

Decentralization of Solid Waste Management in Delhi: An Opportunity for Revenue Generation

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Abstract

Solid waste management is the major problem worldwide. Waste is generated by human activities like domestic, industrial, and agricultural and so on. . Over 40 million tons municipal waste is generated in India .Here open and illegal dumping is a common practice. Less than 9% of wastes are scientifically treated in India. Municipal corporations spent their 80% (approximate) budget on transportation and collections. In the study data was collected from journals, Government reports and publications, personal observation during visiting different places and structured interview with MCD officials. The objective of study is to finding the way to reduce the waste at the source or at community level in Delhi and what are the different alternatives through which waste can be converted into resources. This study will be helpful in the further planning of waste management and how effectively waste may be converted into different useful product and make the environment clean and healthy for the people.

Keywords: Waste Management, Revenue, Decentralization, Solid waste.

Introduction

India generates approximately 40 million tons municipal solid waste (MSW). MSW is growing per capita with 1-1.33 percent per year due to rapid urbanization of country. Increasing urbanization and changing life style are adding extra generation of MSW. Currently, Indian cities are generating 8 times more MSW than in 1947. (Pappu et al., 2007; Shekdar, 1999). The urban India is generating about 115,000 tonnes/day of MSW in the year 1996, and it will increase to about 440,000 tonnes/day by the year 2026 (Hoornweg and Laura, 1999). Presently, Delhi is generating 8000 tons per day and only 300 tons per day of waste processed for composting in exiting three plant but the capacity of plant in full operation is 800 TPD (ton per day) i.e. only 9% of waste treated through composting and rest goes to Landfills. In this article, the municipal solid waste management system of Delhi is studied. The quantity and composition of MSW is discussed and the pattern of primary collection, its treatment through different methods, and its disposal is also studied. In the study financial feasibility of renewable energy or green energy using the MSW will be discussed. It will provide a framework for MCD, NGO, RWA (Resident Welfare Association) and private company to generate the green energy. So, "Green" energy is nowadays an issue of urgent and growing interest for sustainable energy and agricultural production as well as prompting good governance, power utility companies and

private entrepreneurs to more attentively evaluate technology with indeed practical life (Rowlands et al. 2000).

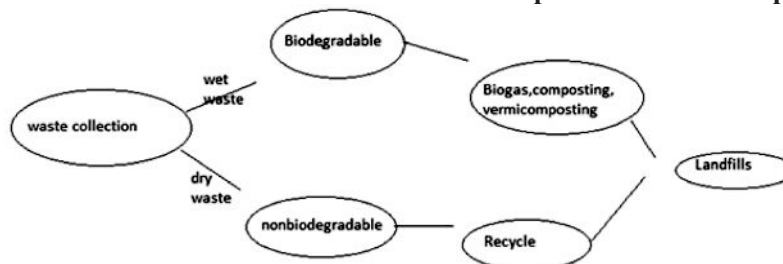
Study Area and Research methodology

The primary data collection is a tedious work .Generally researcher and academicians rely on the published data of MCD, Delhi Pollution Control Committee, health department report, Delhi master plan report 2021, World Bank report on waste management, NGO reports and news papers. The MSW composition and generation are totally based on the sampling method (Breed &Broom, 1995). Even the responsible authorities use the time series to predict or to estimate the MSW waste generation and its composition. Since It is labour intensive and time consuming research. Thus most of the researcher uses the secondary data for the analysis of the MSW. Our study area is limited to Delhi and limited to the biodegradable waste. The research question is ‘is it possible to convert the waste into energy and reduce the waste at the generation point’.

The objective of study is-

- To study the effect of decentralised composting and biogas plant in waste management
- To study the methods of environment friendly waste management technique
- To study the financial benefits of organic disposal of waste

Research Model:-Treatment of maximum waste as soon as possible before dumping in landfills



Generation and Composition of MSW

Currently Delhi is discarding of 9,000 tonnes of the MSW daily. By 2020, the capital region Delhi will generate the MSW 15800 TPD which require 28 km square more area to dump the waste. There are 2,500 dhalaos i.e. large masonry bin and metallic bin that serve as secondary collection centre

for the MCD, NDMC and Cantonment Board. Cantonment Board and NDMC handle only 161 and 221 community bins and rest by the MCD. These bins are insufficient for the 1 crore 20 lakhs people. Thus residents will have no other option except throwing waste outside the bins or in the streets. The source wise quantity of MSW generated in Delhi is given in Table 1.

