

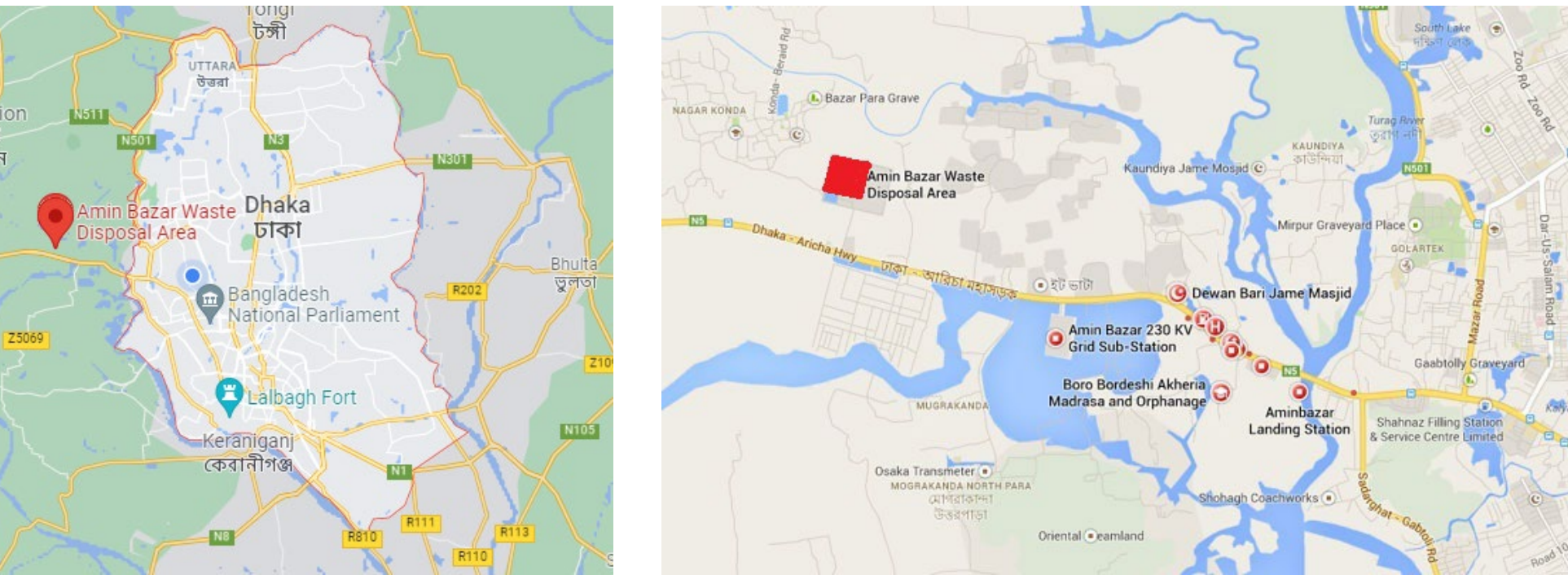
Impact of Municipal Solid Waste Landfill on Climate Change and Human Well-being: A Case Study on Aminbazar Landfill, Dhaka North City Corporation, Bangladesh.

Mst Marufa Khondoker¹, Dr. M. Maksudur Rahman², Dr. Sangchul Hwang¹

¹Ingram School of Engineering, Texas State University, San Marcos, TX 78666, USA, ²Department of Geography and Environment, University of Dhaka, 1000, Bangladesh

Introduction

Solid waste management has become a global issue and increasingly challenging day by day, owing to the expansion in population, industrialization, and the resulting changes in people's lifestyles. Solid waste disposal emissions are predicted to rise as the world's population and GDP growth. According to the Intergovernmental Panel on Climate Change (IPCC), post-consumer waste accounted for up to 5% of world GHG emissions in 2005 (Metz, Davidson et al. 2007). Greenhouse gases (GHG) are released during garbage management (such as transportation) and when waste is left to decompose in landfills. The following are the critical channels via which solid waste management affects GHG emissions (Ahluwalia and Patel 2018). The Amin Bazar trash disposal site, one of the primary dumping sites for Dhaka city wastes, is located on the low-lying floodplain of the River Karanachhali in Savar Upazilla, Dhaka district, was established in 2007 with funding from the JICA, and it is still operational, despite having reached its capacity in 2017. This landfill is around 500 meters away from residential communities, water bodies, and agricultural land, exposing these regions to a variety of risks. In addition to various landfill gases generation, low birth weight, congenital malformations, heart disease, sexual inactivity and respiratory problems are common side effects of living near this piled-up landfill.



Google map location of the landfill (11 January 2022)

Rationale of the Study

Although some pieces of research have been found regarding landfills and their impact on the environment and health of the people, no significant research has been done on the emission of landfill gases (mainly methane gas) in Bangladesh which has a substantial impact on global warming and climate change. However, some exciting research and debates have been conducted regarding methane gas emissions calculated and predicted by several methods. This study has used two methods to estimate GHG (methane gas) emission: one is the IPCC default method and the other is the Landfill Gas Emission Model (LandGEM) method by EPA.

