Solid waste management in bangladesh pdf

Low levels of waste collection in Bangladesh's major cities lead to illegal disposal. This poses a serious environmental hazard and a health hazard. Waste management in Bangladesh faces many challenges because of its large, rapidly growing population in the densely populated country. Bangladesh is the ninth most populous country in the world. In particular, the projected growth rate of the urban population from 2010 to 2015 is 3%. With this population growth, the problem of waste management is growing, especially in large cities. Currently, according to the FICSA report, Dhaka is one of the most polluted cities in the world, and one of the issues involved is the management of municipal waste. The waste creation of the Private Waste Collection Vehicle in Banani Model Town Current (2012) waste production in Bangladesh is about 22.4 million tons per year or 150 kg/cap/year. In Bangladesh, waste production is on the rise and is projected to reach 47,064 tons per day by 2025. Waste production is expected to increase to 220 kg/cap/year in 2025. A large proportion of the population has zero access to appropriate waste management services, which will actually lead to the problem of mishandling of waste. The total rate of waste collection in major Bangladeshi cities, such as Dhaka, is only 37 per cent. If the waste is not properly collected, it will be disposed of illegally, which will pose a serious environmental risk to Bangladeshis. The negative impact of poor waste management One of the most negative effects of poor waste management, especially municipal waste, is the incidence and prevalence of diseases such as malaria and respiratory diseases, as well as other diseases caused by groundwater pollution. Biomedical waste is also at great risk in Bangladesh, as the report estimates that 20 per cent of biomedical waste is highly infectious and dangerous because it is often disposed of in the sewer or sewerage system. Such poor sanitation has serious health consequences for residents, and the report states that a large proportion of child mortality may be linked to this problem. As for living standards, solid waste leads to the blockage of the drainage system, which leads to flooding of streets. Consequently, mosquitoes and odour are among the negative effects. The Government is currently working in Bangladesh to improve waste management, especially in urban areas. In Dhaka, Dhaka City Corporation, backed by the Japan International Agency Corporation (JICA) has a master plan now to better handle solid waste management in Dhaka. For example, the Concern social businesses, sprang up to address the problem of hoarding municipal waste by working with In addition, UNICEF has initiated waste management and management programmes with city corporations and municipalities. However, there is still a lack of incentives to improve waste management in all relevant sectors, especially industrial waste and medical waste. Links to UNdata. (2012). Profile of the country: Bangladesh. Bhuya. G. M. J. A (2007). 1. Bangladesh. Solid Waste Management: Problems and Challenges in Asia, pg 29 (PDF). Waste atlas. (2012). Country data: Bangladesh. Alamgir M. and Ahsan. A. (2007). Municipal solid waste and recovery potential: Bangladesh Perspective. Iran. J. Environ. Sci. Eng., 2007, Vol. 4, No. 2, page 67 - 76 - I. Enayetullah and S.S. A. Khan and A. H. M. Sinha (2005). Management of solid household waste in cities. Bangladesh scenario: challenges and perspectives. Waste technical documentation (PDF). Bhuya. G. M. J. A (2007). 1. Bangladesh. Solid Waste Management: Problems and Challenges in Asia, pg 30 (PDF). b Memon. M.A. (2002). Solid waste management in Dhaka, Bangladesh. Innovation in community-driven composting (PDF). b Waste Concern, Department of environment. Bangladesh Country Newspaper (PDF). There is a media in the Commons related to waste management in Bangladesh. Extracted from Home/Archives / Volume 1 No. 1 (2015) / DOI Articles: Keywords: Solid Waste, Waste Production and Management, Bangladesh This paper focuses on solid waste production status, waste management systems and waste management problems in Bangladesh. The production of solid waste is growing with the growth of the urban population. The country generates about 8,000 tons of solid waste annually from six major cities (Dhaka, Chittagong, Khulna, Rajshahi, Barisal and Sylkhet), of which Dhaka alone contributes about 70%. The waste management system is not well organized. Efforts are being made to improve the collection, transport, processing, burning and filling of land. Lack of rules/standards for waste disposal, landfill use, lack of awareness, poor technology choices and inadequate financial support are the main constraints for waste management in Bangladesh.Asian J. Med. Biol. Res. June 2015, 1 (1): 114-120 Increased Generation methane (CH_4) from solid household waste (MSW) worries the world to adopt appropriate initiatives for sustainable MSW management because it is 34 times stronger than carbon dioxide (CO_2). Mounting land shortage problems worldwide brands waste energy (WtE) strategy to manage MSW in urban areas as a promising option because WtE not only reduces the problem of land pressure, but also reduces the problem of land pressure electricity, heat