, installation and use of barrel composting developed by waste concern (Concern, 2005b)

3.2 RECYCLING OPPORTUNITIES FROM MSW IN BANGLADESH
Table 2 gives an overview of the availability of recyclable items from MSW generation in Bangladesh. Total market value of the recyclable items is 6396,975,262 BDT (US$ 82,428,449.9989). Inclusion of formal sector in reverse supply chain can also boost the overall operational performance of MSWM. Table 3 shows the recycling rate and overall waste reduction of major recyclable items in Dhaka city. It is found that recycling rate of glass, plastic and paper are considerably higher. But as the process food industry is growing in Bangladesh tremendously (Rasul et al., 2006), generation of packaging waste require more adoptable tools and technology for recycling.

Table 2: Market value of recoverable materials in MSW of Bangladesh (adopted from Alamgir and Ahsan (2007b))

Recyclable Items	weight (in ton)	Recoverable weight (in ton)	Market price (BDT/ton)	Total Market Value (in BDT)	Market value (BDT/kg)
Paper	288900	202410	20953.728	4241,244,084	20.9537
Plastic	110400	77280	13193.088	1019,561,841	13.193
Metal	53900	37730	23281.92	878,426,841.6	23.28192
Leather and rubber	34600	24220	8536.704	206,758,970.9	8.536704
Glass	21100	14770	2716.224	40,118,628.48	2.71622
Bone	5000	3500	3104.256	10,864,896	3.1042

1 USD (US$) = 77.6064 Bangladesh Taka (BDT)

Table 3: Estimated volume of recycled wastes in Dhaka city (JICA, 2005)

Material	Recycling rate (in %)	Contribution to waste reduction (in weight %)
Plastic	83	3.2
Paper	65	5.3
Glass	52	0.8
Metal	-	1.3
Compostable	0	0.2
Others	95	2.9
Total		13.6

3.3 THE PRESENT CHALLENGES OF SOLID WASTE MANAGEMENT IN DHAKA CITY

Like, other developing countries, a number of factors are responsible for the poor performance of MSWM in Dhaka which are summarized as below:

(a) Waste sector inventories in Bangladesh are very poor and/or inadequate. Time series database should be developed for future waste sector management planning.

(b) At present, there is no source/waste separation system exists in the DCC - north and south areas. Lack of policy implication leads to potential inhibitors for formalized recycling sector.

(c) Primary collection of MSW from households with rickshaw vans is not suitable because of its design constrains.

(d) The number of transfer stations is very limited. Transfer stations should be established within the proximity of primary collection route, as this operation is generally done by three wheeler manual rickshaw van. Several collection points remain in poor condition due to lack of awareness.

(e) Most of the open trucks and garbage containers are not properly and regularly washed after the disposal of MSW at landfills which eventually reduce the lifecycle of vehicles.

(f) Total units of vehicle are 343, and more than 60% are open trucks (OTs). Other vehicle includes 127 container carrier (CC) and 3 trailer trucks (TTs) (JICA, 2009). The duration required for maintenance and repair generally takes longer, generally handled by private workshops on contract basis. As of September 2004, out of 343 units of vehicles, 60 units were still under repair work. With the existing vehicle and transport facilities, operational efficiency of the DCC MSW management is about 45% (JICA, 2005) which is considerably low.

(g) The fuel consumption of the DCC operated open trucks is not monitored. Most of the DCC trucks are not even marked as a DCC trucks specially designated for waste collection. In this case, the open trucks are covered with hard plastics during its travel from disposal points to landfilling areas. As the trucks are old and under-maintained, high fuel consumption occurs due to limited parts repairing. According to Center for Clear Air Policy (CCAP), improved repairing and maintenance of waste collection vehicles can increase waste collection rate from 44% to 61% from year 2004 to 2015 (CCAP, 2014).

(h) Besides the only official landfilling site Matuail and 2 unofficial dumping sites at Uttara (5% of the total MSW disposed) and Berri Band (30% of the total MSW disposed) (JICA, 2009), a huge quantity of MSW is disposed of in open canals and drains, or dumped into low–lying areas instead being collected and transported to the official waste disposal site.