Research objectives

1. To estimate methane gas (CH₄) emission potential of Aminbazar Landfill by IPCC Default Method and LandGEM Model and differentiate between them.
2. To assess the health impact on the staff who deal with the waste every day.
3. To evaluate the impact on the livelihood of the dwellers residing near the Aminbazar landfill.

Design and Methodology

The overall methodology of the study was done primarily in five steps:

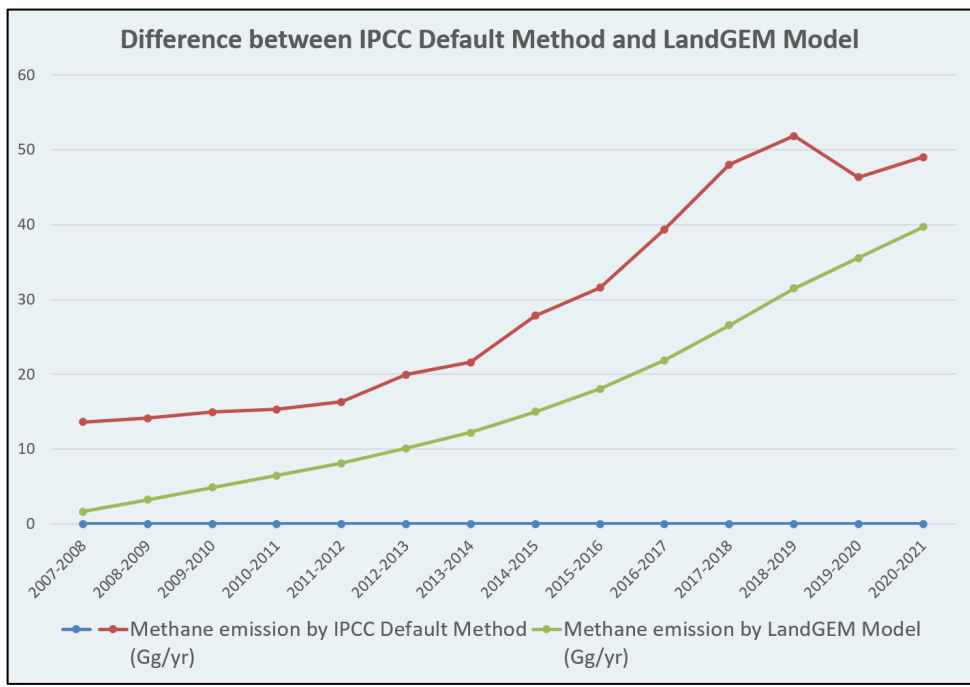
1. Visit the DNCC headquarters and Aminbazar landfill
2. Key Informant Interviews (KII) with DNCC officials of different levels.
3. Focused Group Discussion (FGD) with the waste workers and dwellers residing nearby
4. Data input in the two methods as per IPCC guidelines and the LandGEM model recommended for developing countries.
5. Quantitative analysis between IPCC and LandGEM model, and qualitative analysis on the human well-being.

Waste data since 2007-2008 to 2020-2021 fiscal year (Source: Primary data from the KII of DNCC High Officials, and secondary data from the Waste Reports)

Year	MSW received (tons per year)
2007-2008	295,200
2008-2009	306,000
2009-2010	324,000
2010-2011	331,200
2011-2012	352,800
2012-2013	432,000
2013-2014	468,000
2014-2015	602,975
2015-2016	683,288
2016-2017	852,391
2017-2018	1,039,331
2018-2019	1,122,478
2019-2020	1,002,561
2020-2021	1,061,147

