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Emission Study of Municipal Solid Waste Disposal Scenarios in South Delhi Municipal Corporation Area, India

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***Abstract:** In this study environmental emission of considered different options of an integrated waste management strategies are analyzed. GHG emissions for waste management practices, including recycling, combustion, composting, and sanitary land fill (SLF) are calculated by Waste Reduction Model (WARM). The emissions are calculated in metric tons of carbon dioxide equivalent ($MTCO_2E$). Maximum emission reduction is for scenario 30 which is -220.46 MT and minimum value is 54.0127 MT for scenario 32.*

***Keywords:** Composting, Incineration and Sanitary Land Fill (SLF), Waste Reduction Model (WARM), Greenhouse Gas Emissions (CO_2 equivalent)*

I. INTRODUCTION

A study carried out by Municipal Corporation Delhi for estimating the quantity and characteristics of MSW during the year 2005 and it has indicated that Delhi generates about 8567 tons of waste every day. According to CPCB, 2010-11, Delhi is generating highest quantity of municipal solid waste with 6800 tons per day followed by Greater Mumbai and Chennai. In Delhi Rs. 500 crores is spent on solid waste management, 80% expenditure is on collection and transportation and 10-15% on disposal of solid waste.

In recent years interaction between environment and economics has become more predominant. MSW has a huge potential for reducing green house gas emissions. Waste streams are rich in biodegradable materials; the potential to reduce green house gas emissions is significant. GHG emissions from waste are directly affected by regulatory strategies that encourage energy recovery from waste, restrict choices for ultimate waste disposal, promote waste recycling and re-use and waste minimization.

There is no a single technology that can solve the waste management problem. Integrated waste management system (IWMS) is one of the effective strategies to solve waste management problems. A number of studies were carried out in the past to compare different solid waste management strategies for different places. The present study is an attempt to integrate the best feasible method of solid waste disposal in South Delhi Municipal Corporation (SDMC) area considering GHG emission.

II. STUDY AREA

South Delhi Municipal Corporation (SDMC) is serving the population of 5.6 million citizens with a responsibility of maintaining, upgrading and developing civic amenities efficiently with a view to create a better tomorrow for citizens. It occupies an area of 656.91 sq km which is further subdivided into 4 zones-Central, South, West and Najafgarh Zone and has 104 wards (Figure 1).

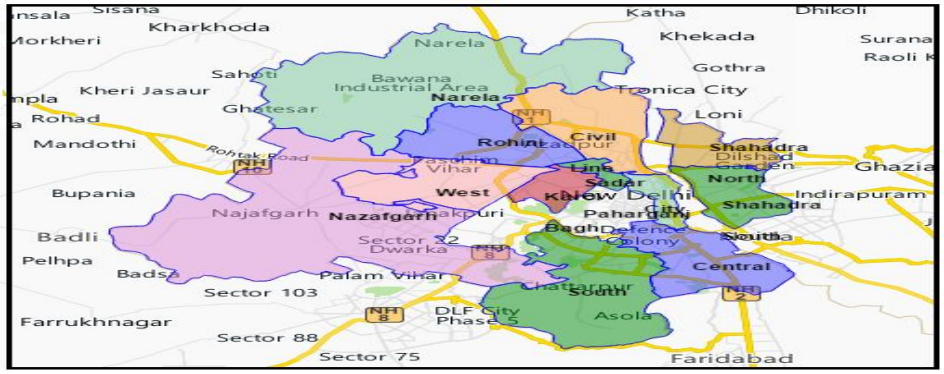

Figure 1: Delhi map showing locations under SDMC

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In SDMC out of 1038 colonies, 221 in central zone, 185 in South zone, 241 in west zone and 391 in Najafgarh zone.

III. WASTE TREATMENT TECHNOLOGIES IN SDMC AREA

In study area following disposal facilities are available or have been implemented in past.

A. Okhla Sanitary Land Fill (Slf)

Okhla landfill site is located at Okhla Phase-I, which is about 2 km from National Highway-2 on South East end of the city, Established in 1994. The area of the landfill is 56 acres. Site serves for dumping of solid waste generated from South Delhi and Central Delhi. The SLF receives around 2000 MT of Solid Waste daily.

B. Bhalaswa SLF

Bhalaswa SLF is located on National Highway 1, on the North West corner of Delhi on the Northern side of the G.T.K bypass. The landfill was established and commissioned in 1993. It has served well past its designed life. Its designed life ended in 2005. The Area of the landfill is around 40 acres. The SLF receives around 2200 MT of Solid Waste daily. Solid Waste is received from the zones-West, Karol Bagh, Rohini, Najafgarh, Narela, Civil Lines, SP, City, Delhi APMC, DMRC and DDA.

