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ScienceDirect
Procedia Environmental Sciences 35 (2016) 337 – 347
Procedia Environmental Sciences

International Conference on Solid Waste Management, 5IconSWM 2015

Methane Emission from Panki Open Dump Site of Kanpur, India

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Abstract

In developing countries, quantities of solid waste generation is increasing day by day and most of which is disposed off through landfilling and open dumping resulting into the release of significant quantities of GHG. CH_4, the major gas produced by these activities, is known to cause global warming. The paper reports the estimates of CH_4 calculated by using IPCC Default, FOD method and LandGEM model, version 3.02 from Panki open dump site of Kanpur, India. The annual average CH_4 emission rates from Panki open dump site is found as 197.33, 24.27 and 25.14 Gg by IPCC Default method, FOD and LandGEM respectively for the period 2010-2030. The study reveals that IPCC Default method over estimate the result therefore it is not recommended for open dump site. however, LandGEM is recommended over FOD method for open dumps due to the fact that [a] estimates of CH_4 emission is very near to GHG emission by FOD method [b] simplicity in model parameters [c] avoidance of over estimation, if parameters are calculated as per the actual site conditions. So the present study reveals that LandGEM provides better estimation compared to other method and the CH_4 emission rate is found as 25.14 Gg/year for the Panki open dump site, Kanpur.

The assessment of methane emission potential reveals the fact that upgrading the open dumps into landfill increases the methane emission rates and their utilization potential and adding the landfill to fill the future needs and utilization of landfill gases.

Peer-review under responsibility of the organizing committee of 5IconSWM 2015
Keywords: Open dump; Municipal Solid Waste; GHG emission; LandGEM;

1. Introduction

The climate change, the most serious environmental challenge being faced by the mankind, is causing sea level rise, increased frequency of cyclones and uneven distribution of rainfall, which is affecting the agriculture production, biodiversity and natural cycles. These natural disturbances are attributed to the global warming phenomenon due to global emission of GHGs like CO_2, CH_4 and N_2O from anthropogenic activities. Global

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Peer-review under responsibility of the organizing committee of 5IconSWM 2015
doi:10.1016/j.proenv.2016.07.014

Warming Potential (GWP) of CH_4 is reported as 21 times while N_2O as 310 times more than CO_2 over a period of 100 years "kumar et al. (2004)". More than 60 % of total CH_4 emissions are accounted from human activities, of which, the waste management practices, especially, MSW generation are the significant contributors of GHG emissions "kumar et al. (2014)". The MSW when subjected to landfills undergoes continuous degradation of biodegradable components under anaerobic conditions resulting in the production of recoverable biogas consisting of CH_4 and CO_2 as the major components (40-60% each) and other gases like H_2S as the minor and can be used as energy source "Deonar Pre-feasibility Report (2014)". If these wastes are not properly managed, lot of CH_4 is released into the atmosphere and causes the global warming. The management of MSW is, therefore becoming an important urban environmental challenge in developing countries due to rapid urbanization, changed life style and population growth "kumar et al. (2004)". MSW management issues include inefficient collection methods, inadequate coverage of collection, processing systems, inappropriate disposal, inadequate budget and lack of proper institutional development. In developing countries, due to the above factors, open dumping of MSW is a common practice and so the wastes are not properly disposed off creating environmental problems like groundwater, surface water and soil contamination, ultimately, adversely affecting the human & animal health, and agriculture productivity "Staley et al. (2009)". Apart from the release of GHG into atmosphere, these open dumped MSW sites are causing global warming / climate changes with no energy recovery. In developing countries like India, inventory estimates of CH_4 emissions from landfills have large uncertainties due to inadequate data on MSW management and emissions. In order to reduce GHG emissions, or to reduce its cumulative global warming impact or to utilize it as a renewable energy resource; it is desirable to manage such sites as the waste should be collected by employing suitable disposal methods and should recover the useful products "Couth et al. (2011)".

The present paper deals with GHG emission potential of three landfill sites of Delhi namely; Gazipur, Bhalswa and Okhla landfill site and one open MSW dump site in Kanpur (UP). Based on data of Chakraborty et al. (2011) and Kumar & Sharma (2014) as well as data collected from Kanpur, the First Order Decay Method (FOD), IPCC Default Method, and LandGEM, version 3.02 was applied to estimate the amount of CH_4 produced from landfill sites in Delhi and from open dump site, Kanpur, India. The results of Kanpur open dump site are compared with considering the open dump is converted to landfill.

1.1. Literature review

Literature reveals that several researchers have estimated GHG emission potential of landfills and open dump sites using different methodologies/models. Kumar et al. (2004) used default method & modified triangular method and found that total CH_4 generation is approximately the same by both the methods LandGEM adopted by USEPA (2005) has been used to prepare prefeasibility report for Deonar and Okhla landfill sites, India. Mor et al. (2006) used FOD for Ghazipur landfill site and compared the results with Modified triangular method. The CH_4 generation potential was found within the range of existing estimates by both models, and suggested that atmospheric CH_4 emission could be reduced if the MSW site is properly planned and landfill gas recovery is taken into account. Stoichiometric approach was adopted by Akolkar et al. (2008) to assess GHG emissions and control the GHG fluxes at different depths of in metro cities, state capitals, class I cities and class II towns in India. Chalvatzaki and Lazaridis (2010) used Triangular, Stochiometric and LandGEM model for Akrotiri landfill site, Greece and found the LandGEM as the most reliable model for quantification of emission rates. Ecuador LFG model was further adopted by Siddiqui and Khan (2011) for evaluation of CH_4 recovery potential from Okhla (Delhi), Gazipur (Delhi), Deonar (Mumbai), Gorai (Mumbai), Pirana (Ahmadabad) and Autonagar (Hyderabaad) landfill sites. Chakraborty et al. (2011) used in-situ CH_4 measurement, FOD, default and modified triangular method for three landfills of Delhi. LandGEM, version 3.02 was adopted by Yang et al. (2012) to estimate total landfill gas and CO_2 emission from Tanjulangstat MSW landfill site in Malaysia. Kumar & Sharma (2012) used the same version to estimate GHG Emission and energy recovery potential from Ghazipur, Okhla and Bhalswa landfills of Delhi, India and compared the results with that obtained using DM, FOD, MTM and chamber methods on the same sites. The author also used this model to estimate GHG emission potential of MSW landfills of Indian metro cities and found Mumbai as the significant contributor of GHG emissions while Visakhapatnam, the least. The work recommended the use of LandGEM for estimation of national inventories of GHG emission. Ramchandra et al. (2015) reported the major GHG footprint of major cities like Delhi, Greater Mumbai, Kolkata, Chennai, Greater Bangalore, Hyderabad and Ahmadabad as 38,633.02 Gg, 22,783.08 Gg, 22,090.55 Gg, 12,734.59 Gg and 91,24.45 Gg respectively and found