(i) A state of the art sanitary landfill must be developed with the collaboration of community participation and donor agencies coupled identifying strategic location of the landfills in Dhaka city. According to Department Environment (DOE) of government of Bangladesh (GOB), land requirements for landfilling site, considering existing capacity, and with 100% collection efficiency will be 141 acres and 273 acres respectively (DOE, 2010b). It is to be noted that the 90% of the Matuail landfill is already being filled up and within one year, it will be totally abandoned if no further expansion is made (Iftekhar Enayetullah and Hashmi, 2006). Furthermore, as the city is situated in low laying areas and under the active flood plain, suitable site selection for future landfilling site will also create problematic situation.

(j) Operational activities and management of Matuail, and other adjacent land filling site is uncontrolled and there is no specific leachate collection and treatment facility available for the sites.

(k) A limited number of environmental impact assessments are carried out concerning surrounding environmental pollution and ground water contamination, which must be monitored on a regular basis with latest available technology.

(l) Health hazard of waste pickers at the Matuail land filling site is very poor. Unhygienic as well as unorganized handling may possesses serious and long term impact on urban poor population whose income generation is largely dominated by waste picking from landfills and dump sites.

(m) Modernization of weighbridge data collection at landfill site is found limited (Yousuf and Rahman, 2007). Weight bridge database is suitable to identify cost minimization of expenditure head of the respective authority.

IV. CLEAN DEVELOPMENT MECHANISM (CDM) OPPORTUNITIES IN WASTE SECTOR IN BANGLADESH

It is estimated that 60% of the methane gas generated from MSW decomposition can be recovered by landfill gas (LFG) collection system when MSW collection efficiency is 50% (Chattopadhyay et al., 2009, Enayetullah et al., 2003). Current MSW collection efficiency is 60% in case of Dhaka (Concern, 2009). Landfill gas (LFG) is found one of the viable bio resource derived from MSW (Assamoi and Lawryshyn, 2012). According to United States environmental protection agency (USEPA), methane is generally considered as a major contributor (2nd place) of global warming potential which is even 20 times higher than carbon dioxide (CO2) considering over a 100 year period (USEPA, 2010). In case of USA scenario, CO2 emission is higher compared to methane, which is 20 tons/year; where Bangladesh is emitting only a fraction – 0.2 tons/capita/year, and this is also comparatively lower to other developing countries - 1.6 tons/year (Enayetullah et al., 2003).

However, Bangladesh is in better position to reduce the greenhouse gas emission especially methane and CO2 from waste sector. Under the current CDM projects in Bangladesh, it is expected that from year 2004 to year 2012, extraction and utilization of LFG from Matuail landfill will reduce 80,000 CO2 equivalents with the help of flaring and cogeneration technology (Visvanathan, 2006). Bangladesh is a good candidate for successful CDM projects including waste sector. Adopting existing technology for LFG collection, especially methane, 100% greenhouse gas (GHGs) emission reduction can be achieved (Enayetullah et al., 2003). CDM projects in Bangladesh should target optimum LFG collection to produce power generation. Electricity generation from LFG and incineration are the two promising and viable technology that reduce GHG reduction (Kofoworola, 2007). LFG recovery project conducted by Waste Concern estimated that a total of 501,473 tons of GHG can be reduced as well as 102,148 megawatt hour (MWh) of electricity can be produced through the recovery of methane with a 7 years project life time (Concern, 2014). In this case, the average dumping of MSW at Matuail landfill was estimated 1200 tons/day and total quantity of the MSW disposal will be 3,066,000 tons. Research conducted by Han et al. (2010) showed that 198,74 MWh of electricity can be generated from LFG which can reduce 1,386,081 tons of CO2 equivalent with a 21 years of operation. On the other hand, incineration which is comparatively superior in technology can produce 611,801 MWh of electricity with GHG emission reduction of 1,339,158 tons CO2 equivalent in just only 10 years' time with an electricity generation efficiency 10% (Han et al., 2010). Comparing these two scenarios, it is expected that CDM project duration of 7 to 20 years in Bangladesh has relatively high potential to be successful in terms of CO2 reduction and electricity generation. Fig. 6 shows the GHG emission potential from waste sector. MSW produced in Dhaka city can generate about 100 MW of electricity considering 40% plant efficiency and 24 hours plant operation (Hamid Khan and Fayyaz Khan, 2009). In such case it is found that plant running cost is one of the lowest compared to other fossil fuel (i.e. coal, gas and diesel) based power plants. This analysis can provide a useful insight for waste to energy (WTE) projects under Kyoto protocol and CDM. Bangladesh government should encourage CDM projects in both public and private sector to achieve CDM implementation concerning GHG emission target, especially to waste sector. Necessary financial, institutional support and infrastructural development should be carried out taking consent of all stakeholders (government authorities, donor agencies, local and international NGOs, civil society, small and medium enterprises (SMEs) in waste management sector.

