Reduction of Greenhouse Gas Emissions By Clean Development Mechanism For Solid Waste Management In Nashik

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Abstract *:*
The Municipal solid waste in Nashik city is increasing day by day. This increase in solid waste is observed due to the increase in urbanization, industrialization, population density and income. The growth of households, industries, commercial units such as hotels, theatres, restaurants, malls and other infrastructures are increasing at greater level; however Nashik Municipal Corporation (NMC) has joined hands with GIZ (Germany) recently and installed a Biomethanation plant of 30 TPD especially for biodegradable waste from hotels, restaurants and other such units, but it is not covered under NWM.These are such units mainly contributing to the generation of solid waste. The solid waste collected in Nashik, its segregation at site and disposal of the same by Municipal Corporation is low and not adequate, but under Swachh Bharat Abhiyan (SBA), it is being implemented by Nashik Waste Management on fast-track basis. In the present study the year wise solid waste generation of Nashik city was analyzed where there is a significant increase of Municipal solid waste from past twelve years which increased up to twice the waste. The energy recovery and emissions reduction from municipal solid waste under clean development mechanism isestimated on daily basis as well as considering the whole plant using IPCC default good practice guidelines.

Keywords: *Clean Development Mechanism (CDM), Emission Reduction (ER),Nashik Waste Management (NWM), Net Power Generation (NPG).*

I. INTRODUCTION

The Clean Development Mechanism(CDM) is part of Kyoto protocol environmental agreement which was designed to stimulate sustainable development through people centered participatory developmental activity in order to reduce greenhouse gas (GHG) emissions. Itis one of the Flexible Mechanisms defined in the Kyoto Protocol (IPCC, 2007) that provides for emissions reduction projects which generate Certified Emission Reduction units (CERs) which may be traded in emissions trading schemes.(IPCC 2007 B. Metz et al. Eds.)[1].MSW generation are the significant contributors of GHG emissions (Kumar et al. ,2014)[2]. Thepurpose of this study is to assess the current status, challenges and opportunities of Clean Development Mechanism (CDM) in Solid Waste Management facility in Nashik city [also called Nashik Waste Management(NWM)] thus adopting measures for reducing the greenhouse gas emissions from Municipal Solid Waste in the facility thus providing confidence that the emission reductions are being achieved and are able to monitor the risks inherent to baseline and project emissions which plays a vital role in climate protection.There are 7977 CDM projects worldwide, among which 7784 projects have been registered by the CDM Executive Board, whereas the remaining 193 projects are still pending to be registered [3]. Around 50% projects are mainly from India & China. 2938 CDM projects have been registered by Indian CDM Executive Board in Delhi. Until Dec 2015, 1 billion metric tons of CO_2e[or Certified Emission Reductions(CERs)] have been issued worldwide.Solid waste, including municipal waste and its management, is a major challenge for most cities and among the key contributors to climate change. GHG emissions can be reduced through recovery and recycling of resources from the MSW stream (King and Gutberlet, 2013)[4]. Due to initiatives such as the Clean Development Mechanism (CDM), reducing GHG emissions for a developing country can offer an important route to attracting investment in a variety of qualifying project areas, including waste management (Barton et al., 2008)[5]. CDM can play a major role in managing MSW by motivating municipalities to go in for energy recovery projects, as it will bring in carbon credits, which makes the projects financially more attractive (Unnikrishnan and Singh, 2010)[6] .

II. NEED OF RESEARCH

The current level of generation of solid waste and its projected rate of annual increase pose an environmental challenge in Nashik. The heavy urbanization and increasing population in Nashik generates solid waste in significant quantities in the near future. Due to improper segregation, proper organic matter is not available for degradation. The improvement of nearby local air quality of landfill sites should also be considered for the population living in the vicinity of waste management facility. To reduce the emission by practicing remedial alternatives that can be adopted like collection of greenhouse gases. Identifying occupational and health related hazards.The increasing population, pollution and waste generation poses a great threat in the emissions of greenhouse gases. About 65-70% of the emissions are due to solid waste. The implementation of CDM will collect the GHG emission entering the environment which will act as clean technology as well as control over pollution. As methane and carbon dioxide are main emissions from MSW, it can be utilized for power generation.