and green jobs. The purpose of this study is to assess the assessment renewable electricity capacity and the associated reduction in carbon emissions in Bangladesh using WtE strategies. The study is being conducted in two major cities in Bangladesh: Dhaka and Chittagong. Six different WtE scenarios consisting of a mixed MSW and landfill gas (LFG) combustion system are evaluated. The energy potential of the different WTE strategy is assessed using the standard energy conversion model and subsequent GHG emission models. Scenario A1 leads to the highest economic and energy potential and net negative GHG emissions. Sensitivity analysis by changing MSW moisture content shows higher energy potential and fewer GHG emissions from MSW low moisture content. The study proposes the mixed combustion of IHS, which could be a potential WtE strategy for renewable electricity generation in Bangladesh.1 The introduction of the Digital Race of Human Society to modern urban life around the world generates a huge amount of solid household waste (ICW) because the rate of generation is growing even faster than the rate of urbanization. Global MSW generation has shown double growth in 10 years alone from 0.68 billion tons per year in 2000 to 1.3 billion tons per year in 2010. In addition, it is projected to reach 2.2 billion tons per year by 2025 and 4.2 billion tons per year by 2050. This huge waste load of the urbanized world, if not managed properly, will certainly have a negative impact on sustainable lifestyle, local environment, and human health. Serious MSW management problems are reported in a number of cities in various countries, such as China, India, Malaysia, Thailand and Bangladesh due to rapid population growth, rapid industrialization and urbanization. The huge MSW generation due to rapid population growth and ongoing economic development is already being blamed for significant environmental disruptions in Bangladesh. Bangladesh has enjoyed tremendous growth in its economy over the past few years and this is convincing of the large influx of rural labor in the cities. In this case, for sustainable management of the IHS, the population and the growth of the economy must be constructively transformed, as they are the main factors in waste generation .6, 14. Worldwide, four options, such as thermal treatment, biological processing, energy recovery dump, and recycling, as presented in Figure 1, are currently being considered to ensure sustainable management of IHS. Among them, thermal processing, biological processing, and energy recovery dumps are based on the topic of the MSW power recovery hierarchy option. The process of cleaning waste generating energy in the form of electricity, heat or transport fuels is seen as a waste of energy By 2025, 2.3 billion tonnes of ISW will be produced, equivalent to the equivalent of Energy. Thus, WtE is a very promising alternative energy option for the future, because with so much energy 10% of the global annual electricity demand can be met. In fact, in a report by the World Economic Forum Green Investing: To Clean Energy Infrastructure, published in 2009, WtE is identified as one of eight technologies with significant potential to contribute to the future of a low-carbon energy system. According to some estimates, the wtE option by 2022 will treat at least 261 million tons of MSW per year to produce 283 terawatt hours (TWh) of electricity and heat . The most common practices for the WtE method are the mixed MSW and landfill gas combustion system (LFG), but the most economically feasible solutions to be used in the future energy system are the mixed burning of MSW. A general overview of WtE's core technologies is presented in Table 1.WtE TechnologyDescriptionConversion Efficiency (MWh/ton MSW)The typical cost of entering MSW (MJ/Kg)Max fuel moisture (%)Incineration of MSW Products is burned in a boiler and equipped with CHP. The combustion temperature is usually between 1,000 and 1,200 degrees Celsius.0.5308-10.540-50Miked MSWElectricity and heat. Temperatures usually range from 200 to 300 degrees Celsius.0.320 10 Assorted MSWLiquid oil, char, and gas. GasificationProcess responds organic fraction of MSW at high temperatures with controlled amounts of oxygen and steam to produce carbon monoxide, hydrogen and carbon dioxide. Operating temperatures are 700 degrees Celsius.0.92016.540-50Sorted MSWElectricity, CH_4, hydrogen and ethanol. Anaerobic digestionBiological process of decay of the organic fraction of MSW by a consortium of anaerobic microorganisms working synergistically in conditions of poor oxygen. Most anaerobic reactors are designed to operate in a temperature range of 30-35 degrees Celsius.0.15202.5Approx. 97 MSWElectricity, Heat and LNG. LFG gas recoveryLandfill gas (LFG) is a saturated gas consisting of 50% CH_4 and 50% CO_2 by volume, along with some other trace elements. CH_4 is trapped to generate electricity. 