Table 1

Household Waste	shopping centre waste	Vegetable and fruit market	Debris and construction waste	Medical waste	Waste from Industry
3011	1069	540	380	108	500

Source:-MCD (2004)

The several studies conducted by the different agencies to determine the average composition weight percentage and

chemical characteristics of MSW in Delhi as given in table 2 and table 3

Table 2 Composition weight percentage (as wt. %) of MSW in Delhi

Component	2002	1995	1982
Organic	38.0	38.6	57.7
News paper	5.6	5.6	5.9
Plastics	6.0	6.0	1.6
Metals	0.2	0.3	0.6
Glass and crockery	1.0	1.0	0.3
Non Organic	13.9	14.0	5.9
Inerts	34.7	34.7	28.9

Sources;- (TERI 2002,NEERI 1995,IHPH 1982)

Table 3 Chemical characteristics (as wt.%) of MSW in Delhi

Component	2002	1995	1982
Moisture	44.0	43.7	15-40
Organic matter	20.5	20.5	22.8
Nitrogen	0.9	0.9	0.86
Phosphorus	0.3	0.3	0.74
Potassium	0.7	0.7	0.52
Carbon Nitrogen Ratio	24.1	24.0	28.0
Calorific Value (kcal/kg)	713.0	712.5	661-1200

Sources;- (TERI 2002,NEERI 1995,IHPH 1982)

Approximately 45-50% of the MSW is fit for composting and 25- 27 % of MSW may be recycled. Effective and proper segregation at household level and community level of MSW will make only 20 per cent of the refuse is to be sent to the landfill site which is still 4000-5000TPD per day by the 2020 (DUEIIP, 2001) . It will make the city clean and reduce the community bin's garbage load and provide the saturated landfills a longer life.. But instead of proper segregation, only random picking of mixed waste practice is continues. The MCD spend Rs. 5030 million (Rs. 1130 million planed and 3860 million non planed) on Municipal solid waste in which 80% on the Transportation and collection only and only 20 % on disposal

Disposal and Treatment of MSW

Composting: - Composting is an aerobic decomposition of organic matter .It is a controlled process involving microbial decomposition of organic matter in the presence of oxygen. Organic or biodegradable waste is converted to a soil-like substance (compost), which is used as the manure for improvement of soil quality. A few municipalities have adopted composting as a treatment option in their SWM strategy. Sustainable and effective composting is possible only with the organizational and the financial support of municipal corporations. In Delhi MCD and NDMC establish the compost plant but it is not sufficient for composting .The details of composting plants are

Table 4 Municipal Solid Waste overview

Authorities	Waste Generation (Tones per Day) in 2001	Projected generation for 2021 (Tons per day)
MCD	6000-6300	15000
NDMC	350-400	550
Delhi Cantonment Board	100	100

Source:-Public Health Department of MCD

Table 5 List of existing Composting plant in Delhi

Composting plant	Starting year	Capacity	Area (ha) (Tons/day)
Okhla (MCD)	1980	150	3.24
Okhla (NDMC)	1985	200	3.44
Bhalsava	1998	500	4.90
Tikri Khurd	2001	125	2.6

The above all plant is either working below the capacity or closed due to some technical problems. The composting process reduces the organic waste by 20-30% to its initial weight.

During the 2003-2007 the zero waste colonies project was working. It was funded by the Ford Foundation. During this tenure of the project MCD worked with RWA, Societies and NGO in Delhi to set up decentralised units of municipal waste management, i.e. composting using the pit method and window method. If the municipal waste is composted at the household level or society level or community level i.e. composted at the source of generation, significantly much less waste to be transported and disposed of.

Composting projects can also take the advantage of carbon finance because these processes not only reduce the weight of solid waste but also save the environment by diverting the Methane (Green House Gas). By preventing biodegradable or organic waste from getting into the landfill, composting plants significantly reduce methane gas emissions, and this reduction can be claimed as emissions reductions and it can be sold to the carbon fund. In developing countries, where 40-60 % of the waste consists of organic compound can search their way to manage their waste management by establishing the decentralised composting plant.

