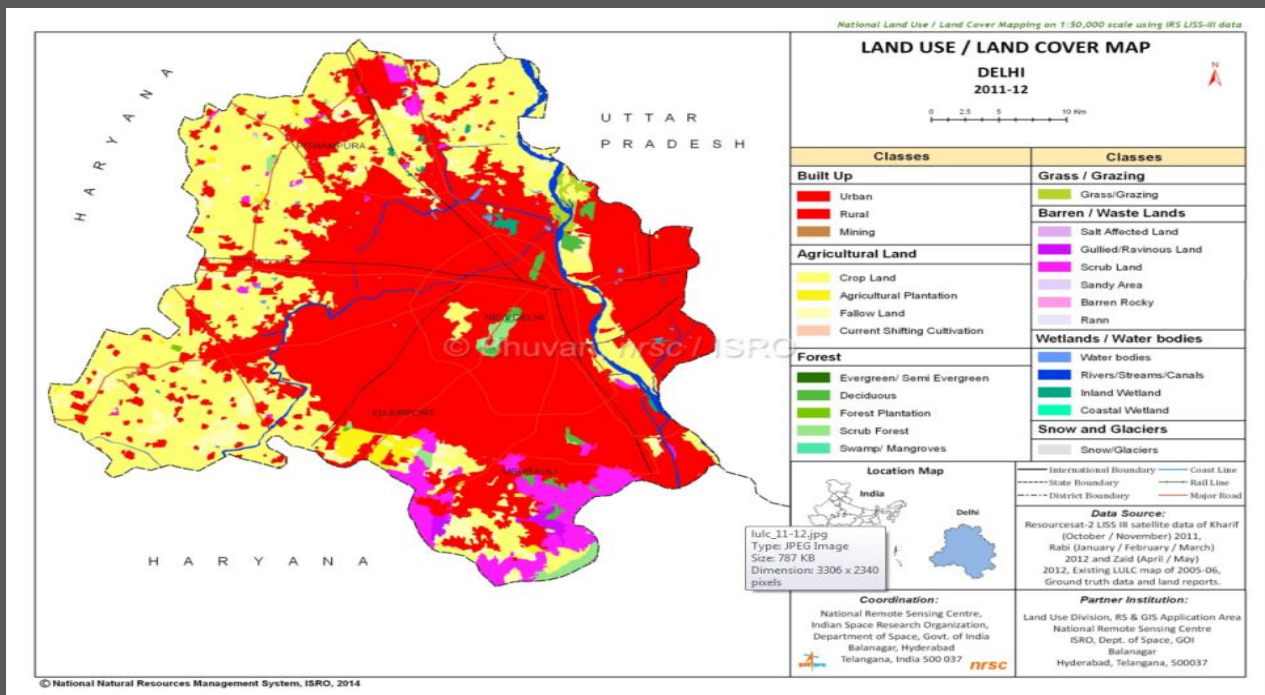


MUNICIPAL SOLID WASTE MANAGEMENT IN DELHI

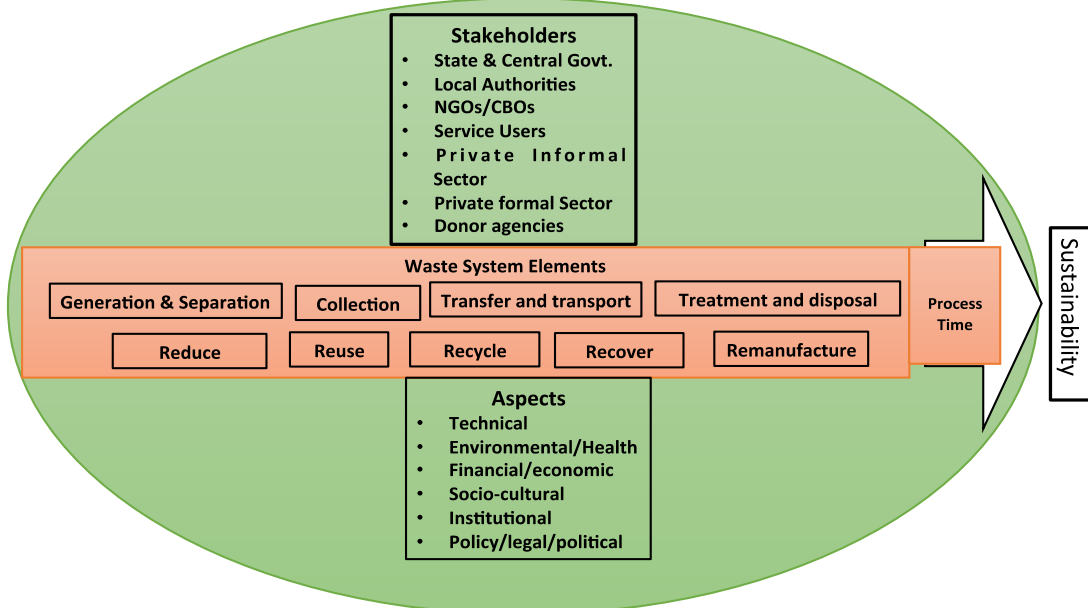
Part II: Aggregate

Delhi -LULC (2011-12)





Integrated Sustainable Municipal Solid Waste Management



INTEGRATED MSW STRATEGY AND PLAN FOR NORTH, SOUTH and EAST MCD , NDMC & DCB



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1. Assessing gaps in MSW service

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Abbreviations

C & D Waste: Construction and Demolition Waste

CPHEEO Report: Central Public Health and Environmental Engineering Organizations Report

E t E: End-to-End MSWM

IMSWM: Integrated Municipal Solid Waste Management

JNNURM: Jawaharlal Nehru National Urban Renewal Mission

MCD: Municipal Corporation of Delhi.

MoEF & CC: Ministry of Environment, Forests and Climate Change

MoUD: Ministry of Urban Development

NOM: Non Organic Matter, **OM:** Organic Matter

PPP: Public Private Partnership

TF Report: Task Force Report of Planning Commission, 2014.