III. Research Methodology

The research on this study consists of following steps. First, a literature survey was conducted to find out the sites where most of greenhouse gases were emitted, mainly methane and carbon dioxide. The emissions where mainly contributed but windrow composting, biogas plant and landfill. The emissions in the form of tons of carbon dioxide equivalent (tCO_2e) have been calculated. The energy recovery and emissions reduction from municipal solid waste under clean development mechanism is estimated on daily basis as well as considering the whole plant. For the theoretical calculations of the same, the Municipal waste generation of Nashik viz. 500TPD is divided into various components, namely Sanitary Landfill (250TPD), Biogas Plant (10TPD), windrows (100TPD), Refused Derived Fuel (RDF) (140 TPD). In this, the main greenhouse emissions are caused due to biogas plant, windrow composting, and landfill. The emissions were theoretically calculated for methane generation, Net Recovery Potential (NPG), and Emission Reductions (ERs)

IV. Data Collection

For the study, a successful case study of Gorai closure projectwas taken in order to understand how greenhouse gases as well as other components were brought under control and the necessary measures taken for the same. The project was registered under Clean Development Mechanism (CDM) of United Nations Framework Convention on Climate Change (UNFCCC) on 10th February 2010.

4.1. Success Case Study: Gorai Closure Project.

The objective of the proposed project was to address the environmental problems arising due to the unscientific disposal of the MSW at the site, in a manner that will provide an everlasting solution. Implementation of the project would improve current solid waste management practices and made a strong contribution in achieving scientific management of solid waste disposal in Mumbai. In addition, this would demonstrate the application of developing a comprehensive scientific system for management of huge quantities of unprocessed solid waste, already accumulated at other dumping sites in India. The project will also demonstrate that the carbon credit finance mechanism can catalyze environmentally sustainable and financially viable closure of existing dumping sites and thus directly eliminating methane and replacing fossil fuel electricity generation to prevent GHG emissions in the atmosphere. The implementation of project resulted in control on odor during transportation and littering of waste due to spillage from the transportation vehicles; improvement in coastal water quality near the creek areas adjacent the site due to elimination of discharge of untreated leachate into the environment.; improvement of environmental conditions near the sites due to control on malodorous conditions and flying refuses; improved aesthetic conditions near the site due to transformation of waste dump into scientifically managed landfill and green area. The project also resulted in improved quality of life of people living in the vicinity; created 19 hectares of green space and restored mangroves which had degenerated due to toxic leachate from the dumpsite and also the value of in that area increased with higher property tax collection for the Municipal Corporation of Greater Mumbai.

V. Data Analysisand Discussion

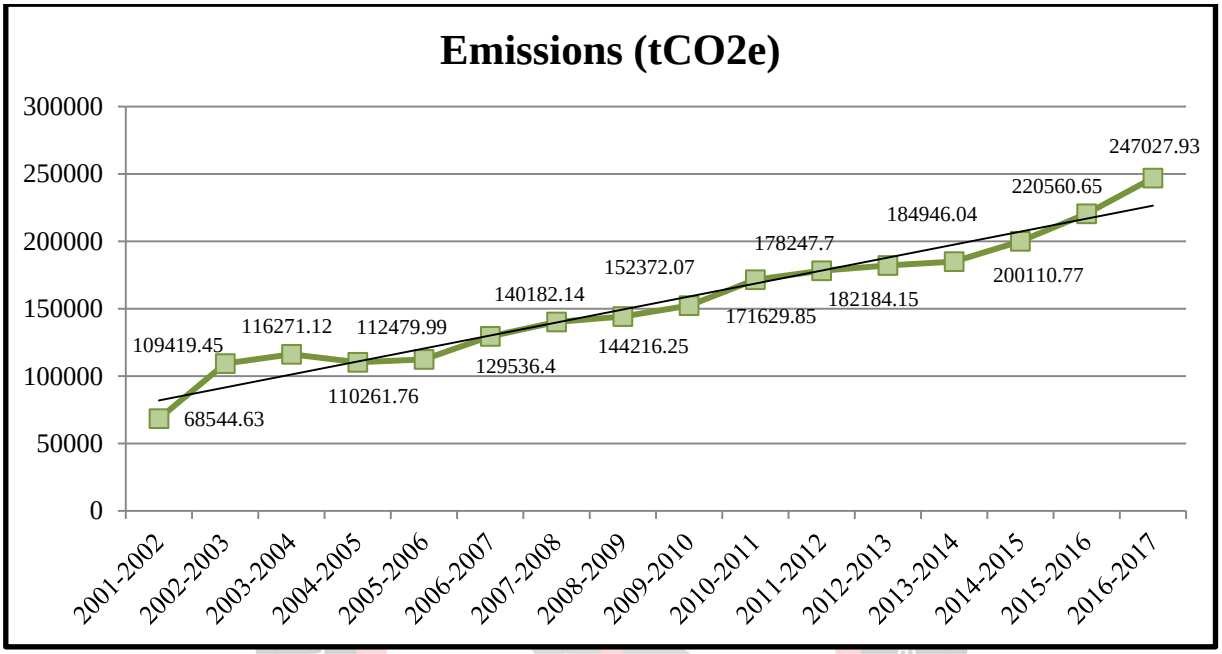
In the waste management facility, the main emissions i.e methane and carbon dioxide are mainly contributed by windrows, biogas plant, and landfill. The energy recovery and emissions reduction from municipal solid waste under clean development mechanism was estimated on daily basis as well as considering the whole plant. The daily based methane generation was estimated to be 671.62 tons for leachate treatment/ biogas plant of capacity 10 TPD. The daily based Net Power Generation(NPG) and Emission Reduction (ER) of plantweretheoretically estimated to be 115 kW and 14.7 tCO_2erespectively.For aerobic windrow composting (100TPD), thedailybasedmethane generation, NPG, ERs were theoretically estimated to be 6716.16 tons, 1150 kW and 147 tCO_2e respectively.For sanitary landfill (250TPD), the daily basedmethane generation, NPG and ERs were theoretically estimated to be 16790.4 tons, 2875 kW and 367.5 tCO_2e respectively.Considering the whole Waste Management Plant, the methane generation, NPG and ERs from landfill were theoretically estimated to be 12936422.32 tons, 2215.1 x 10^3 kW and 2, 83,146 tCO_2e respectively.Considering the whole Waste Management Plant, the methane generation, NPG and ERs fromaerobic windrow composting was theoretically estimated to be 311860.48 tons, 53.4 x 10^3 kW and6825.87 tCO_2e. The total waste collected by Nashik Waste Management from 2001 – 2017 was 1510859.16 tons, the total estimation of emission reductionnet power generation potential from 2001 – 2017are shown in table 5.1