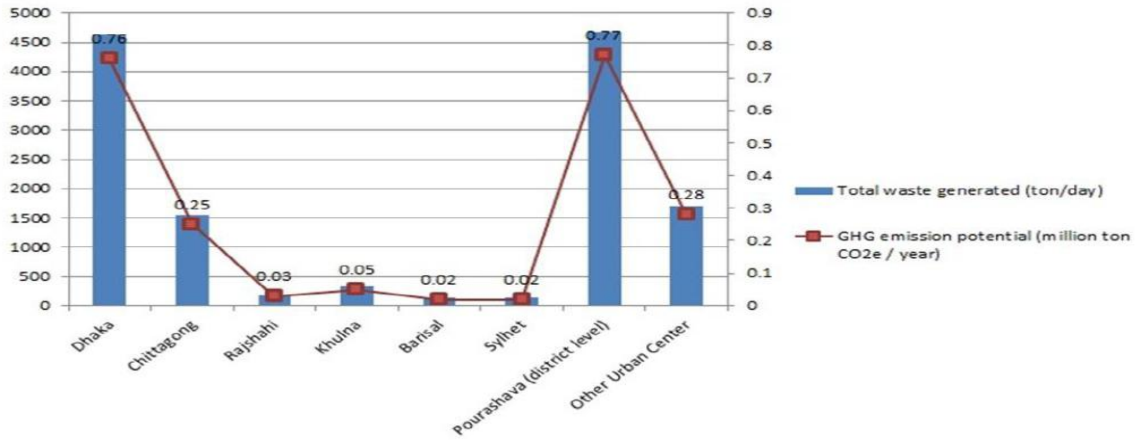

Fig. 6: Greenhouse gas emission potential from solid waste in Bangladesh (Concern, 2009)

A detailed techno-economic assessment of WTE plant and estimation of LFG generation from the landfills in Dhaka city should be carried out aiming to achieve socio-economic benefits (electricity generation, composting etc.) as well as opportunities for carbon trading under CDM. A generic flow diagram of electricity generation from LFG is shown in Fig 7.

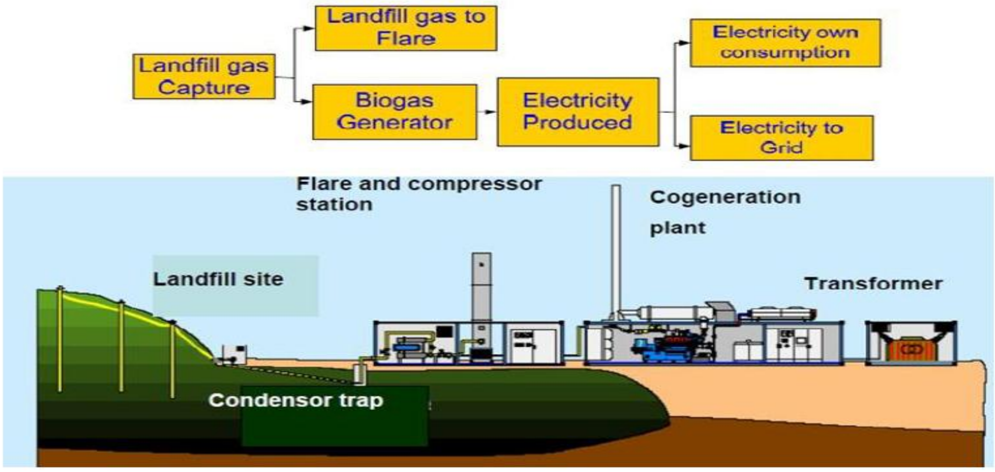

Fig. 7: Landfill gas utilization for electricity generation (Visvanathan, 2006)