TPD: Tons Per Day, **TPY:** Tons per Year

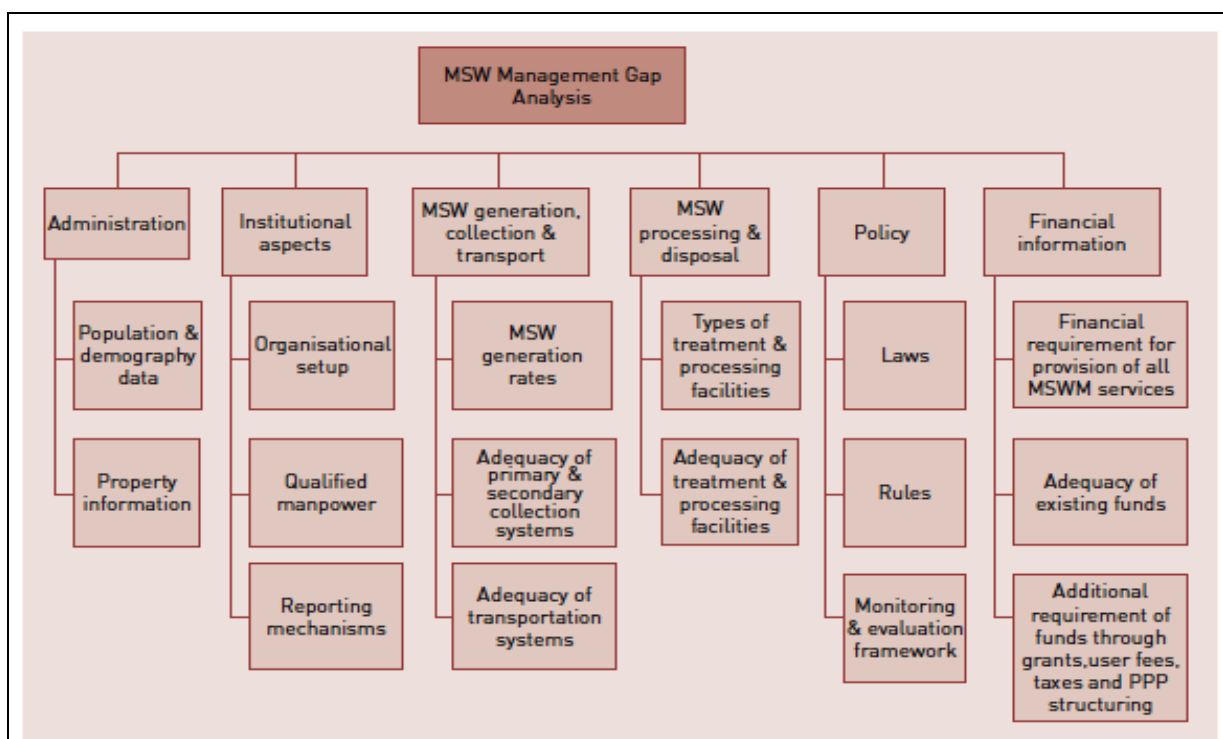
ULB: Urban Local Body

INTEGRATED MSW STRATEGY AND PLAN FOR NORTH, SOUTH and EAST MCD, NDMC & DCB

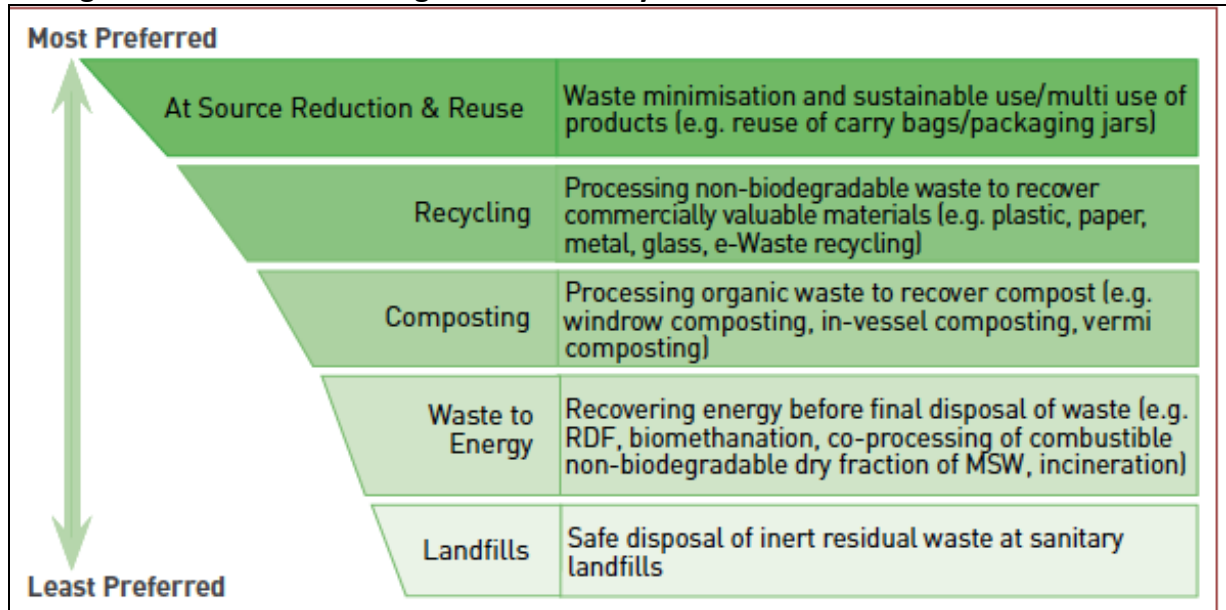
1. Sustainable Technical and Financial MSW Strategy for Delhi

Integrated Waste Management (IWM) has been accepted as a sustainable approach to solid waste management. The Assessment of Integrated Municipal Solid Waste (IMSW) practices world over indicates, that in order to achieve the goal, IMSW Management has to be Sustainable and should lead to Zero waste. In order to build a sustainable Municipal Solid Waste Management (MSWM) model it is necessary to assess and evaluate the effects and results of the various waste handling methods implemented and ensure that the selected option is financially viable, Environmentally, Managerially and technologically Sustainable and Socially acceptable. There are a number of useful assessment tools, particularly with reference to the environmental, economic, and social dimensions of waste management. These analytical tools include life-cycle assessments (LCA) material flow analysis (MFA), which are widely used in environmental impact assessment of waste disposal and health risk assessment (HRA) ,used for the evaluation of potential public health problems. In addition, economic affordability and Managerial sustainability are determined through economic methodologies, such as cost-benefit analysis (CBA), life-cycle cost (LCC) and full-cost accounting and role of Municipality and Private partners through analytical hierarchy process (AHP).The HRA analysis shows that Material Recovery facility and biomethanation presents the lowest Public Health Risk (PHR) and WtE option of unsegregated waste is not environmentally friendly and cost effective.

The issues to be considered while assessing gaps in MSW service (Text Box-1)being provided and the preferred ISWMS Hierarchy is illustrated in the text boxes(2) below.



Integrated Solid Waste Management Hierarchy



CPHEEO MSWM Manual, 2016.

1.1 MSW Management in Delhi

The Union Territory of Delhi with a population of around 18 million is one of the biggest metropolises of the world. One of the major goals of the Government is to make Delhi a centre of urban excellence; a well managed; clean and hygienic city. The urban population increases @ 3.5% per annum and the per capita waste generated in the city increases @ 1.3% per year. Cleanliness is the most vital indicator of good Urban Management Process, Poor Solid Waste Management practices affect the health and amicability of Metropolis in many ways like trans matting diseases among residents and environmental degradation, including emission of green house gases from land fills etc. The Solid Waste generated by the City contributes the major share towards the environmental problems and challenges for better urban management; and on account of tremendous increase in population and increase in per capita income, generation of domestic waste has increased considerably. It is estimated that the quantity of Municipal Solid Waste (MSW) would reach 17,000 – 25,000 MT per day by 2021.

The Five agencies responsible for Municipal Solid Waste (MSW) management in Delhi are;

1. North Municipal Corporation of Delhi (North MCD),
2. South Municipal Corporation of Delhi (South MCD)
3. East Municipal Corporation of Delhi (East MCD)
4. New Delhi Municipal Council (NDMC), and
5. Delhi Cantonment Board (DCB).