Quantitative Results

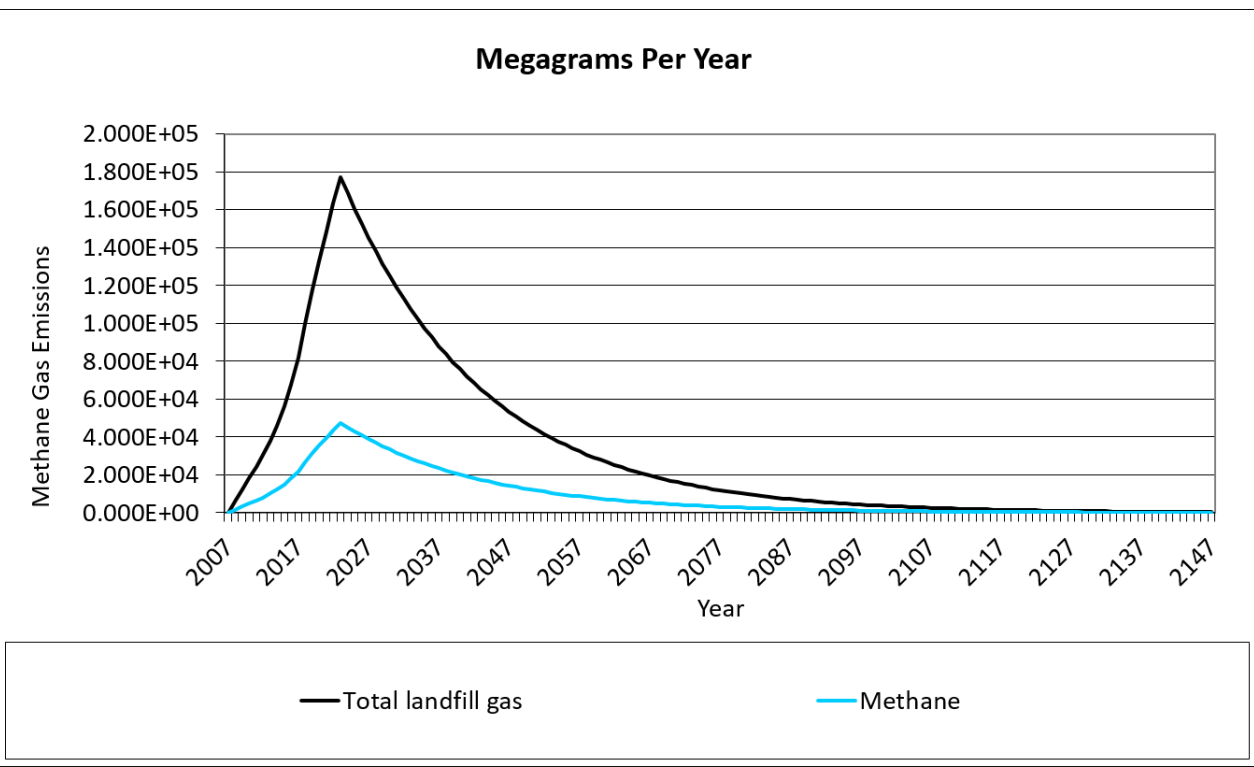
- IPCC default method
 - Total methane emission in 2007 and 2021: 13.64 and 49.02 Gg/year
- LandGEM model
 - Total methane emission in 2007 and 2021: 1.64 and 39.68 Gg/year



Graphical representation of the difference between the output value from IPCC default method and LandGEM Model

- Landfill gas production by LandGEM model
 - Total LFG: about 6.13 Gg in 2007, 148.56 Gg in 2021.
 - Total methane gas: 1.64 Gg in 2007 and 39.68 Gg in 2021.

Graphical representation of Total landfill Gas (LFG) and CH₄ in (Megagrams/yr)



Qualitative Results

- Findings from the FGD and KII of the staff at the site
 - Suffer from Body itching and irritation, irritation of the eyes, acidity issue, high temper, low appetite, chest pain, etc.
 - Gradually become sexually inactive which prohibits them from becoming a father, they think this is the impact of working in the landfill.
- Life of extremely poor people
 - Build tents on top of the waste piles and stay daylong to collect the recyclable and reusable materials
 - Lives with crows, kites, flies and other harmful insects
- People who owned the land-
 - Lost their livelihood (agricultural lands),
 - Pungent smell of kerosene in the fishes as leachate goes to the river,
 - Meal plates get filled with the flies coming from the disposal site.
- Experiencing skin problems, loss of appetite and other health problems from the beginning of the landfill, now they became used to living with them.



Several photos were obtained during field visits to illustrate the site's state as well as the suffering of the extremely poor people.

Conclusion

- If we consider on average 40 Gg/ year methane gas is being emitted from Aminbazar landfill, it can be said that the landfill is responsible to emit methane gas amounting to 2.96 kg/acre/day .
- We as individuals are responsible for global warming by emitting 17.96 grams of methane gas daily.
- More research on this topic should be done on other landfills to provide a complete picture of the influence of solid waste landfills on climate change.
- To protect agricultural land, groundwater, and stormwater runoff, treatment plants should be appropriately managed.
- To limit the health impact, employees should be required to wear PPE while at work.
- Government should place a greater emphasis on waste management and its impact on climate change.



Google Earth images of the facility before 2007 and after fourteen years of operation in 2021.

Acknowledgment

Ms. Mst Marufa Khondoker is currently pursuing a Master of Science degree in Civil Engineering in Ingram School of Engineering at Texas State University under the supervision of Dr. Sangchul Hwang. She has conducted this research in partial fulfillment of her Master of Science in Disaster Management degree from the Department of Geography and Environment, University of Dhaka, Bangladesh under the supervision of Dr. M. Maksudur Rahman.

Reference

- Islam, M., et al. (2015). "Assessment of the present state and economical prospects of solid waste at Amin Bazar Waste Dumping Site, Dhaka, Bangladesh." Journal of Scientific Research 7(3): 129-137.
- Metz, B., et al. (2007). Climate change 2007-mitigation of climate change, Intergovernmental Panel on Climate Change, Geneva (Switzerland). Working...
- Ahluwalia, I. J. and U. Patel (2018). "Solid waste management in india: an assessment of resource recovery and environmental impact."