0.2330 to 50-70-80Mix or sorted electricity, heat and MSW LNG. Note: 56, 20, 57, 58 and 6. A large-scale version of WtE, mainly the burning of mixed MSW as a means of sustainable MSW management, has been implemented in countries such as Denmark, Germany, the Netherlands, Sweden and the United Kingdom; Malaysia (19); Indonesia, China, Japan and Korea; 22. Currently, 40 countries more than 800 WtE incinerators. Most of them are located in Europe (472), Japan (100) and the United States (86). In China, WtE WtE incinerators operating or under construction by the end of 2015, there will be more than 300 of them, with the aim of building the world's largest incinerator WtE in Shenzhen. On the other hand, the sustainable governance of IHS in Bangladesh remains a dilemma, despite the Government's continued efforts. This is reflected in the available scientific literature related to the management of IHS in Bangladesh. A number of studies have been carried out covering a number of aspects related to IHS management in Bangladesh, such as msW characterization and generation factor (10, 26-29), recycling and management problems ,8, 30-35), people's willingness to pay for various waste management options (36, 37), composting aspects (26, 38, 39) and recycling aspects (33, 40). Several studies have been conducted to assess the potential of electricity generation ,41-43), but none of the studies are being conducted to comprehensively assess the feasibility of WtE strategies in terms of energy conversion and carbon reduction from MSW management in Bangladesh.Energy accessibility significantly stimulates economic and social development as well as the standard of living in society. Bangladesh is an energy-deficit country and the energy source is not sustainable because of the main share of fossil fuels in the energy balance (46, 47). In addition, in order to overcome this energy scarcity situation, the Government of Bangladesh has recently sought to reduce gas-based electricity generation and gradually move to a coal-fired power plant, which will certainly increase the national carbon footprint (48-50). Bangladesh is an energy-dependent country, and increased energy supply has a positive impact on economic development. Under these conditions, wtE for MSW management in Bangladesh may be a viable option for alternative and renewable electricity generation. Such a strategy would also avoid significant GHG emissions by replacing equivalent electricity from fossil fuels. In addition, the deployment of the VTE strategy will help Bangladesh move towards a zero-waste society and adopt the principle of a circular economy at the national level. In view of the above contexts, this study is being conducted to assess the potential of WtE's renewable electricity strategy from MSW and the related carbon avoidance of fossil fuels in Bangladesh. Dhaka and Chittagong are accepted as research sites because these two are Bangladesh's most crowded and strategically important cities. Dhaka is the capital, while Chittagong is considered the commercial capital of Bangladesh. Two WtE technologies, such as MSW mixed combustion and LFG recovery, are selected to assess renewable energy production and reduce carbon emissions, as these two options are the most preferred and mature practitioners around the world2. The existing MSW office in Dhaka and ChittagongPod by the Ministry of Local Government and Department in every major city or municipality, city corporation or municipality is responsible for managing MSW in Bangladesh. Dhaka City Corporation (DCC) is responsible for collecting, transporting and disposing of MSW in Dhaka with 92 administrative districts named Chambers. But now, the DCC is divided into DCC (North) with 36 chambers and DCC (south) with 56 chambers. The collection, transportation and disposal of MSW in Dhaka are also divided accordingly. Similarly, Chittagong City Corporation (CCC) is responsible for the collection, transportation and disposal of MSW in Chittagong with 41 wards. All MSW is disposed of in open landfills after collecting from household or large waste containers in Dhaka and Chittagong (30, 31, 55). Typical features of open landfills in Dhaka and Chittagong are presented in Table 2. In Dhaka, all waste is sent to an open dump at the Matual and Amin Bazaar landfill. Matuail landfills are called sanitary dumps, but now there is an open landfill (figures 2 (c) and 2 (d)). Waste from 55 wards in Dhaka is dumped on the Matualil landfills, and waste from 36 wards is dumped in the open Amin Bazar landfill. In Chittagong, all waste is currently dumped in the open landfills of Ananda Bazaar, Calurgant and Arefin Nagar, and the open landfill in Rufabad closed in 2014. Ананда Базар свалки является старейшим открытым свалки в Читтагонге и, как ожидается, закроется в 2020.Salient featuresDhakaChittagongMatuailAmin БазарАнанда БазарАрефин НагарКалургхатRoufabadArea (га)40202.02329.57.282.83Управка В эксплуатацииВ эксплуатацииВ эксплуатацииClosedLand заполнение началось2003200719602011201520011угод месторождения MSW (метр)76.413.76.569Distance от города (км)686575Closed/expected конец жизни20212020202020172016 2014Уставка в день (тонны)2000120035067172295 0Current CH_4 статусNo recoveryNo recoveryNo recoveryNo recoveryNo recoveryWard охватывает553621 в таблице 3 представлена 202128(a)a)(b)(c)(d)(e)(f)(g)(h)(i)(a)(b)(b)(d)(e)(f)(g)(h)(i)(Типичная характеристика MSW в городе Дакка и Читтагонге в ходе различных исследований. Из таблицы 3 можно четко указано, что твердые отходы Дакки и Читтагонга состоят главным образом из органических и неорганических фракций, таких как пищевые отходы, бумага, текстиль, резина, пластик, стекло, металлы и древесина. Основная