The area covered by NMCD, SMCD and EMCD is approximately 1399.26 sq.km. NDMC and Cantonment is spread over 81 sq.km. The function of the DEMS of all 5 DMC's , which includes NMCD, SMCD, EDMC, NDMC and the Cantonment can broadly be divided into two components;

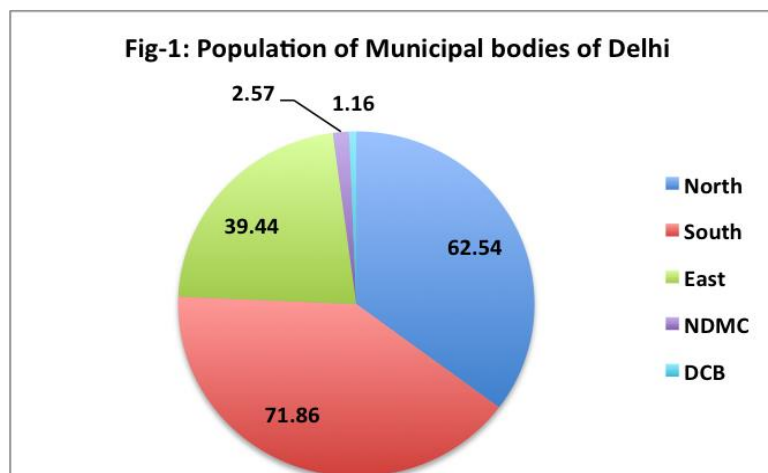
- Solid Waste Management
- Management of Storm water drainage system

The jurisdiction of the 3 MCD(North, South and East), includes 135 urban/191 rural villages; 567 unauthorized regularized colonies; 1639 unauthorized colonies; 45 resettlement colonies; 725 jhuggi jhopri clusters; 18 industrial estates; 9 dairy colonies; roads; streets and public conveniences. About 49% of the total population of Delhi lives in slum areas, unauthorized colonies and about 860 JJ Clusters with 4,20,000 Jhuggies. A sizeable population therefore lives in unplanned areas having no proper system of collection, transportation and disposal of Municipal Solid wastes. As a rough estimate only, about 25% of population lives in planned development areas. There is also the floating population visiting Delhi in connection with business activities, Delhi being a major distribution centre of retail business in North India.

As per the Municipal Solid Waste Rules 2016, which has replaced the 2000 rules, notified under the Environment (Protection) Act, 1986, the collection, segregation, storage, transportation, processing and disposal of MSW continues to be the responsibility of the local bodies. It is also the obligatory function of MCD to provide receptacles, depots and places for waste disposal. MCD is helped by various agents in private sector e.g. private sweepers and garbage collectors employed by private premises; rag pickers; junk dealers and industries , which use scrap to produce products.

The Municipal Solid Waste operation under three MCD is by far the biggest in the Union Territory with more than 50,000 employees. The comprehensive operation of street cleaning; waste transportation and waste disposal is done by MCD.

The Municipal Corporation of Delhi , commonly known as the MCD ,was trifurcated in 2012 into North MCD, South MCD and East MCD which covers an area of 1399 Sq.Km and has a population of 174 lakhs and comprises of 12 Zones and 272 wards. The other two agencies responsible for MSW management in Delhi are New Delhi Municipal Council (NDMC) , with a population of 2.56 lakhs and Delhi Cantonment Board (DCB), with a population of 1.16 lakhs both have 9 wards each. (Fig-1)

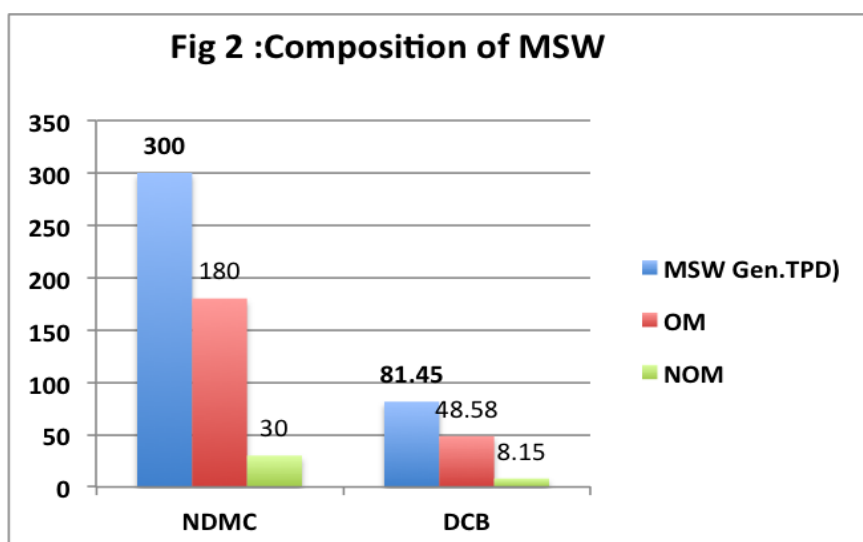


North MCD , spread over 604.54 Sq Km ,consists of six zones namely; 1.City, 2.Karol Bagh, 3.Sadar Paharganj, 4.Civil Lines , 5.Narela, and 6.Rohini. South MCD consists of four zones, namely ;west, South ,Nazafgarh and Central. The MSW generation , and Sustainable and integrated MSW strategy for the North and South MCD should be Zone wise and needs to follow the model set out in the Table -1.

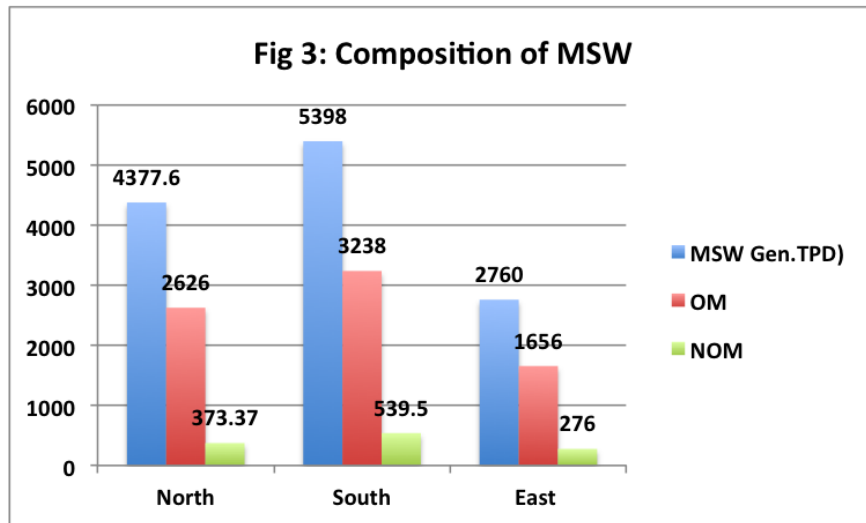
The MSW Strategy for East MCD with a population of 39.44 lakhs (2011 Census) and generating 2761 tonnes of MSW approximately a day is also as set out in Table -1. Considering that East MCD consists of two zones namely; Shahdara South and Shahdara North and has a population of 23.89 and 15.45 lakh respectively and generates , as reported in Jan., 2017 by East MCD , 1102 TPD and 710 TPD respectively and as per CPCB norm communicated to NGT the Shahdara South generates 1679 MT/PD and Shahdara North 1081MT/PD, it is proposed that both Shahdara South and Shahdara North should follow Tech options indicated for Shahdara North , the quantum of Value Added Products (VAP) are as set out in the Table 1 below. Fig 2 & 3 depicts the MSW generated TP day along with percentage of Organic and Non-organic components on the waste.

The New Delhi Municipal Council area comprises of the territory that has been described as Lutyen’s Delhi and which has historically come to be regarded as the seat of central authority in Union of India. Efficient function of the Municipal services in this area is critical for the internal image of the country and is a factor which has an important bearing on the functioning of the Government apparatus itself.

Sustainable and Integrated MSW Strategy for New Delhi Municipal Council with a population of 2.54 lakhs (2011 census) , spread over a area of 42.74 sq km and generating 250-300 TPD of MSW should be as indicated in table-1.



As per DCB, the total solid waste generation per day in tons is 60.53 TPD. This includes , 1.74 TPD (52 TPM) of horticulture waste, 1.5TPD (45 TPM) of C & D waste , 0.22 TPD (6.5 TPM) of silt and 0.39 TPD (11.64 TPM) of slaughter house waste collected separately. The MSW fig does not include recyclable waste , for which an NGO has been engaged



The Integrated Municipal Solid Waste (IMSW) Management Systems recommended for Zones indicated of North MCD, South MCD and East MCD is set out in Fig-4 and for specified Zones in North MCD, South MCD and East MCD is in Fig-5 below. Fig-6 depicts IMSW system for DCB.