C. Incineration Plant of Timarpur

In Delhi, an attempt was made to recover energy from waste by implementing the Timarpur Refuse Incineration-cum-Power Generation Station (Timarpur Plant) in 1987. This plant was designed to incinerate 300 TPD of MSW and generate 3.75 MW of electric power. The plant when put on trial could neither incinerate the desired amount of MSW nor generate 3.75 MW of electric power.

D. Timarpur - Okhla Waste to Energy Plant

In December 2006, the Govt. proposed another waste to energy plant in Okhla where it was decided that a plant would be set up that will process 1300 TPD MSW and would generate 450 tons of RDF per day, along with a 100 TPD bio-methanation plant that would generate 16 MW of power The system would operate on MSW having low calorific values of 1000 - 1400 Kcal per Kg.

E. Bio-Methanation Plant in Timarpur

The project has a bio-methanation facility for a combined treatment of 50 tons per day of segregated vegetable market waste and 6 million gallons per day (MGD) of sewage, which could produce biogas, equivalent of 2500 kg LPG, to be used as fuel for generating electricity. A two phase modified Up-flow Anaerobic Sludge Blanket (UASB) is adopted for this project activity. This biogas will be used as supporting fuel for the boiler and dryer in RDF plant. The disadvantage of this process is that some of the gases tend to escape through cracks and crevices by diffusion (concentration gradient) or convection (pressure gradient) mechanism posing threat to nearby structures and vegetation.

F. Composting Plant at Okhla

The first composting plant was set up at Okhla in 1980. The compost Plant in Okhla is spread over an area of 2 hectares. It was semi mechanized plant of 150 tones per day capacity for composting the waste. Later this plant was expanded with its some additional capacity in 1985. However, this plant was not in an operational condition during 1991-1995 due to low quantity of waste material and higher operational cost. This plant converts 73,000 tones of MSW into compost every year. This is equivalent to 200 tones of municipal solid waste per day. It is a total 200 TPD capacity plant. It gets its waste from south zone, North zone & central zone. The rejects from the plants are Combustibles (498 Tons/ month) which are sent to Waste to Energy plant in Okhla & Inert (212TPM) disposed at Okhla Sanitary Landfill.

G. Composting Plant at Bhalswa

The Bhalswa composting plant was established in 1999. Bhalswa plant is spread over an area of area of 4.9 hectares. It is operated and maintained by M/s Nature Waste Management Pvt. Ltd (M/s Excel Industries Pvt. Ltd.). It is operating at about 300-350 MT/ day as against the installed capacity of 500 MT/ day. Compost is approximately 24% of the total garbage received. It gets waste from West zone (100%), Rohini zone (10%), Najafgarh zone (3%), Narela (100%), Karol bag.

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IV. MATERIALS AND METHODS

For the study following steps have been followed,

A. MSW Treatment Technologies Consideration

Integrated waste management options are now been applying in most of the countries with recycling, recovery, land fill gas recovery and energy generation from the solid waste. There are three main different technologies are available for managing MSW. Brief descriptions of these three technologies are given bellow,

1) *Composting:* It is a process of biodegradation of waste under aerobic (oxygen-rich) conditions. Composting converts biodegradable organic carbon to mostly carbon dioxide (CO_2) and a residue (compost) that can be used as a fertilizer.
2) *Combustion:* Combustion is a thermal waste treatment process where raw or unprocessed waste can be used as feedstock. The combustion process takes place in the presence of sufficient quantity of air to oxidize the feedstock (fuel). Waste is combusted in the temperature of 850ºC and in this stage waste converted to carbon dioxide, water and non-combustible materials with solid residue
3) *Landfill:* Landfills consist of a complex system of interrelated components and sub-systems that act together to break down and stabilize disposed wastes over time. Landfill gas are generated from the landfill site in different gas generation phases.

B. Data Collection and Survey

Data on MSW management in India are not readily available. Percentage waste composition of selected SDMC wards have been collected by field survey in SDMC area. Following scenarios are developed for analysis of the data (Table 1).

Table 1: Scenarios description

Scenario No.	Description
27	50% Composting, 25% Incineration and 25% SLF waste treatment, benefits of all
28	25% Composting, 50% Incineration and 25% SLF waste treatment, benefits of all
29	25% Composting, 25% Incineration and 50% SLF waste treatment, benefits of all
30	50% Composting and 50% Incineration waste treatment, benefits of all
31	50% Composting and 50% SLF waste treatment, benefits of all
32	50% Incineration and 50% SLF waste treatment, benefits of all

C. Calculation of Greenhouse Gas Emission ($MTCO_2$ equivalent)

Waste Reduction Model (WARM) calculates GHG emissions for waste management practices, including recycling, combustion, composting, and SLF. The model calculates emissions in metric tons of carbon dioxide equivalent ($MTCO_2E$) across a wide range of material types commonly found in MSW.