4.1 OVERVIEW OF POTENTIAL WASTE TO ENERGY (WTE) PROJECTS IN DHAKA CITY

Incineration is found to one of the best possible WTE solutions in both developed and developing countries. According to Environmental Protection Department (EPD), Hong Kong, Integrated Waste Management Facilities (IWMF) aims to produce 480 million kilowatt-hours (kWh) of electricity from incineration plant which can supply electricity to 100,000 households using 3000 tons/day of MSW in Hong Kong (EPD, 2013). Council for Sustainable Development (CSD) of Hong Kong estimated that total cost for 10,000 tons/day waste incineration will cost about 10 to 15 billion Hong Kong dollar (HKD) (CSD, 2012). European Union (EU) Waste Incineration Directive 2000/76/EC is being followed to establish such large scale incineration plant which will also reduce 440,000 tons of greenhouse gas each year. Some of the countries found to be reluctant in establishing WTE incineration plant such as Australia due to political pressure (Chattopadhyay et al., 2009). From global perspective, importance of waste-to-energy is significantly growing. British glossary stores are utilizing waste food products to generate electricity by microbial anaerobic digestion. With this process, produced energy can be supplied to 200 homes for a year (SCIENCEALERT, 2014). However, major constrain of such project is significant initial capital investment. Fig. 8. shows that several developed countries possess higher degree of incineration options.

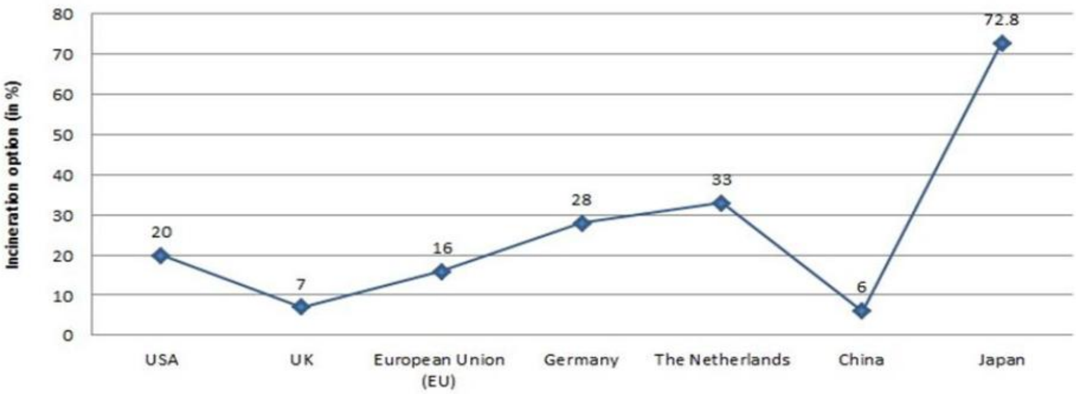

Fig. 8. Incineration option in different developed countries (Chattopadhyay et al., 2009, Hau et al., 2008)

In DCC there is no electricity generation plant from MSW (Sufian and Bala, 2006). Research conducted by JICA (2005) recommended that with a lower calorific value range from 2,303 to 3,559 kJ/kg is not suitable for combustion. However, it is estimated that current MSW generation and its growth projection up to year 2025, can contribute to 1,894,400 MWh of electricity that can meet 79% of electricity demand by 2025 in Dhaka city (Sufian and Bala, 2006). With the similar MSW composition Malaysia, an incineration plant can produce 640 kW of energy from 1500 tons of municipal solid waste (Kathirvale et al., 2004). Fig. 9. shows an incineration plant layout.