доля (75%) MSW in Bangladesh is food waste (28, 31), while in China - 50%, in Malaysia - from 40% to 60%, in the U.S. and European countries - from 20% to 30%. MaterialDhaka ChittagongWeight%ABCDAEFGFood/organic68.384.378059.9173.761722Plastic4.31.744.5-2.8332Paper10.75.681011.21109533 Textile-21.83———831Wood—————23Grass/garden wastes———8.76-3---Rubber ——————Glass0.76.381.7-0.9335Alumminum/metals2.0-10.152.2249Textile Wood2.2———2.1-3-Leather1.4---17.671———Pack---69Stone/rocks———2.30-526Others/miscellaneous10.4-3.5-7.46---Remarking. The same msw character of The city of Dhaka and Chittagong is reported in these studies (26, 40, 59). (43), 29, 41, 31, 27 and 28 ... Methodology3.1. Data collected At the ground in Dhaka and Chittagong (Figure 3) for a total period of five months. During this period, a team of data collectors conducted a detailed survey. The detailed survey covers mainly direct observations, interviews with IHS officials in both cities and the segregation of IHS at solid waste disposal sites (SVDs). The segregation of IHS was carried out at the primary level (source), at the secondary level (garbage basket along the street) and at the third level (SWDS) to identify and quantify the different categories of IHS. The quantitative score and percentage of the different MSW were calculated from the 5 kg sample. Data on the generation and disposal of IHS for both cities from 2000 to 2015 were collected from the authorities of both cities. An extensive literature review was also carried out to compare the composition and characteristics of the IHS in both cities. MSW projection models through (1) and (2) were used to predict the future of MSW in Dhaka and The City of Chittagong (section 3.2), (6) and (7) were used to simulate energy production through the MSW incinerator (section 3.4), and (8) were used to simulate CH_4 emissions from landfill (section 3.4). Equations (10) and (11) were used to model net carbon emissions (sections 3.6 and 3.7). Different WtE variants have been analyzed in six different scenarios to find the best solution. Sensitivity analysis was carried out to assess the effects of MSW moisture on energy potential and GHG emissions. The methodological basis of the study is presented in figure 4.3.2. The projected future MSW GenerationFuture MSW generation is projected for Dhaka and the city of Chittagong using (1) and (2). A brief sketch of these two approaches is given here: (i)Historical trend: the annual population growth rate in the city concerned was calculated on the basis of census data (62), and the average growth rate of per capita waste production was calculated from historical waste production (2001-2015). Projected waste generation was calculated using Here, PWG is projected to generate waste per year (tonne); PBY is the population in the base year; AGP is an annual rate of population growth; PCWB is a per capita waste generation in the base year (kg/cap/day); AGW is an average growth rate of per capita waste production. Cumulative annual growth rate (CAGR), gross annual product (GAP) and income expenditure approach: cumulative annual growth rate (CAGR) of the population in the corresponding were calculated first using census data. Gross Annual Product (GAP) (GAP) Bangladesh's rate was adopted as 4%, and 70% of the income is expected to be used for expenses to carry personal consumption in Bangladesh. The growth rate of waste production is calculated as 0.028 (4% × 70%). PBY is the population in the base year. CAGR is a composite annual rate of population growth. PCWB is the generation of waste per capita in the base year (kg/cap/day). WGG is a factor in the growth of waste production.3.3. The physical and chemical properties of MSW Physical characteristics of MSW flow, such as the fraction of waste composition based on wet weight, the fraction of dry weight and moisture content, are critical factors for determining an alternative to energy recovery. Similarly, chemical properties such as organic carbon, inorganic carbon (), hydrogen (H), oxygen (O), nitrogen (N), sulfur (S), and ASH content MSW, also affect this decision. The physical characteristics of the MSW flow in Dhaka and Chittagong were determined by separating solid waste at the primary level (source), secondary level (dump along the street) and third level (SWDS). The quantitative estimate and percentage of the various solid wastes were calculated from a 5 kg sample. The standard molecular composition of different categories of solid waste based on the dry weight share of MSW was used in this study. Moisture content (%) and dry weight fraction (%) MSW were calculated using (3) and (4). Wet weight fraction (%) The IWC of Dhaka and Chittagong was rounded to the nearest whole. In (3), is the proportion of msW moisture (%), is the initial weight of the sample, which belongs to a separate class, and the weight of a separate class after drying. B (4), is the dry weight of the MSW fraction (%), is the wet weight of the MSW fraction (%), and the moisture content (%). Food wastesPlasticPaperGrass & strawGlass & ceramicMetalsTextilesOthersPhysical propertiesDhakaWet weight fraction (%)8028211—6Moisture content (%)72.340.533.238.2100—8.67Dry weight fraction (%)22.131.997.741.241.001.00—5.48Physical propertiesChittagongWet weight fraction (%)7051021453Moisture