V. RESULTS AND DISCUSSION

Table 2 below shown optimizes disposal cost and relevant emission data from WARM model for cost-emission analysis.

Table 2: Emission Reduction

Scenario	Emission Reduction ($MTCO_2$)
27	-174.163
28	-82.6725
29	-36.3759
30	-220.46
31	-127.867
32	54.0127

Analysis of the result of considered scenarios are described as:

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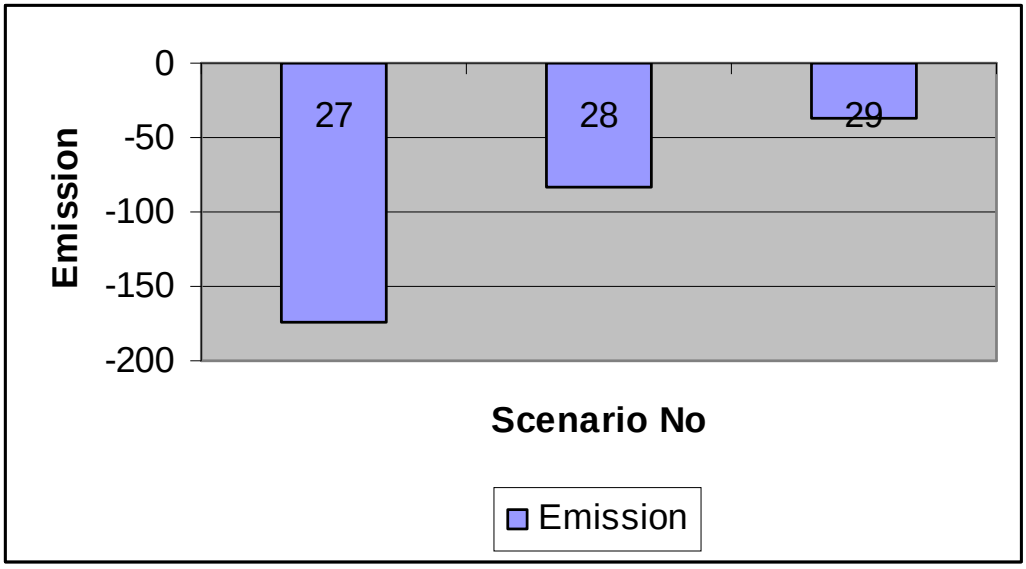

Figure 2: Emission comparison for Scenarios 27, 28 and 29

In above (Figure 2) comparison maximum emission reduction is available for scenario 28, 25% composting, 50% incineration and 25% SLF.

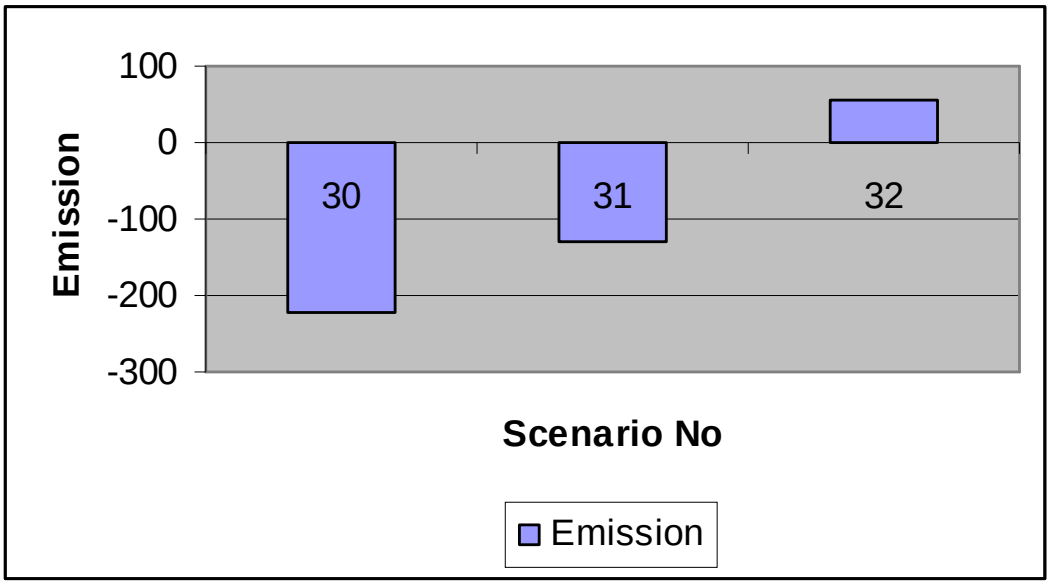

Figure 3: Emission comparison for Scenarios 30, 31 and 32

In above (Fig 3) comparison scenario 30, 50% composting and 50% incineration reduces maximum emission.