The community or society complaint about two problems

from the composting units- odour and residual plastics in the final product. The odour problems may be remedied by the installation of the bio filters and the plastics problems solved by the source separation at the house hold levels.

Landfills:- Landfills is the common dumping ground of the municipal waste disposals. This is the last destination of all types of waste and residues. Incinerators, composting, biogas etc. all scientific technology unable to complete disposal of waste. There are 10-20% residue remain in all process. All these technologies only reduce the waste up to 80-90%. Thus landfill is essential need for the dumping waste. The people lives surrounding the landfills oppose strongly due to hazard and health issue.. The black thick liquid, leachate, make the soil unfertile and poisonous. It also affects the ground water of the surroundings. During rainy season it flows in the streets. Thus landfills gases pollute the air and leachate pollutes the soil, surface water and ground water. Currently, Landfills covers 66.5 hectare area in Delhi which is approximately 1% of the total area of Delhi. The estimated production of poisonous leachate is 81.5 million per year and the most of leachate is produced during the rainy seasons (Kumar et al., 2002). From 1975, there are 20 landfills have been developed but only three landfills are operational. 15 landfills were closed and rest two were suspended. There are at present three landfill sites in operation:

Table 6 Details of three Landfills

Sl. No.	Name of SLF site	Location	Area	Start Year	Waste Received	Zones
1	Bhalaswa	North Delhi	21.06 Ha	1993	2200 TPD	Civil Line, Karol Bagh, Rohini, West and Najafgarh
2	Ghazipur	East Delhi	29.16 Ha	1984	2000 TPD	Shahdara (North), Shah. (South), City, Sadar Paharganj & NDMC area
3	Okhla	South Delhi	16.20 Ha	1994	1200 TPD	Central, South, Najafgarh and Cantonment area

Source : (www.mcdonline.gov.in)

In the landfills decomposition of biodegradable waste take place aerobically and anaerobically and produces the landfills gas. The emission of different gases like CO₂, CH₄, H₂S, SO₂ and heavy metal like mercury create a panic situation because these gases and metals have fatal effect on human life it also lead to permanent disability These gases pollute the environment. Major constituent of the landfills gas is methane. The landfill authorities can recover or capture these gases and use them to generate energy. According to the study, 1 million ton of municipal waste generate 2100 tons of methane. Recovery of gas is not only reduce the odour but also generate energy. It generate the revenue from selling the energy and claim carbon credit.

Wastes to Energy (WtE) :

Incinerators: - Incineration is the latest technology which burns all types of waste and generates energy and reduces the quantity of waste by 80-90%. The plant work properly

when the waste net calorific value is least 1462.5 kcal/kg but the Delhi's waste average calorific value is between 700-1000 kcal/kg. In Delhi, Incinerators plants are running with the collaboration with corporate houses. These plants propose to segregate, dry and burn the waste in incinerators to produce electricity. But some reports and studies have shown that the incinerator technology abroad has had a devastating effect on the health of the local population with an increased incidence of cancer and it emits poisonous gas like Dioxines. Even though the waste to energy plants (Incinerators) claim that they are not motivated by profits and are concerned about the environment, huge profits are accrued by selling carbon credits and electricity. First incinerator was established in Timarpur in 1987 but it was closed after 21 days trial due to low calorific value of MSW.

There are three Wastes to Energy plants at Okhla, Bawana & Ghazipur. Waste to Energy Plant at Okhla is operational and other two are under installation. Details are as under

Table 7 List of Waste to energy Plant

S.No.	Name	Capacity of Electricity generation(MW)	Capacity of waste processing (MTD)	Status of operation
1	Timarpur-Okhla Waste Processing Company Okhla Compost Site	16	1950	Operational
2	East Delhi Waste Processing Company Pvt. Ltd. Ghazipur	12	1300	Under installation
3	Delhi MSW Solutions Ltd. Narela Bawana Road	24	3000	Under installation
	Total	52	6250	

Sources: Economic survey of Delhi 2014-15

Energy from Biogas (Renewable Energy) and MSW treatment

On August 14, 2005, Abdul Kalam, the former president of India, made an announcement that India became the energy independent in the next coming 25 years and this must be the nation ultimate goal. (Indian Energy Portal 2012). Up to 1980, India was self dependent. During 1981 to 2006, the demand of energy increased sharply with annual growth rate 5.34 (EIA, 2006). In 2009, India become fourth largest energy consumer after USA, China and Russia. (EIA, 2010). Thus biogas plant may serve purpose of waste management and meet the requirement of energy.