Table 5.1 Theoretically estimated Emissions Reduction and Net Power Generation (2001-2017)

Sr. No	Year	Emission Reduction (tCO_2e)
1	2001-02	68544.63
2	2002-03	109419.45
3	2003-04	116271.12
4	2004-05	110261.76
Sr. No	**Year**	**Emission (tCO_2e)**
5	2005-06	112479.99
6	2006-07	129536.4
7	2007-08	140182.14

8	2008-09	144216.25
9	2009-10	152372.07
10	2010-11	171629.85
11	2011-12	178247.70
12	2012-13	182184.15
13	2013-14	184946.04
14	2014-15	200110.77
15	2015-16	220560.65
16	2016-17	247027.92
TOTAL		**2467990.9**

The increase in the emissions from 2001-2017 are depicted in Fig. 5.1



Fig, 5.1 Theoreticallyestimated Emission Reduction from 2001-2017

The crediting period for the project is estimated to be 30 years, for which the following table depicts the forecasted Emissions Reductions as well as the NetPower Generation as methane and carbon dioxide production will decrease in course of time, if Clean Development Mechanism alternatives like Biogas, landfill gas etc. are recovered so as to produce electricity, thus saving the energy cost, decreasing load on the electric grid as well as functioning of various components of the waste management facility.

Table 5.2 Forecasted emissions and Net Power Generation

Sr. No	Year	Emission Reduction (tCO_2e)	Net Power Generation (MW)
1	2017-18	192240	2098.75
2	2020-21	94973	2388.38
3	2023-24	50423	2728.38
4	2026-27	28820	3093.56
5	2029-30	17767	3479.73
6	2032-33	11837	3891.08
7	2035-36	8540	4323.43
8	2038-39	6687	4780.95
9	2041-42	5696	5272.06
10	2044-45	5290	5817.74
11	2046-47	5290	6195.51

The following figure depicts the forecasted emission reductions under CDM methodology