Fig-4:- Integrated MSW Management System for Population above 2 million & 1-2 million , North MCD (Zones -City, Civil Lines, Sadar pahar Ganj and Karol Bagh Zones) ,South MCD (Zones -West, South and Nazafgarh) and East MCD (Zone-Shahdara South)

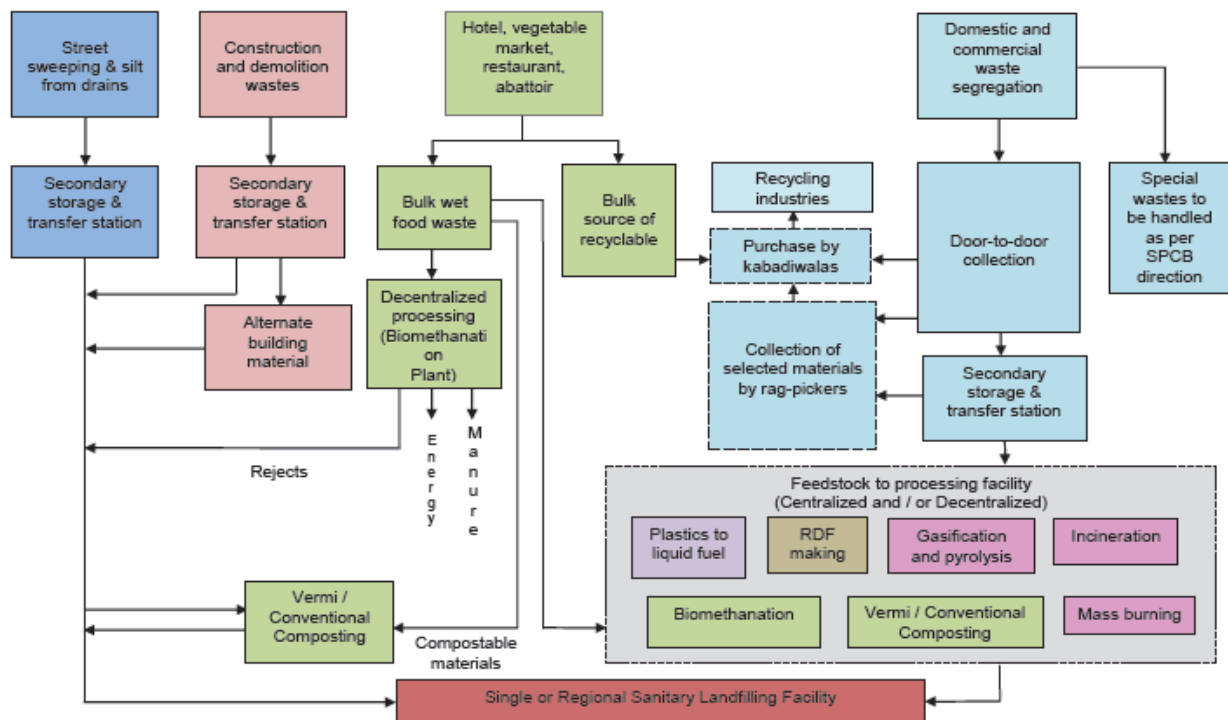


Table-1:-Sustainable and Integrated MSW Strategy for North, South and East Municipal Corporation of Delhi

MCD	Population In Lac*/**	Waste Gen. TPD (0.700 Kg PD)	OM (60%) / NOM (10%)in TPD	Technology Options	Minimum Requirement	Value Added products and Generation Zone wise in TPD	Approx.Cost Exc. land
North MCD Zone							
1.Civil Lines	17.298*	1210.99	781.6 /	1.Renewable CNG gen. @ 10% of OM. 2.Bio-fertilizer generation @ 40% of OM 3.Green Diesel generation @ 30% of NOM. 4.Renewable bitumen gen. PD @40% of NOM.	Segregate OM and NOM wastes at Source/ collection Center.	1. R CNG ----78.2, 62.9 , 40.4, 38.4 . 2.Bio-Fert-----312.48, 251.6, 161.6, 153.6 . 3.G.Diesel-----39.06, 31.5, 20.1, 19.2 1. R-Bitumen.-----52.08, 42.0, 26.8, 25.63	Rs 50 lakhs PT for R-CNG and Bio-fert Rs 4 Cr PT for NOM conversion to G.Diesel and R-Bitumen Rs 10 lakhs PT for Conversion of C & D waste
2. Rohini	13.67	956.90	629.16 /				
3. Narela	8.305	581.39	403.91 /				
4.Karol Bagh	9.617	673.19	67.32				
	7.842	548.94	384.47 /				
	9.154	640.78	64.08				
5.City	3.589	251.27	205.6	As above	Segregate OM and NOM wastes at Source/ collection Center	1. R CNG --20.6 and 22.2 TPD 2. Bio-Fert-----82.24 & 88.8 3.G.Diesel-----10.2 & 11.1 4. R-Bitumen.-----13.6 & 14.8	As above
6.Sadar Pahar ganj	4.90	343.0	34.3				
	3.964	277.48	221.59				
	5.276	369.32	36.93				
TOTAL	54.668* 62.540**	3826.96 4377.6	2626 / 373.37	* Population as per 2011 census, ** Population as on 2016 Dec. Calculations are all based on Dec. 2016 data.			
South MCD Zone	Population In Lac*/**	Waste Gen. TPD (0.700 Kg PD)	OM (60%) / NOM (10%)in TPD	Technology Options	Minimum Requirement	Value Added products and Generation Zone wise in TPD	Approx Cost , Exc. land
7.West	25.43	1780	1068 /178	As Above	Segregate OM and NOM wastes at Source/ collection Center	1. R.CNG--100/115/55 2. Bio-fert---400 /450/225 3. G-Diesel --53/55/45 4. Bitumen--70/75/65	Rs 50 lakhs PT for R-CNG and Bio-fert Rs 4 Cr PT for NOM conversion to G.Diesel and R-Bitumen Rs 10 lakhs PT for Conversion of C & D waste
8.South	27	1913	1147/191				
9. Najafgarh	13.65	955	573 /95.5				
10.Central	5.78	405*/ 750* *	243 / 40.5 450/ 75	As above	Segregate OM and NOM wastes at Source/ collection Center	1. R-CNG --24 2. Bio-Fert-160 - 3. 12 TPD G-Diesel 4. 16 TPD Bitumen	* CPCB National norm. ** SDMC Rep
Total	71.86	5398	3238 /539.50				

EAST MCD Zone	Population in Lac*/**	Waste Gen. TPD (0.700 Kg PD)	OM (60%) / NOM (10%) in TPD	Technology Options	Minimum Requirement	Value Added products and Generation Zone wise in TPD	Approx.Cost , Exc. land
11. Shahdara. South	23.98	1679	1008 /168 503 (C & D & Silt)	1.Renewable CNG gen. @ 10% of OM. 2.Bio-fertilizer generation @ 40% of OM 3.Green Diesel generation @ 30% of NOM. 4.R. bitumen gen. PD @40% of NOM	Segregate OM and NOM wastes at Source/ collection Center	1. R-CNG --100 2. Bio-Fert-400 3. G-Diesel --53 4 Bitumen--67	Rs 50 lakhs PT for R-CNG and Bio-fert Rs 4 Cr PT for NOM conversion to G.Diesel and R-Bitumen Rs 10 lakhs PT for Conversion of C & D waste
12. Shahdara North	15.45	1081	648 /108 325(C&D & Silt)	As above	Segregate OM and NOM wastes at Source/ collection Center	1. R-CNG --64 2. Bio-Fert-254 3. G-Diesel --30 4 Bitumen--43	
Total	39.43	2760	1656 / 276				