content (%)74.860.613.6034.18007.37.24Dry weight fraction (%)17.604.979.641.321.004.004.642.78Chemical propertiesDhaka and ChittagongOrganic carbon (, %)48.00043.5047.80055.0024.3Inorganic carbon (, %)060.00000.504.5000Ash (%)5.0010.06.004.5098.900.462.5068Sulphur (S, %),2.600.000.303.400.10090.500.2Nitrogen (N, %),0.400.100.200.300.0000.100.5Oxygen (O, %),37.607.2044.0038.000.404.3031.204Hydrogen (H, %)6.4022.806.006.000.100.606.603Note: standard molecular composition of MSW [60].3.4. Энергия от MSW от содержания сжигания отходов MSW сильно влияет на процессы сжигания отходов incinerator for Unregulated waste burns in a furnace or boiler at high temperature (980 to 1090 degrees Celsius) with excess oxygen to generate electricity by burning IHS. THE MSW feed stock is converted into heat, gases and particulate matter, as well as ash for the burning of the bottom. Heat is used to produce steam and based on the Principle of the Rankin cycle, the steam turbine generates electricity (19, 60, 61). Ideally, MSW chemical reaction combustion processes are represented using 19 MSW's energy content, usually expressed by its lower heating value (LHV). In this study, the approximate LHV MSW of The city of Dhaka and Chittagong is calculated by final analysis and composite analysis. According to the final analysis, LHV MSW of Dhaka and Chittagong was evaluated using the mathematical correlation of the modified Dulong equation, as shown in (6) (19, 60). According to the composite analysis, LHV MSW of Dhaka and Chittagong city was evaluated using typical heat values of MSW components and use (7). Typical msW thermal values are represented in Table 5. Variable values in (6), such as, and MC (moisture content), presented in table 4.In (7), is a typical heat value component of MSW and dry weight fraction (%) Component. Value COMPONENTS MSWHeat (KJ/Kg, Dry Weight)Food Waste957.13Paper3445.68Plastics6699.94Textiles3589.25Glass and ceramic28.71Metals143.57Grass and straw1339.99Others1435.70Note: values are converted from Btu/lb dry weight to dry weight KJ/Kg. 3.5. Generation CH_4 at the Methane Emissions Landfills (CH_4) of SWDS was made using a simple and direct method called the Intergovernmental Panel on Climate Change (IPCC) Methodology (IPCC) (63). The Potential for Global Warming (GWP) CH_4 has been adopted as 34. Methane emissions from SWDS have been evaluated using (8), and the accepted parameters are presented in table 6.In (8), MSW is a total waste generation (tone/year); MSWF is a fraction of the waste disposed of in SWDS; 16/12 Conversion rate for conversion C to CH_4. Below are a few coefficients associated with the adoption of the IPCC model for estimating CH_4 emissions for this study. (a) MSWF (a fraction of waste disposed of in landfills): the entire total volume of IED produced in Bangladesh is sent to the open dump of SWDS (30, 31, 55). During a field visit to the study, the study was also identified and presented in Table 4. Thus, MSWF was taken as one. (b) MCF (methane correction factor): MCF is a coefficient for different types of SWDS. For properly managed sanitary landfills, MCF No 1; for non-cate SWDS, MCF 0.6; For an open landfill with a 5m-high waste, MCF 0.8; and for an open landfill with a waste height of 5 m, MCF 0.4 (44, 63, 65). As In Table 4, all existing SWDS open graves in Dhaka and Chittagong have a height of more than 5 m, so the MCF value was taken as 0.8. (c) DOC (decomposable carbon) and DOCF (dissymylated organic fraction): according to the IPCC methodology, the DOC ranges from 0.08 to 0.21 and is evaluated using (8). Here, this share of the documents in MSW, is part of the kitchen/food waste in MSW, and the share of straw in MSW. Again, DOCF is necessary because DOC biodegradation does not occur completely for a long period, so the default 0.77 was considered 44, 57. (d) FM (methane fraction in LFG): The share of methane production from LFG was set as 0.50 for Dhaka and Chittagong. (e) RM (restored CH_4) and OF (oxidation factor): since methane recovery does not occur in Dhaka or Chittagong, the RM is zero and the oxidation factor (OF) has also been adopted as zero in accordance with the IPCC default. HdhakaChittagongMSWF11MCF0.80.8DOC0.1580.151DOCF0.770.77FM0.50.5RM00OF003.6. GHG emissions from combustion, presented in (8), the combustion of MSW mainly converts the chemical energy stored in it into thermal energy through combustion processes at high temperatures from 980 to 1090 degrees Celsius. Because burning MSW for the WtE project, although CO_2 is emitted, it avoids the use of fossil fuels and the release of CH_4 from SWDS. This type of WtE project can also take into account carbon credit because the burning of MSW and associated electricity generation avoid CO_2 emissions from fossil fuels (19, 66). In this study, CO_2 emissions from the WtE project under various analysis scenarios were estimated usingIn (10), is the dry weight of the component waste fraction; is a man-made carbon fraction of the component; is an oxidation factor, with default 1 for MSW; CO_2 conversion rate with 44/12; and is a component of the incinerator MSW.3.7. The GHG study quantifies GHGs to avoid the equivalent of avoiding CO_2 emissions from coal-fired electricity. Bangladesh is now setting up an entire coal-fired power plant to provide permanent