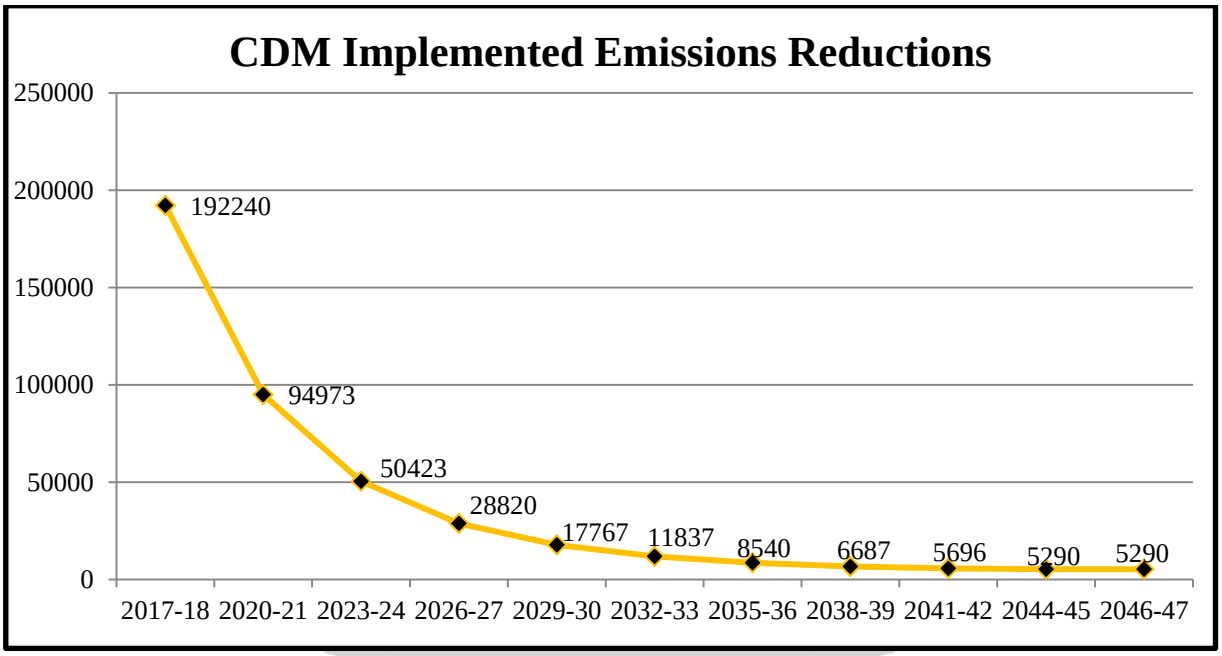


Fig. 5.2 Forecasted emission reductions

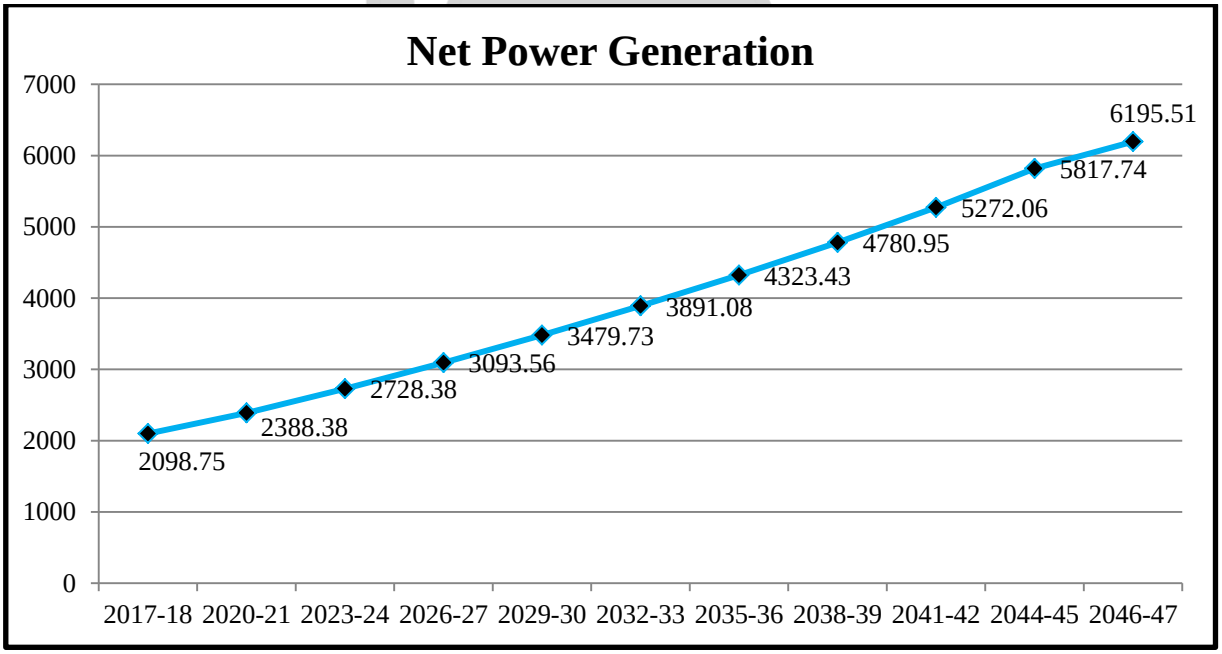


Fig.5.3 Forecasted Net Power Generation

5.1. Cost Benefit Analysis under CDM for Waste Management Facility

The Cost–benefit analysis to run the solid waste management facility in order to reduce the Greenhouse gas emissions was worked out by determining the costs required to install new technology like biomethanationplantalong with leachate treatment plant, air monitoring station as well as for managing the facility which will yield benefits to the facility in the long run.The benefits include revenue from gate fee, revenue from compost sale, as well as from RDF sale in large scale along with Swachh Bharat Cess.The costs includeinitialtotal investment, land cost, operation and management cost(O&M cost) and other lump sum cost. The cost benefit analysis of GHG reduction was calculated according to benefit-cost model quoted by (Yuan Wang, ShengnanGeng etc.)[7], where the benefit to cost ratio was estimated to be 1.12.

VI. Concluding Remarks

It is crucial to set up system boundaries and assumptions when establishing a GHG emission inventory (Braschel and Posch, 2013)[8]. The CH_4 emissions in tons from different sections have been estimated individually where the bio-chemical process

takes place using IPCC default good practice guidelines, 1996.At a collection efficiency of seventy percent and varying difference with respect to time, 0.07 tons of CH_4 can be recovered, multiplied with the GWP for CH_4 (i.e., 21), using gas yield methodology.The waste generation is increasing day by day along with increase in emissions but can generate power for the operation of waste management facility along with reduction in power rates as compared to earlier consumptions. The distribution of methane gas to customer will be difficult, instead the gas generated will be converted into steam and it will be utilized for power generation. This will be studied for the future project work.

VII. LIMITATIONS

The accurate facility's sector-wise estimation of emission and itsenergy recovery potential is difficult due to the limitations on availability of input data as well as resources.The different technologies for recovering useful energy from Municipal Solid Wastes already exist and are being extensively utilised in different countries for their multiple benefits. It is necessary for the success of these technologies in India to evolve an Integrated Waste Management system, coupled with necessary legislative and control measures.Pollution standards to be improved which will increase the importance for emission reductions. Theoretical and practical emissions estimation will have vast differences which can/cannot be relied upon.