NDMC & Cantonment	Population in Lac*/**	Waste Gen. TPD (0.700 Kg PD)	OM (60%) / NOM (10%) in TPD	Technology Options	Minimum Requirement	Value Added products and Generation Zone wise in TPD	Approx.Cost , Exc. land
NDMC	2.54	300	180 /30	1.Renewable CNG gen. @ 10% of OM. 2.Bio-fertilizer generation @ 40% of OM 3.Green Diesel generation @ 30% of NOM. 4.R. bitumen gen. PD @40% of NOM	Segregate OM and NOM wastes at Source/ collection Center	1. R-CNG --18 2. Bio-Fert-72 3. G-Diesel --9 4 Bitumen--12	Rs 50 lakhs PT for R-CNG and Bio-fert Rs 4 Cr PT for NOM conversion to G.Diesel and R-Bitumen Rs 10 lakhs PT for Conversion of C & D waste
Total							
Cantonment	1.16	81.45	48.87 /8.15	As above	Segregate OM and NOM wastes at Source/ collection Center	1. R-CNG --4.89 2. Bio-Fert-19.57 3. G-Diesel -2.45 4 Bitumen—3.26	As above
Total							

Fig-5 Integrated MSW Management System for Population range 1-10 lakhs North MCD (zones-Narela and Rohini Zone) , South MCD (Zones-Central) and East MCD (Zones-Shahdara North)

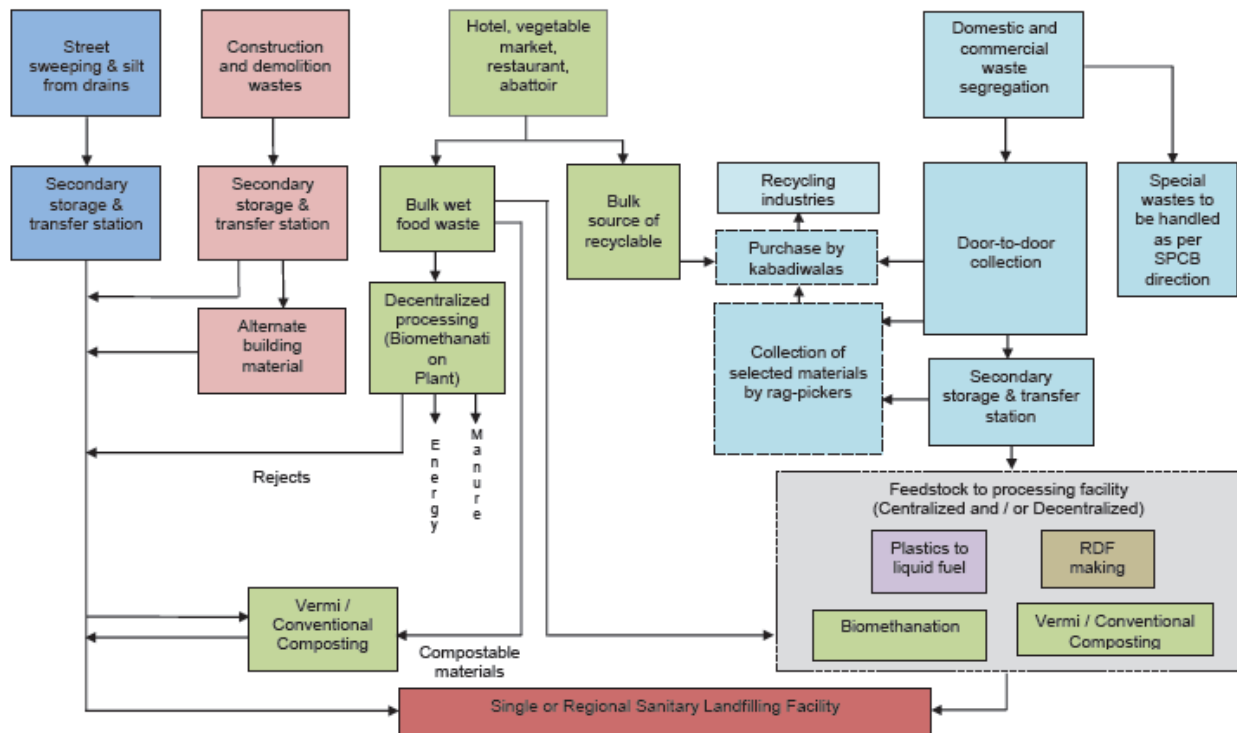
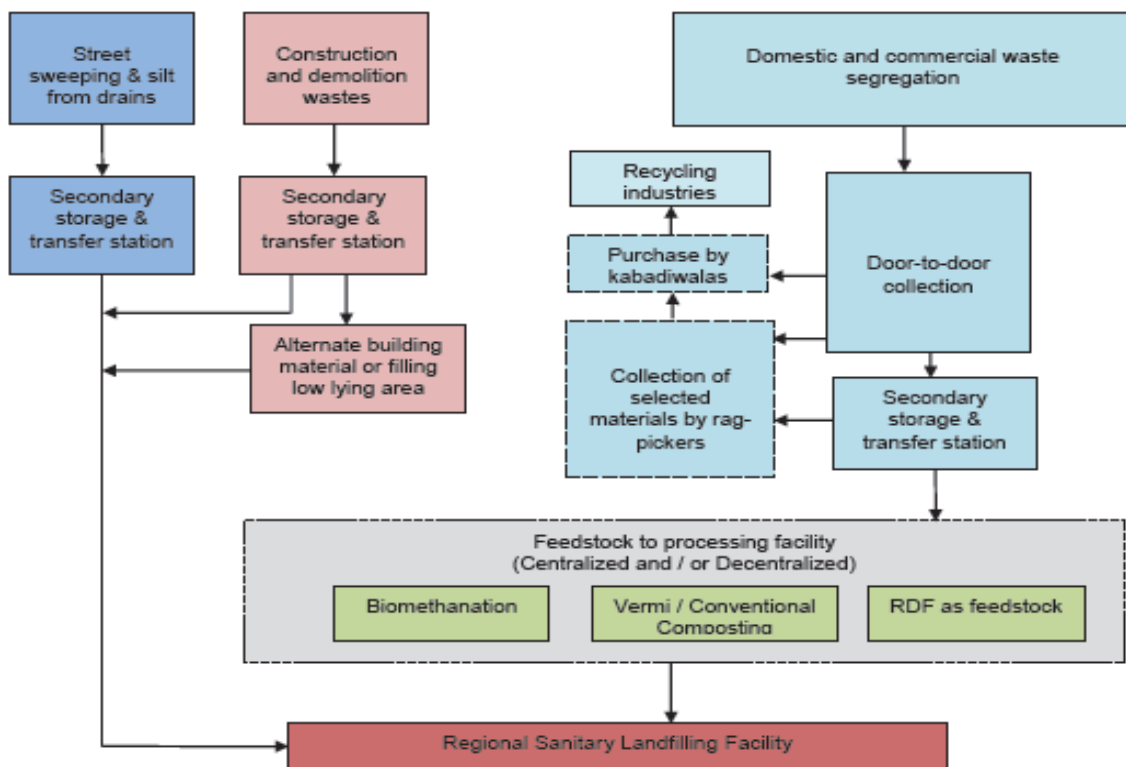


Fig-6 Integrated MSW Management System for Population range 1-2 lakhs DCB



1.2 Technological Options for Delhi ULB's

Selection of appropriate technology is one of the key considerations for success of a waste management system for a particular Zone /town/city besides taking consideration of other aspects like resource recovery, environmental soundness, financial support, involvement of stakeholders/ public and institutional capability. The following technologies were identified for processing of MSW in the TF report of the Planning Commission:-

- a. Biomethanation for wet biodegradable wastes
- b. Conventional microbial windrow/mechanized/ vermi composting for wet biodegradable wastes
- c. Preparation of briquette/ pellets/ fluff as Refuse Derived Fuel (RDF) from dry high-calorific value combustible wastes
- d. Incineration / Gasification / Pyrolysis for dry high-calorific value combustible wastes and
- e. Plastic wastes to fuel oil.