Earlier renewable energy (green energy) treated as technological infeasible or even economically not viable.

Nevertheless, investment cost of renewable energies such as biogas plant is higher as compared to fossil fuels, but viewed over time, the use of renewable energy becomes economically viable due to low operating cost. It is also environment friendly and generate employment. (Bahauddin and Salahuddin, 2012)

Biogas plant is based on anaerobic biodegradable process. The biogas production takes place in the absence of oxygen and this process is known as Biomethanation. (pauss, Naveau and Nyns, 1987). The biogas is the mixture of CH₄ (Methane), CO₂ (Carbon dioxide), N₂S and small quantities of other gases. These gases are responsible for the global warming. Note that N₂S is 296 times and Methane is 23 times more responsible for the global warming than that of CO₂.

Biogas is a product of an anaerobic biological process called methanogenesis, which takes place without the impact of oxygen and a technical process called biomethanation (Paus, Naveau and Nyns, 1987). The gas is a mixture of methane (CH₄) and carbon dioxide (CO₂) as well as parts of oxygen, nitrogen and some other trace gases. The standard application of the biogas is heat and power production simultaneously.

Revenue Generation from Decentralised Biogas Plant

In Delhi there are 2500 dhalao i.e. community bins in which on an average 3.5 tons waste is collected daily. If there is an average 50% organic compounds in the MSW. Then total quantity of organic waste is 1.7 tons/dhalao. According to the BARC (Bhabha Atomic Research Centre) 500 kg waste may produce 20 kg LPG equivalent gas (i.e. 2 cylinder of Gas) and on an average 30 kg manure. A decentralised Biogas plant may established in only 40 square metre area and 12 lakhs investment. (Amir khan's Satyamev Jayate Show) .On the basis of this a dhalao (from 3.5 tons) can produce 70 kg Biogas and 90 kg manure with a small investment.

On the basis of above data Delhi can produce-

If daily collection of waste is 8000 TPD. 1 Ton waste may produce 40 kg gas and 60 kg Manure.

Total gas production in Delhi= $4000 \times 40 = 160000$ kg gas. (Taking 50% Biodegradable waste)

Number of cylinder of gas produce in Delhi= 16000 (One gas cylinder is 10 kg) daily.

Revenue generation from this gas production = 16000×500 (considering 10 kg cylinder price is Rs. 500 per cylinder)

=Rs 800,000 daily from the biogas plant.

The manure produced by the biogas plant may be used by the Delhi Municipal Corporation for their parks and their forest. Since Delhi has rich greenery, manure can be used for this. Biogas may be upgraded to bio-fuels like Biodiesel and Bio-ethanol which may use in transportation. Thus new invention make biogas more efficient, environment friendly (reduce GHG) and economical viable.

Conclusion & Suggestion

Sustainable Development of a country and city also depends on the proper MSW management. A sustainable MSWM system give emphasis on (1) minimization of waste, (2) maximise the recovery of resources, (3) minimise adverse environmental impacts , and (4) maximise the MSW coverage area (UNEP 2005). Sustainability calls for a move

away from traditional arrangement of MSWM, namely, collection and disposal of mixed MSWM. Action at source becomes one of the main characteristics of sustainable MSWM. (Panate, 2005)

The government should attach the promotion of source separation and waste reduction with his "Swach Bharat Abhiyan" and educate about the wet and dry waste. In Delhi approximately 95 % waste is mixed. MCD and other authorities do not care about these practice. Waste pickers separate the non-biodegradable (like Plastics, Board, paper form the dhalao or community bins. Door to door collection of MCD is also not that much effective. The MCD staffs and sweeper just do formalities of waste collection. They should also adopt the two bins system for waste separation during the door to door collection and educate people about the advantage of waste separation. Thus waste is not waste but unattended resource.

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