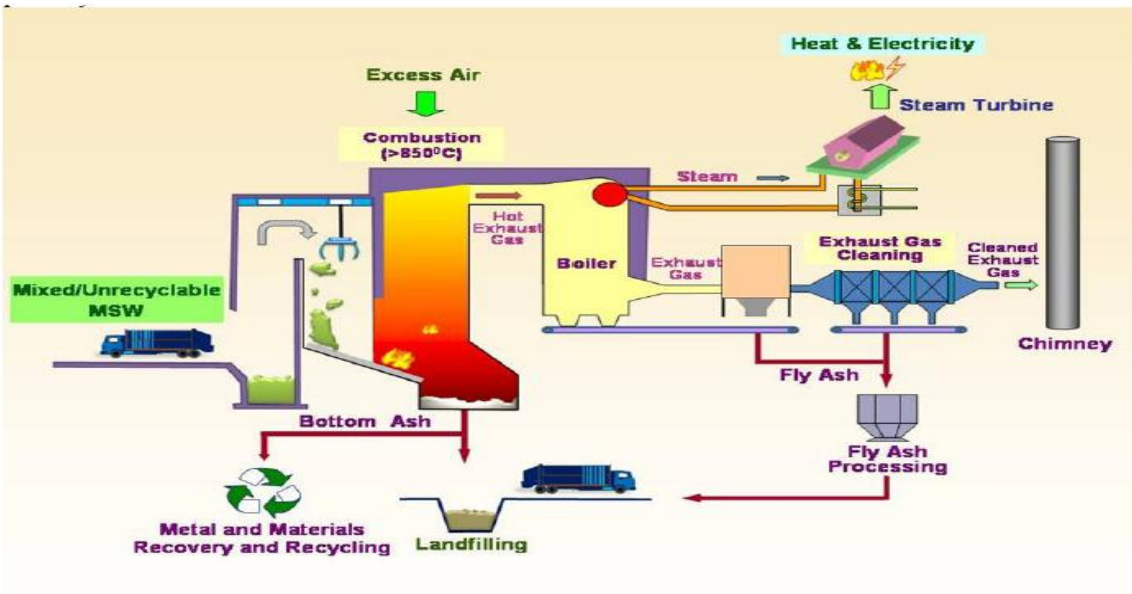

Fig. 9: Generalized incineration flow (EPD, 2009)

Bangladesh can adopt similar type of technology. However, initial capital investment for incineration plant is relatively higher. With the present chemical composition and organic content of MSW, mass burn technology is considered as the most viable solution in this regard compared to other available technology such as gasification, plasma, and pyrolysis. (Chattopadhyay et al., 2009, Islam and Saifullah, 2001, Sufian and Bala, 2006). WTE projects have potentials to mitigate the overwhelming waste management scenario, as well as taking opportunities of CDM (i.e. GHG reduction and carbon trading). A techno-socio-economic study should be conducted perspective and waste generation trend in Bangladesh especially in the Dhaka city.

V. HAZARDOUS, MEDICAL AND ELECTRONIC WASTE(E-WASTE) OVERVIEW

With the inventory study of Department Environment (DOE) of Government of Bangladesh (GOB) with the support of Asian Development Bank (ADB), it revealed that there are total 22 hazardous waste generating industries are currently situated at different parts of the country. Mainly, pharmaceuticals, dying and printing of textile industry, pesticides, paints and varnishes, plastics, industrial chemicals are responsible for generating hazardous waste in Bangladesh (DOE, 2010a). Among the divisional cities in Bangladesh, Dhaka and Chittagong have the highest concentration of hazardous waste. However, treatment facilities for the hazardous waste are not yet to be established, except some effluent treatment plant (ETP) in readymade garments (RMG) sector. Besides these typical waste streams, hospital and clinical waste become a major source of hazardous waste in Dhaka. Most of the medical waste is thrown untreated from the health care establishments (HCE). It is found that more than 22.6% of medical waste is generated in Dhaka with an average generation of 0.5kg/patient/day, and increasing at an alarming rate (Hassan et al., 2008). Fig. 10. shows medical waste management practice and material flow in some of the HCEs in Dhaka city.