2. E t E waste Collection to Elimination scheme

The E t E waste collection to elimination scheme recommended is based on modern Technological Options (WTG1XG +WTG2XG) to Manage MSW and is detailed below.

WTG1XG process converts all types of biomass and waste like household garbage, kitchen waste, agro waste, animal waste (even human waste) to very high quality clean renewable natural gas-**rNG™**, which can be further converted to renewable-PNG & CNG better known as **rPNG™& rCNG™**.

WTG1XG technology eliminates Solid and Sewage Biodegradable waste based on biological catalysts which are naturally present in nature and degrade biodegradable waste. With this technology natural bio degradation is performed in controlled manner inside a bioreactor and environment friendly.

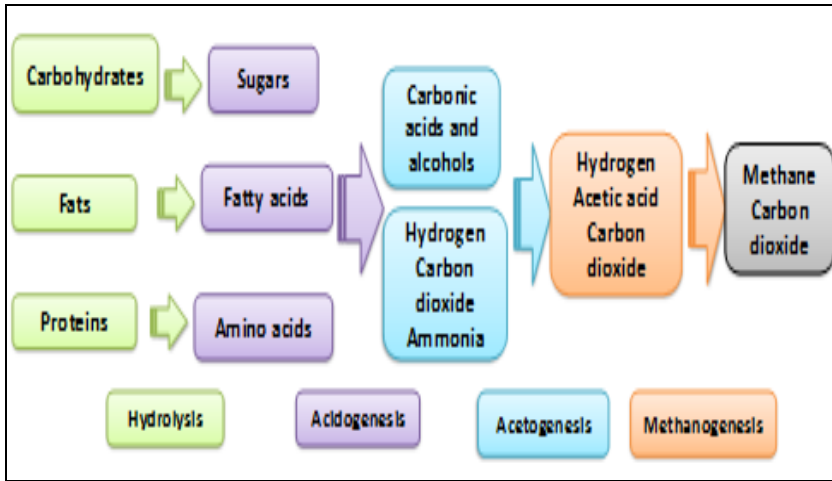
WTG1XG process is carried out by combining **four stages** of microbial degradation of the biodegradable wastes in four independent bio-reactors each loaded with separate set of microbes functioning under different temperature and pH conditions. The four Stages involved are detailed below:-

1. WTG1XG Hydrolysis bio-reactor, uses speciality microbe that consumes sulphur so that H₂S is not produced. Hence there is zero corrosion and **no stinking smell** in WTG1XG process.
2. WTG1XG Acidogenesis bio-reactor is aided by the heating to support the efficient growth of thermophilic and thermophilic microbes of Genus *Bacillus*. The solid organic matter is converted to liquid in the form of volatile fatty acids.
3. WTG1XG Acetogenesis bio-reactor is loaded with speciality microbes that convert VFA to acetic acid and heads towards methane formation process.
4. WTG1XG Methanogenesis bio-reactor converts acetic acid to natural gas with a **low HRT of 14 days**.

The leftover from WTG1XG Methanogenesis bio-reactor is clean water with zero BOD and very high quality Bio-fertilizer. WTG1XG **bio-fertilizer is rich in nitrogen, carbon, and potassium and phosphorous** and devoid of any heavy metals. The seeds of weed are killed by heat in Acidogenesis reactor; hence WTG1XG bio-fertilizer is **weed-free**. The technology Stages and Process flow diagram are at **Fig 7 and 8**.

Fig. 7:- Key Stages of Multi-Phase WTG1XG Waste to Biofuel Technology-

Bio-methanation reactor

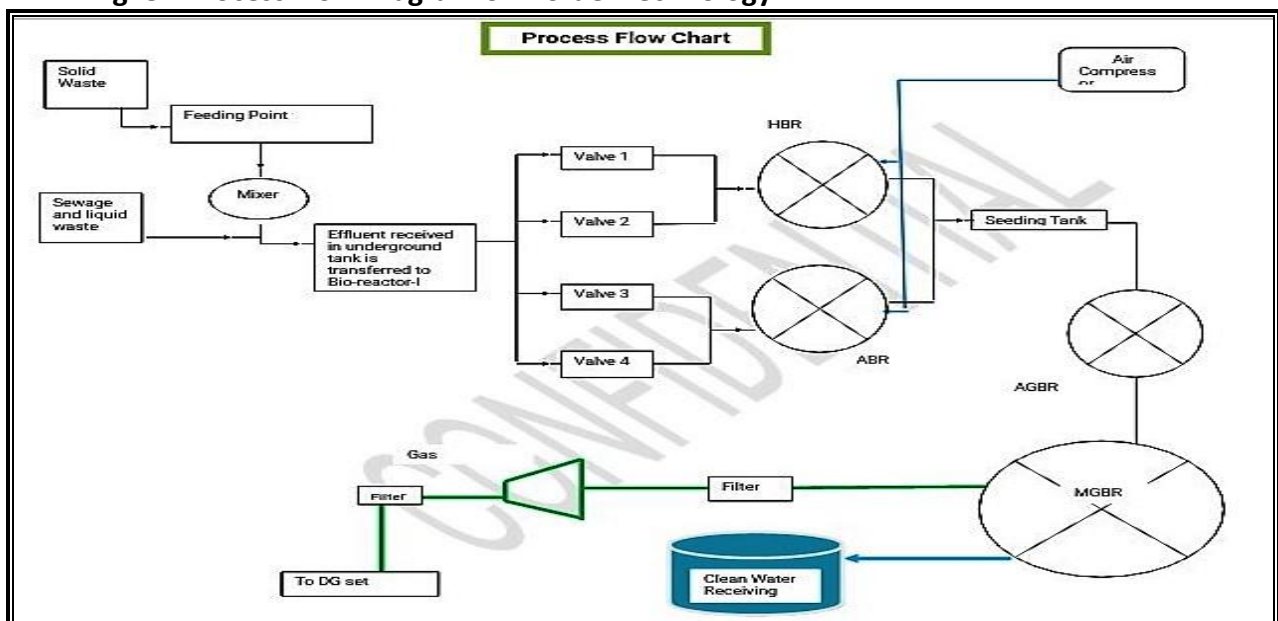


3. Estimated Capital Investments for Technologies

3.1 Estimated Capital Investments for Technologies recommended by Task Force, 2014

To start with and facilitate determining the financial requirement / support needed by the ULBs a cost estimate has been prepared for setting up waste processing plants including W to E plants,

Fig. 8 :-Process Flow Diagram of Biofuel Technology



preparation of RDF, biomethanation, composting and vermi composting facilities based on the recommendations of the Task Force on WtE constituted by the Planning Commission , 2014 and as illustrated in Fig-4 & 5 above. The estimated capital investment works out to approximately Rs.

1001 crore detailed in **Table 2** for Zones in North MCD, South MCD and East MCD.