electricity in the future. Thus, the electricity generated by MSW in Dhaka and Chittagong under different scenarios using the WtE strategy was to replace electricity generated from coal, and therefore the prevention of CO_2 emissions was calculated using inn (11), is the production of electricity from MSW using WtE or LFG projects and is a factor in carbon emissions per kWh of coal generation. The carbon emission ratio of 1,001 kg of CO_2/KWh was considered in this study .67.4. Results and discussion4.1. MSW and GHG emissions projectionThe actual and projected waste production (a) and associated GHG emissions (b) in Dhaka and Chittagong from 2001 to 2050 are represented in Figure 5. Waste production shows a growing trend with 1.04 million up to 6.6 million tonnes per year in 2000-2050, in line with the CAGR approach in Dhaka. The associated GHG emissions from untreated IHS have also gradually increased from 0.86 million tonnes of CO_2 CO_2 up to 5.5 million tonnes of CO_2 equivalent. Similarly, GHG emissions from untreated IHS in Chittagong have shown a gradual upward trend from 0.18 million tonnes of CO_2 to 2.9 million tonnes of CO_2 equivalent, with waste production rising from 0.23 million tonnes to 3.6 million tonnes between 2000 and 2050. In Dhaka, ISW estimates that 1.18 million tonnes and 1.4 million tonnes of CO_2 equivalent were produced in 2010 and 2015, respectively, and an estimated 2.8 million tonnes of CO_2 equivalent and 5.5 million tonnes of CO_2 equivalent will be produced by 2030. On the other hand, as expected, the total estimated co2 equivalent emissions for the year mentioned were lower due to the reduction in IHS production at Chittagong. It can be concluded that in Dhaka and Chittagong, the increasing rate of IHS generation is the leading direct increase in GHG emissions. (a) (b) (b) (b) 4.2. The WtE analysis is shown in Table 7. LHV MSW in Dhaka and Chittagong according to the final analysis was 6.32 MJ/kg and 8.44 MJ/kg, respectively. According to the composite analysis, LHV MSW in Dhaka and Chittagong was 0.71 MJ/kg and 1.06 MJ/kg, respectively. The final analysis of MSW in both cities resulted in a higher cost of LHV. The efficiency of restoring heat from the MSW mixed incinerator is reported to be between 80 and 90% (19, 68-70). In this study, the efficiency of heat recovery of the MSW mixed incinerator in Dhaka and Chittagong is considered to be 80%. The rate of power generation during combustion using a steam turbine was taken as much as 1 MWh/15.65 GJ heat . CO_2 emissions from the mixed msW combustion in Dhaka and Chittagong were 0.046 tCO_2/tMSW and 0.12 tCO_2/tMSW, respectively. Ch4 landfill density is estimated to be 0.667 kg/m3, LHV is 17 MJ/m3, and the electricity generation rate is 0.2775 kW/MJ (19, 44). ValueeMSW Burning LHV MSW Final analysis6320 MJ/tMSW (Dhaka)8440/tMSW (Chittagong) Composite analysis710 MJ/tMSW (Dhaka)1060 MJ/tMSW (Chitong) MWh /15.65 GJ Working time24 hoursLandfill CH_4 emissions0.024 tCH_4/tMSW (Dhaka)0.023 tCH_4/tMSW (Chittagong)Methane GWP34CO2 emissions factor 0.827 tCO_2 equ./tMSW (Dhaka)0 .791 tCO_2 equ./tMSW (Chittagong)CH4 conversion ratio volume 667 m3/tonne CH4Calorie value CH417 MJ/m3Electricity generation ratio0.2775 kW/MJ Environmental and economic factor CO_2 emissions factor For electricity1.001 kg of CO_2/KWh electricityCaricated in the forest zone1.22 tons of CO_2 sequestered per year / 1 acre of forest carbon loan income 15.2 /tonne CO2Electricity revenue from sales of 0.13 / KWh of electricity, Phygura 6 represents energy potential through electricity generation WtE strategy. How To Previously, MSW's energy in Dhaka and the city of Chittagong could be restored through a mixed MSW burning plant and the restoration of LFG. Figure 6 shows that electricity generation from mixed incineration of IHS and the recovery of LFG is expected to increase between 2001 and 2050 as the ihs generation rate increases. In Dhaka and Chittagong, it is estimated that by 2050, 1,444 and 1,394 GWh of electricity could be produced by the burning of IHS, respectively, in the context of the final analysis of the energy value received and the historical rate of IHS generation. The potential for power generation from the MSW combustion was even higher when MSW was projected in line with the CAGR approach, which was 2,132 GWh for Dhaka and 1,556 GWh for Chittagong. The WtE analysis noted that MSW burning has a higher power generation potential in both cities than LFG. Other similar wtE potential study estimates also reported mass incinerator of MSW as the highest power output option than other WtE options like RDF and biometanization and combustion with recycling (71) and LFG recovery. (a) (b) (b) (b) 4.3. The msW mixed incinerator's capacity for power generation in Dhaka and Chittagong is expected to be 1,200 tonnes per day. Electricity is expected to replace coal-fired power in Bangladesh. Since the economic lifespan of existing as well as proposed coal-fired power plants in Bangladesh is estimated to be 30 to 50 years, for WTE the burning of the plant economic life has also been accepted as 35 years. For an economic analysis of this study, the capital costs of the incinerator for power generation in Dhaka and Chittagong are considered $36 per tonne of IED per day, and operating and operating