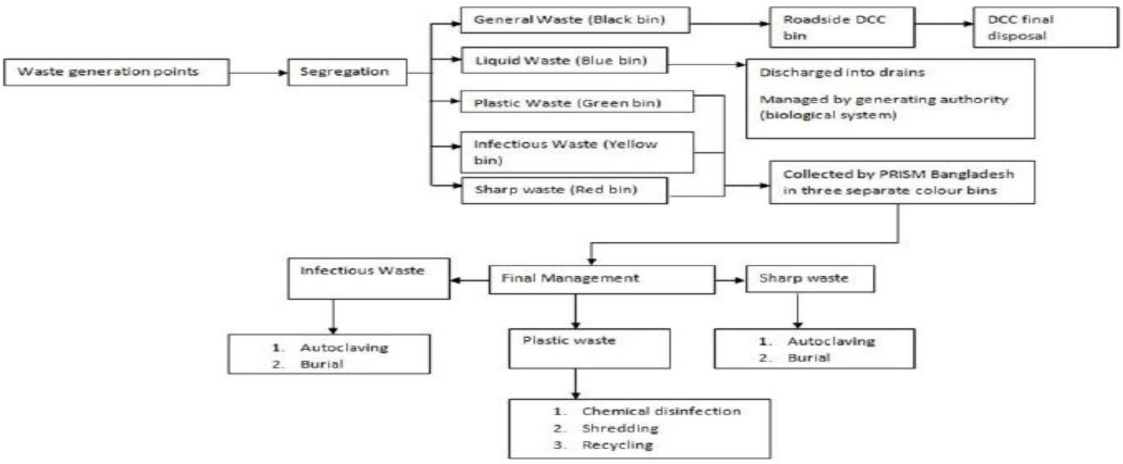

Fig. 10: Medical waste management flow in Bangladesh (Hassan et al., 2008)

Another emerging waste stream in Bangladesh is waste derived from waste electrical and electronics equipment (WEEE), or namely as e-waste. So far, no particular inventory has been developed on e-waste management (Ahmed, 2011, UDENRIGSMINISTERIET, 2014). However, most recent research conducted by Environment and Social Development Organization (ESDO), a total 2.81 million metric tons of e-waste are being generated in Bangladesh. Ship breaking industry is the highest contributor to current e-waste generation which is 2.5 million metric ton (MT)/year (ESDO, 2010). At present, total mobile subscriber in Bangladesh is 100 million with an annual growth rate of 10%. Among the whole population, mobile penetration is 66.36% (Islam, 2013). With current mobile phone penetration in Bangladesh market, it is expected that end-of-life (EOL) mobile phones will be considered as one of the major sources of e-waste in near future. Fig. 11. shows e-waste generation from other sources in Bangladesh. Like other developing countries, e-waste recycling is entirely controlled by large informal sector in Bangladesh. As Bangladesh is a signatory of Basel convention, trans-boundary movement of electronic waste is strongly prohibited (UDENRIGSMINISTERIET, 2014), which is still remained in paper work. E-waste contains several hazardous substances/components which are harmful for human health and can cause serious environmental impact, if not properly managed (Wei and Liu, 2012). GOB is preparing a draft named as Electrical and Electronic Waste (Management and Handling) Rules, 2011, which is still under preparation as priority concern under DOE jurisdiction (Ahmed, 2011). Government policy and regulation on e-waste management can take experience from EU's WEEE directives as well as lesson learnt from other developing countries.

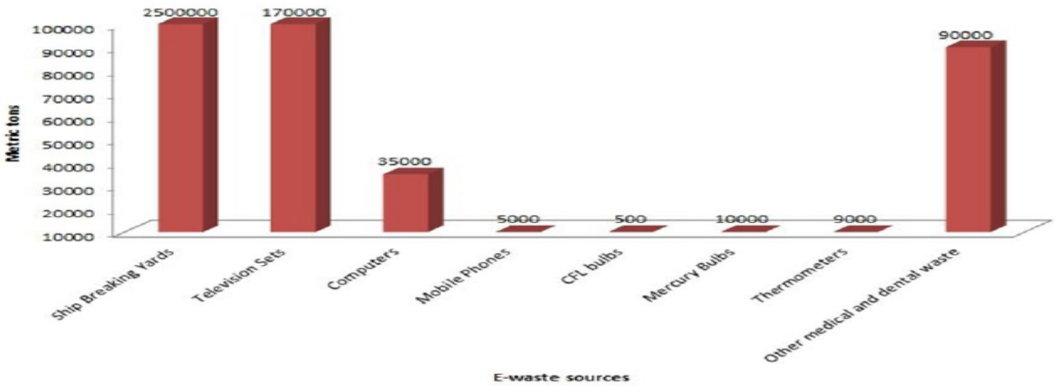

Fig. 11: E-waste generation in Bangladesh (ESDO, 2010)

5.1 REMOMMENDATION FOR HAZADOUS WASTE MANAGEMENT

Hazardous waste should be classified according to the following categories so that it would be convenient for further disposal and treatment.