Table-2: Estimated Capital Investment for Technology Options suggested by PC TF Report

MCD	Popula- tion In Lakhs	Total Waste Gen. TPD	Waste to be Treated 70%* TPD	i Waste for WtE 40%	ii Waste for Bio- Metha Nation 10%	iii Waste to Compost 50%	Cost –I @ Rs.10/12 **Cr. Per 75 TPD plant	Cost –II @Rs15Cr . . per 100 TPD plant	Cost-III Rs.5 Cr. Per 100 TPD plant
North MCD	62.54	4377.8	3063.9	1225.2	306.39	1531.59	183.43	60	75
Total + 15% Cost escalation									366.19
South MCD		5053	3537	1414,8	353.7	1768.5	226.36	45	70
Total + 15% Cost escalation									392.56
East MCD	39.44	2760	1794	717	180	896	130	30	50
Total + 15% Cost escalation									243
GRAND TOTAL									869.79
GRAND TOTAL + 15% COST ESCALATION									1001.75

*This does not include 108 TPD (10%) recyclable wastes collected by rag pickers and 225 TPD (20%) of inert waste

** Rs 2 Cr extra for Segregating RDF. *** Add 15% on account of delay and likely price rise.

Note: The total cost can be reduced by about 15-20% by deducting the cost of existing operational plants.

3. 2. Capital Cost Estimates For Processing Various Fractions of MSW for Tech option (E t E)

The tentative Capital Cost estimates for MSW processing indicated in Table-1 is for E t E waste collection to elimination scheme based on modern Technological Options (WTG1XG) being recommended, The capital cost estimate for MSW processing for all the three MCD's is **Rs 9174.64 Crores (Fig-6) details , zone wise are in (Table-3,3A,3B and 3C)**, for Vehicles, equipment, etc is (**Rs 450.45 Crores**, (Table-3D) and cost sharing for MSWM is detailed in Table 3F.

The tentative Capital Cost estimates for processing of NDMC and DCB waste is **Rs 219 and 57.04 Crores (Table-3)**, Vehicles, equipment, etc (**Rs 16.97 and 137.41 lakhs**,) and **cost sharing for MSWM is detailed in Table 4 below**. Fig-12 lists the functions of Municipality and indicates the PPP Agreement Options available to EMCD. The End to End (E t E) waste collection to elimination Scheme based on modern Technological Options to Manage MSW including finances is in Table 4, 4A , 4B and 4C .

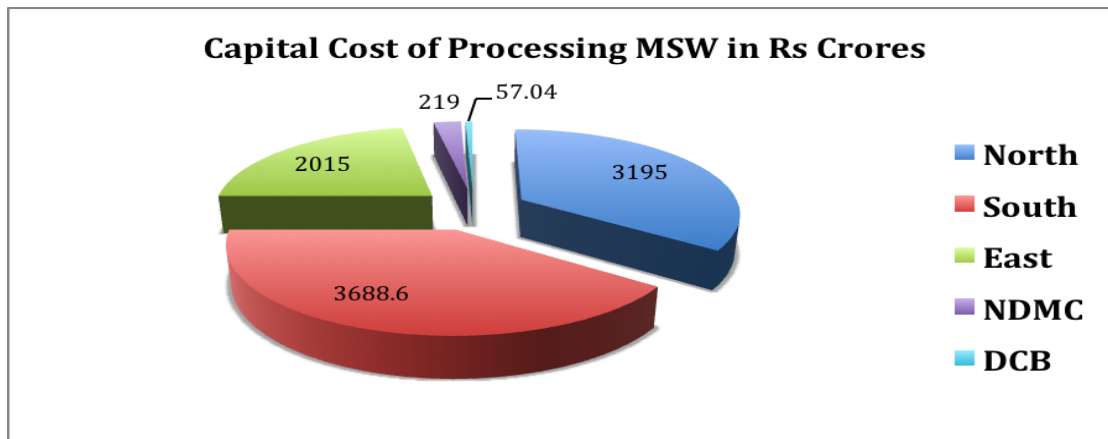


Table-3 Capital Cost Estimates for Processing Various Fractions of MSW in MCD---North MCD

Zones	No.of Wards	Population in Lakhs	Waste to be Treated TPD	I Non - Bio-Waste 10%. TPD	II-Bio-degradable waste-60%-TPD	III-C & D Waste 30%. TPD	Cost -I (Rs.4 Cr 1TPD Plant Rs.Cr	Cost-II (Rs.50 lakhs PT Plant in Rs Cr	Cost-III (Rs.10 lakhs PT Plant) Rs,Cr
Civil lines	27	18.61	1302.7	130.2	781.2	390.6	520.8	390.60	39.00
Rohini	34	14.98	1048.6	104.9	629.16	314.58	419.6	314.58	31.46
Narela	10	9.62	673.2	67.32	403.91	201.96	269.28	201.96	20.19
Karol bagh	16	9.15	640.8	64.08	384.47	192.23	256	192.24	19.22
City	8	4.9	343.0	34.30	205.6	103.1	137.2	102.80	10.28
S.Paharganj	8	5.28	369.32	36.93	221.59	110.8	147.72	110.80	11.08
Total	104	62.54	4377.8	437.45	2627	1313.27	1750.58	1312.98	131.23
Grand Total Rs 3194.79 Cr / 3195 Cr									

South MCD

Zones	No.of Wards	Population In Lakhs	Total Quantity Waste +C&D Gen. TPD **	Waste to be Treated	I Non - Bio-Waste 10%	II-Bio-degradable waste-60%	III-C & D Waste 30%	Cost -I Rs.4 Cr 1 TPD Plant	Cost - II Rs.50 lakhs PT Plant	Cost-III Rs.10 lakhs PT Plant
West	28	25.43	996+200	1780	178.0	1068	534	712	534	53.4
South	24	27.33	816+216	1913	191.3	1147.8	573	765.2	573.9	57.3
Najgarh	21	13.65	683+275	955	95.5	573	286.5	382	286.5	28.65
Central	31	5.78	750+300	405	40.5	243	121.5	162	121.5	12.15
Total	104	72.19	3196+991	5053	505.3	3031.8	1515.9	2021	1516	151.5
Grand Total :- 3688.60 Crores										

*CPCB national Average , **Reported by South MCD

East MCD

Zones	No.of Wards	Population In Lakhs &	Total Waste	Waste Treatment	I-Non Bio-degradable	II-Bio-degradable	III-C&D Waste	Cost -I @Rs.4 Cr.	Cost -II @Rs.0.5Cr.	Cost-III Rs.0.1 Cr.
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		Waste 0.70 Kg /D	Gen. TPD	100%	waste 10%	Waste 60%	30%	PT Plant	PT Plant	PT
Sh. North	33	15.45	1081	1081	108	648	325	432	324	32.5
Sh.South	31	23.98	1679	1679	168	1008	504	672	504	50.4
Total	64	39.44	2760	2760	276	1656	828	1104	828	83.0
Grand Total capex: 2015 Crores										

New Delhi Municipal Council

Zones	No.of Wards	Population In Lakhs & Waste 0.70 Kg /D	Waste to be treated TPD	I-Non Bio-degradable waste 10%	II-Bio degradable Waste 60%	III-C&D Waste 30%	Cost -I @Rs.4 Cr. per ton Plant	Cost -II @Rs.0.5Cr. per ton	Cost-III Rs.0.1 Cr. Per ton
NDMC		2.54 / 300	300	30.0	180	90	120	90	9
Total		1.16	300	30.0	180	90	120	90	9
Total Capex:- 219 crores									

Capital Cost Estimates for Processing Various Fractions of MSW -Cantonment

Zones	No.of Wards	Population In Lakhs & Waste 0.70 Kg /D	Waste to be treated TPD	I-Non Bio-degradable waste 10%	II-Bio degradable Waste 60%	III-C&D Waste 30%	Cost -I @Rs.4 Cr. per ton Plant	Cost -II @Rs.0.5Cr. per ton	Cost-III Rs.0.1 Cr. Per ton
Cantonment	9	1.16 / 81.45	81.45	8.15	48.87	24.44	32.6	24.44	2.44
Total	9	1.16	81.45	8.15	48.87	24.44	32.6	24.44	2.44
Total Capex:- 57.04 crores									

Capital cost estimates for Biodegradable (3A) Non-Biodegradable (3 B) and C & D(3C) , Fractions of MSW for all the MCD's are detailed below Zone wise..