costs as $60 per tonne of IWH. On the other hand, it is estimated that the LFG recovery plant will have a capacity of more than 1,000 tons of mixed MSV/day over a period of 35 years. For economic analysis of this study, capital costs for the landfill with the LFGs recovery system in Dhaka and the city of Chittagong are expected to be as much as $14 per tonne of MSW per day, as well as operating and operating costs as much as $10 per tonne of MSW. Carbon loan revenues are considered $15.2 per tonne of CO_2. Electricity revenues come from the residential property rate ($0.13/kWh) of Dhaka Power Distribution Company Limited (DPDC) because it is assumed that the electricity generated is consumed in the residential sector. Economic analysis based on electricity sales, carbon credits, capital and operating costs for the MSW incinerator and the restoration of LFG in Dhaka and Chittagong, Figure 7. Higher electricity generation at the MSW incinerator increased revenue as a result of increased electricity sales and related carbon credit claims due to higher CO_2 failure from the coal-fired power plant. Approximately US$535 million and $251 proceeds can be derived from the sale of electricity and claiming Carbon credits from MSW's combustion and LFG recovery, respectively, in Dhaka and Chittagong are in line with MSW's CAGR approach forecast in 2050, while according to the historic MSW generation rate based on MSW's forecast resulted in US$412 million and U.S. $188.92 million in revenues in Dhaka and Chittag in 2050. However, combustion requires higher capital and operating costs than the LFG recovery system, and the income from the burning of IHS is much lower when the compositional LHV value was used as shown in Figure 7. (a) (b) (b) (b) 4.4. Scenario analysis4.4.1. Energy potential scenarios and Net GHGSix with different WtE strategies were selected to assess the impact of IHS use on GHG conversion and GHG emissions (table 8). The scenario was analyzed using the LHV MSW value assessed by the final analysis. The results of a scenario analysis of energy potential and net GHG emissions for the various WtE strategies in Dhaka and Chittagong are presented in Figure 8. The net issue of GHGs for all scenarios ranged from 0.29 to 0.81 tCO_2 equivalent/tMSW. The negative value of net GHG emissions reflects the idea that this strategy has avoided more CO_2 emissions than its emissions. In the same IHD composition, net GHG emissions from the LFG system and harvesting were markedly higher than the burning of IHS. The BAU scenario was the worst, as expected, due to the highest net GHG emissions. Based on an analysis of this study, it is recommended that Bangladeshi policy makers be able to think of alternative management of the WtE incinerator to improve environmental protection and generate higher economic benefits. The study tested five alternative scenarios with VTE strategies to illustrate To Bangladesh's policy makers on the potential of VTS. The results show that the mixed burning of MSW has a higher energy potential even with negative net GHG emissions. It can be said that the mixed combustion of MSW avoids more CO_2 emissions than what it generates due to the higher avoidance of coal-fired electricity. Scenario A1 was the best WtE strategy, generating 0.37 MWh/TMW of electricity with the equivalent of 0.29 tonnes of net GHG emissions. In the combustion of half of the IHS and the remaining half, a total of 0.27 MW/TMSV of electricity generation and moderate net carbon emissions (0.17 tCO_2 equivalent/TMVS) were observed for the recovery system of LFG (scenario A3). On the other hand, more performance (0.31 MW/TMW of electricity and 0.01 tCO_2 equivalent/TMSV net GHG emissions) was also observed in the A4 scenario compared to scenarios A2, A3 and A5, where MSW combustion was a key strategy MSW and 30% of the LFG Recovery System) to manage MSW in Dhaka and Chittagong Chittagong A0Business as usual (BaU) scenario that does not represent the WtE implementation. The A1All MSW scenario will be burned to generate electricity as part of the WtE project. The A2All MSW scenario will be a landfill to generate electricity from LFG, as part of the WtE project. The A350% MSW scenario will be incinerated and 50% MSW will be used through the LFG recovery system to integrate wtE (landfill and combustion) strategies. The A470% MSW scenario will be incinerated and 30% OF MSW will be used through the LFG recovery system to integrate wtE (dump and burning) strategies. The A530% MSW scenario will be incinerated and 70% OF MSW will be used through the LFG recovery system to integrate the wtE (landfill and incineration) strategy.4.4.2. Costs and Profits AnalysisNo Energy Recovery is being instigated in Dhaka and Chittagong according to the baU scenario (scenario A0). Thus, operating costs reflect the ongoing management costs (collection) of MSW in Dhaka and Chittagong. In Dhaka, the operating costs of MSW's current management practice are approximately BDT 626.24 ($7.97)/tonne MSW, while in Chittagong it is BDT 439 ($5.59)/tonne MSW. Thus, these costs were considered as operating costs under the BaU scenario (scenario A0). Figure 9 is a cost-benefit analysis of the various WtE strategies for this study in a different scenario. The BaU scenario resulted in negative net profit