(i) Wastes those are going to landfilling sites.

(ii) Wastes first needs to be stabilized and before transferring to landfills.

(iii) Establish appropriate and state of the art treatment facilities, especially for hazardous waste.

(iv) Wastes that require storage and further treatment should be considered as an economic and viable source of recycling and reuse.

(v) Some of the wastes may go for incineration process. This process will generate additional energy production that can be used in the other heating purpose.

VI. SUMMARY, RECOMMENDATION AND CONCLUSION

The generation of huge quantities of MSW in Dhaka has become a critical environmental issue. Local waste management authority – DCC found difficult to manage growing amount of waste in the Dhaka City for many reasons, among them lack of ordination among the urban planning authorities affects the most. Besides, there are a large number of open containers which are now generally being placed at the bus-stop causing serious nuisance and unbearable polluted air (bad odor). Closed container should be placed instead of open vats/container. Waste collection time from intermediate collection point to landfill must be maintained and monitored. Appropriate disposal points/transfer station should be established in DCC areas. Besides, in broaderscope, Geographical Information System (GIS) tool kit, weight bridge data and continuous monitoring unit should be used developing location of the collection points as well as in the landfill area - such as a Matuail landfill. In near future, government should implement online management information system (OMIS) to track records as part of development planning of waste management sector.

Transportation and collection vehicles should be modernized. Open trucks must be removed from the vehicle fleet and 5 tons compactor trucks should be introduced more, considering average fuel consumption and GHG emission potential. Vehicle repair time and maintenance schedule should be continuously followed.

Expenditure in landfill management must be increased, as this is the predominated part of MSW disposal in Dhaka. DCC spends on an average of 1.5% of total budget allocation. Planning for sanitary landfill should be established with possible local adoptable technology. In such way, pollution and ground order contamination will be mitigated and energy harness possibility can be developed. Mass burn technology could be implemented as an adoptable electricity generation technology from MSW. Besides, LFG can be converted into usable fuels for the waste collection vehicle to available technology.

Another issue, came out to this fact of mismanagement is the lack of waste segregation option. Collection efficiency can be much higher in separate bins for different types of wastes – glass, plastic, paper etc. School, colleges and universities can be primary separation points for MSW. Public awareness programs should be added more. Both government and non-government sector should come forward to make people understand environmental sustainability. Certain collection points with bins for different waste items should be placed. Community based waste management could be good solution. Recycling rate and urban poor employed can be mobilized through waste separation scheme project. Informal sector recycling should be considered as a starting point to become formalized by providing necessary technical support, awareness of health impact and know-how in required technical field. Non-government organization should come up more with the foreign donors investing in promoting the concept of ‘’Green Entrepreneurship’’ – an implication of social business.

E-waste can be collected where information and communication technology (ICT) products are sold and repaired. As the e-waste products got resell value in Bangladesh, there should be one concrete policy framework collecting e-waste in formal way but keeping informal sector alive by providing financial and technical support adhering with the Basel Convention. A special technique should be adopted for e-waste coming from ship breaking industry. There are a number of child labours working in waste management cycle in Dhaka city as well as in whole Bangladesh. Environmental awareness among the street pickers should spread out. Human health impact can easily understandable in the battery recycling industry in Dhaka city, that employs a number of child labour. A formalized framework needs to be established mitigating current recycling practice and developing efficient formal recycling industry through the concept of social business enterprise in association with small and medium enterprises (SMEs). Composting is a good example in this regard.

Political influence is predominant in development works in Bangladesh. A clear and concise articulation of the waste management planning has to be made without politically biased decision or ―idea of not in my backward’’ concept. Capacity building and improvement should be stressed out in a clear framework with existing waste management scenario.

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