VIII. REFERENCES

[1] IPCC (2007). "Glossary J-P. In (book section): Annex I. In: Climate Change 2007: Report of the Intergovernmental Panel on Climate Change (B. Metz et al. Eds.)". Cambridge University Press, Cambridge, U.K., and New York, N.Y., U.S.A. Retrieved 2010-04-23.

[2] A.Kumar, M.P. Sharma, Estimation of GHG emission and energy recovery potential from MSW landfill sites, Sustainable Energy Technologies and Assessments, Volume 5, Year (2014), Pg 50–61.

[3] King MF, Gutberlet J (2013) Contribution of cooperative sector recycling to greenhouse gas emissions reduction: A case study of RibeirãoPires, Brazil. Waste Manag. 33:2771 - 2780.

[4] https://cdm.unfccc.int/Statistics/Public/CDMinsights/index.html

[5] Barton JR, Issaias I, Stentiford EI (2008) Carbon – Making the right choice for waste management in developing countries. Waste Manag.28:690 - 698.

[6] Unnikrishnan S., Singh A. (2010) Energy recovery in solid waste management through CDM in India and other countries. Resour. Conserv.Recycl. 54: 630 – 640.

[7] Y.Wanga, S.Genga, P.Zhao, H.Du, Yu He, J.Crittenden,Cost–benefit analysis of GHG emission reduction in waste to energy projects of China under clean development mechanism, Resources, Conservation and Recycling, Volume 109, Year (2016), Pages 90–95.

[8] N Braschel, APosch. A review of system boundaries of GHG emission inventories in waste management. J. Cleaner Prod. Volume 44, Year (2013) 30–38.

[9] A. Potdar, A. Singh, S. Unnikrishnan, N. Naik, M. Naik, I. Nimkar, V. Patil (2016). Innovation in Solid Waste Management through Clean Development Mechanism in Developing Countries, ProcediaEnv. SciVol 35Pg.193 – 200

[10] Carbon Trust (March 2009) Global Carbon Mechanisms: Emerging lessons and implications (CTC748) Carbon Trust website. Retrived 2010-03-31.

[11] DPR for SWM Nashik, 2007.

[12] CPHEEO Manual on Solid Waste Management, Ministry of Urban Development, Government of India.

[13] Municipal Solid Waste Report, NMC.

[14] Municipal Solid Waste Management and Handling Rules(MSW M&H Rules 2016)

[15] Government of India, Swachh Bharat Mission, Municipal Solid Waste, Management Manual, 2016.