VI. CONCLUSION

The environmental emission of an integrated waste management strategy is computed for defined disposal scenarios using WARM model. Maximum emission reduction is -220.46 $MTCO_2$ when integrated strategy is 50% Composting and 50% Incineration waste treatment including benefits of both. Emission reduction is minimum for strategy 50% Incineration and 50% SLF waste treatment including benefits of both and emission reduction is 54.0127 $MTCO_2$. To improve the current situation of waste management in SDMC area there is a need for policy makers to carefully select the waste management strategy considering Environmental emission involved in it.

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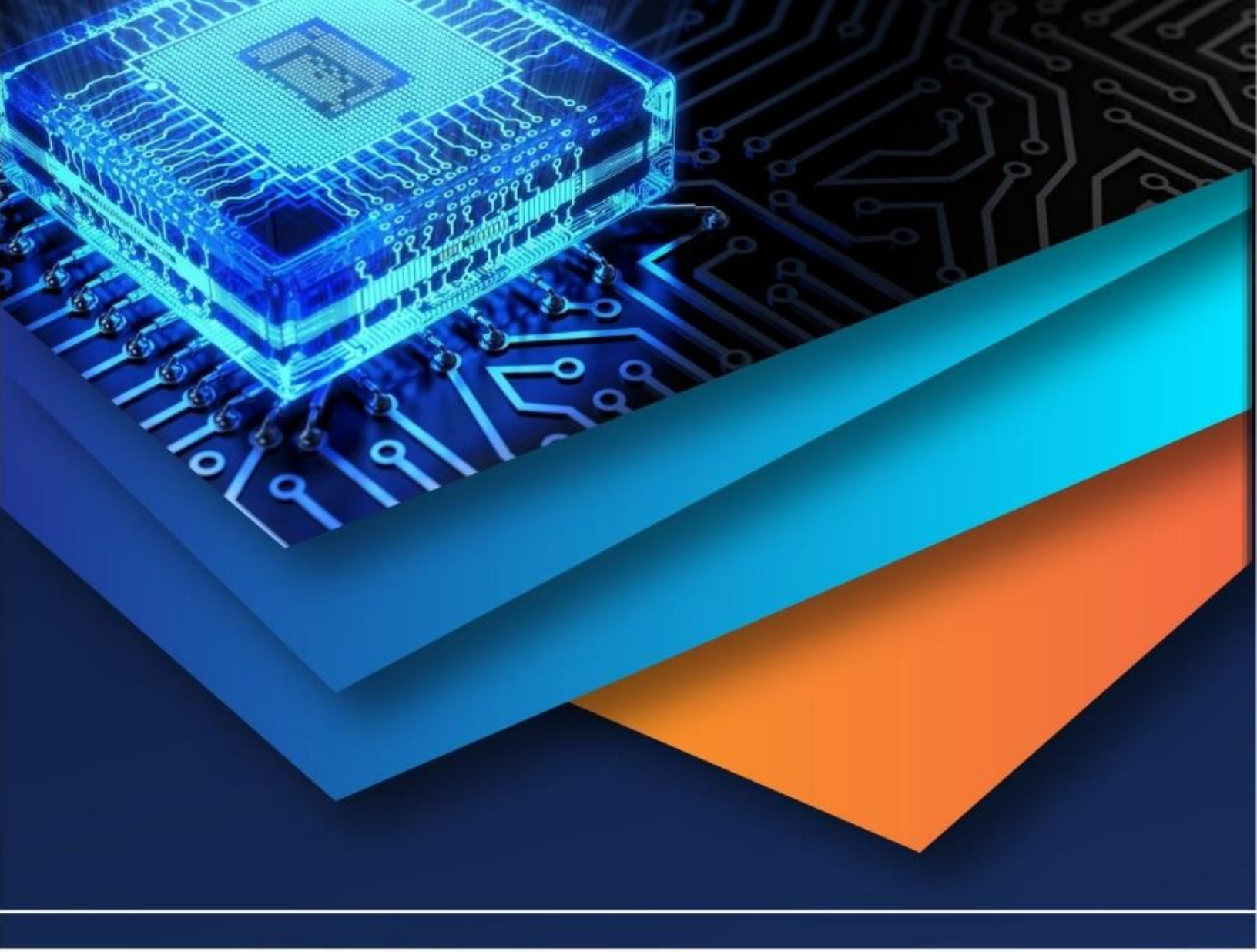

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