as expected because at present both cities have not implemented any effort to restore energy or generate revenue from MSW. Scenario A1 was WtE's best strategy with the highest profit at $16.73 per tonne MSW. Scenario A1 can be seen as the best scenario with the greatest energy potential, the best economic benefit and the reduction of GHG emissions. The next best strategy for WtE was the A4 scenario with the second-highest profit at $11.87 per tonne MSW.4.5. Sensitivity analysis to assess the effect of moisture content on overall energy potential and GHG emissions was conducted by analyzing sensitivity by changing the moisture content of MSW between ±0 to 30%. The effectiveness of the A1 scenario was assessed as the best option for WtE's strategy for IHS management in Dhaka and Chittagong, Bangladesh. The results of the sensitivity analysis, which vary the moisture content of MSW, are presented in Figure 10. The results show that total GHG emissions and energy generation were largely due to moisture content in IHS. With the increase or decrease in moisture content, energy content, electricity generation and GHG emissions changed back to 2%, 4.3% and 9.5%, respectively. Thus, it can be said that heating UP MSW to reduce moisture content will increase the energy potential in Dhaka and the city of Chittagong, as well as reduce GHG emissions. Future the study is an attempt to inform inform Bangladesh has the potential for IHS as a renewable energy source in two Bangladeshi megacities, namely Dhaka and Chittagong. The growing demand for energy and the unsustainable management of IHS, coupled with the ever-increasing shortage of available land, have necessitated the development of a national VTV strategy. Bangladesh is trying to diversify its energy base by deploying a broad energy mix. On the other hand, energy security is one of the four security issues addressed in the National Climate Change Adaptation Action Plan (NAPA), 2009. Despite growing concerns about energy security, Bangladesh is still not taking a step forward to expand renewable energy technologies while relying only on fossil fuel resources, with little aim of generating 5% and 10% of electricity using renewable energy technologies by 2015 and 2020, respectively. The study feels the urgent need to reform this policy because of global concerns about GHG emissions from fossil fuels and IHS production. In the national contributions submitted to the UNFCCC, Bangladesh announced a voluntary reduction in GHG emissions of 5 per cent in industry, energy and transport by 2030. Developing countries such as Bangladesh will also be subject to strict regulation of GHG reductions today or tomorrow because of uncertainty about climate sensitivity. This study evaluated two selected WtE technologies, such as mixed MSW combustion and LFG recovery, based on MSW characteristics and generation. The WtE strategy has confirmed the prospects for mixed-burning IHS in Bangladesh to reduce GHG emissions and generate significant revenues from electricity and carbon credit.6 The conclusion, based on a recognized energy conversion model and a clean carbon model, WtE's analysis in Dhaka and the city of Chittagong focused on potential electricity generation, GHG prevention and higher economic returns. Six alternative wtE development scenarios in Dhaka and Chittagong in Bangladesh were evaluated. Scenario A1 provided the highest net profit with the best energy potential and net GHG reduction. Total estimated economic profit in 2050 from the two cities could be $170.76 million and $128.87 million, respectively, in line with CAGR's approach and MSW's historical A1 forecast. Estimated economic profit of US $170.76 million is approximately 10 times higher than the 2013-14 fiscal year revenue (US$16.45 million) from CCC (79) and approximately 4 times higher than the 2012-13 fiscal year revenue (US$40.82 million) from Dhaka City Corporation (DSCC) Sensitivity Analysis showed that a kind of heating up MSW to reduce humidity can stimulate energy recovery as well as reduce GHG emissions for selected WtE WtE Dhaka and Chittagong. WtE's strategy for managing MSW in Dhaka and Chittagong is vital to initiating a nationwide principle of circular economics and the concept of industrial ecology. This WtE strategy will also provide cheaper and more environmentally friendly energy, which will certainly reduce the problem of the energy crisis to some extent and create green jobs. The economic life of the WTE plant is chosen taking into account the economic life of the coal-fired power plant on the grounds that the electricity generated will replace coal-fired electricity. However, a shorter lifespan like 20 years or less can change the economic perspective of the chosen WtE scenario. The study concludes that that WtE's mixed-burning MSW strategy for power generation will bring environmental benefits nationally and globally and will guarantee MSW's integrated management for sustainable development in Bangladesh.Source:Chittagong City CorporationDCC:Dhaka City CorporationDSCC:Dhaka South City CorporationGHGs:Greenhouse LFG:Landfill GasLV:Lower Heating Sites :Waste to energy.Competing InterestsThe author states that there are no competing interests in the publication of this document. 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