Table-3A_ Capital Cost Estimates for Processing Biodegradable Fractions of MSW – North MCD

North MCD Zones	No.of Wards	Population In Lakhs	Waste to be Treated. TPD	II-Bio-degradable waste60%. TPD	Cost -II (Rs.50 lakhs PT Plant) Rs Cr
Civil lines	31	18.61	1302.7	781.2	390.60
Rohini	36	14.98	1048.6	629.16	314.58
Narela	10	9.62	673.2	403.91	201.96
Koral bagh	16	9.15	640.8	384.47	192.24
City	8	4.9	343.0	205.6	102.80
Sadar Paharganj	8	5.28	369.32	221.59	110.80
Total	109	62.54	4377.8	2627	1312.98

Capital Cost Estimates for Processing Biodegradable Fractions of MSW – South MCD

South MCD Zones	No.of Wards	Population In Lakhs	Waste to be Treated	II-Bio-degradable waste-60%	Cost -II Rs.50 lakhs PT Plant
West	28	25.43	1780	1068	534
South	24	27.33	1913	1147.8	573.9
Najafgarh	21	13.65	955	573	286.5
Central	31	5.78	405	243	121.5
Total	104	72.19	5053	3031.8	1516

Capital Cost Estimates for Processing Biodegradable Fractions of MSW –East MCD

Zones	No.of Wards	Population In Lakhs	Total Waste Gen. 0.70 Kg /D	II-Bio degradable Waste 60%	Cost -II @Rs.0.5Cr. per ton
Shahdara North	33	15.45	1081	648	324
Shahdara South	31	23.98	1679	1008	504
Total	64	39.44	2760	1656	828
Total Capex-828 crores					

3 B :-Capital Cost Estimates for Processing Non-Biodegradable Fractions of MSW – North MCD

Zones	No.of Wards	Population In Lakhs	Waste to be Treated. TPD	I Non - Bio-Waste 10%. TPD	Cost-I (Rs.4 Cr 1 TPD Plant) Rs Cr
Civil lines	31	18.61	1302.7	130.2	520.8
Rohini	36	14.98	1048.6	104.9	419.6
Narela	10	9.62	673.2	67.32	269.28
Koral bagh	16	9.15	640.8	64.08	256
City	8	4.9	343.0	34.30	137.2
Sadar Paharganj	8	5.28	369.32	36.93	147.72
Total	109	62.54	4377.8	437.45	1750.58

Capital Cost Estimates for Processing Non-Biodegradable Fractions of MSW – South MCD

Zones	No.of Wards	Population In Lakhs	Waste to be Treated	I Non - Bio-Waste 10%	Cost-I Rs.4 Cr 1 TPD Plant
West	28	25.43	1780	178.0	712
South	24	27.33	1913	191.3	765.2
Najafgarh	21	13.65	955	95.5	382
Central	31	5.78	405	40.5	162
Total	104	72.19	5053	505.3	2021

Capital Cost Estimates for Processing Non-Biodegradable Fractions of MSW –East MCD

Zones	No.of Wards	Population In Lakhs	Total Waste GenTPD	I-Non Bio-degradable waste 10%	Cost -I @Rs.4 Cr. per ton Plant
Shahdara North	33	15.45	1081	108	432
Shahdara South	31	23.98	1679	168	672
Total	64	39.44	2760	276	1104
Total Capex-1104 Crores					

Table-3C_ Capital Cost Estimates for Processing C & D Fractions of MSW – North MCD

Zones	No.of Wards	Population In Lakhs	Waste to be Treated TPD	III-C & D Waste 30% TPD	Cost-III (Rs.10 lakhs Per ton Plant) Rs Cr
Civil lines	31	18.61	1302.7	390.6	39.00
Rohini	36	14.98	1048.6	314.58	31.46
Narela	10	9.62	673.2	201.96	20.19
Koral bagh	16	9.15	640.8	192.23	19.22
City	8	4.9	343.0	103.1	10.28
Sadar Paharganj	8	5.28	369.32	110.8	11.08
Total	109	62.54	4377.8	1313.27	131.23

Capital Cost Estimates for Processing C & D Fractions of MSW – South MCD

Zones	No.of Wards	Population In Lakhs	Waste to be Treated	III-C & D Waste 30%	Cost-III Rs.10 lakhs Per ton Plant
West	28	25.43	1780	534	53.4
South	24	27.33	1913	573	57.3
Najafgarh	21	13.65	955	286.5	28.65
Central	31	5.78	405	121.5	12.15
Total	104	72.19	5053	1515.9	151.5

Capital Cost Estimates for Processing C & D Fraction of MSW –East MCD

Zones	No.of Wards	Population In Lakhs	Total Waste	III-C&D Waste	Cost-III Rs.0.1 Cr. Per
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			Gen. TPD	30%	ton
Shahdara North	33	15.45	1081	325	32.5
Shahdara South	31	23.98	1679	504	50.4
Total	64	39.44	2760	828	83.0
Total Capex-83 crores					

3.3 Cost Estimates for Vehicles, Tools and Equipment for MSWM & SLF

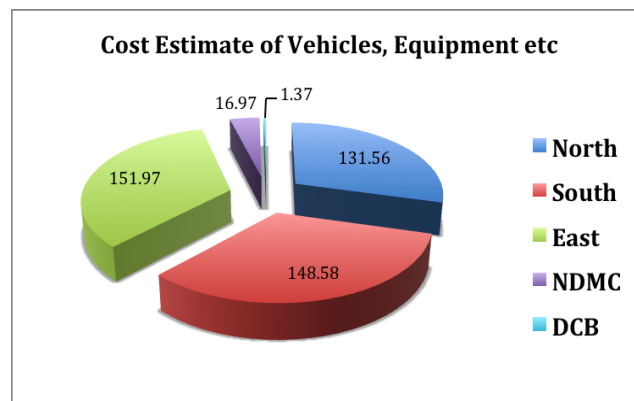


Table-3D: Cost Estimates for Vehicles, tools and Equipment for MSWM and SLF----North MCD

Item & unit cost	Numbers Required						Total Cost in Rs.Crores
	City	Karol Bagh	S Pahargj	CivilLines	Narela	Rohini	
Door to Door Collection Vehicles @1 per 10,000 pop. Rs 5.5 lakhs	186	150	10	10	5	6	20.18
Containerized Tricycle for collection in narrow lanes (20%) of area. 5 per SqKm, Rs 16,000							0.96
Handcarts for street Sweepings 2 @ per 1000 population, Rs 8000	3720	3000	200	200	100	120	5.87
Mechanical Road Sweepers 2@ for 1 Million zones, Rs 65 lakhs	4	3	2	2	1	1	8.45
Secondary Storage containers (1.1 m3) for street Sweepings and inerts(30% waste), Rs 20,000	438	353	226	215	115	124	3.10
Equipment for Pre-processing. Rs	40	30	20	20	10	12	41.00

31 lakhs. (132 No. x31)								
Preprocessing Centres at Dhalaos Rs 4 crores (13 N0.x 4)	4	3	2	2	1	1		52.00
Total								131.56
C&D waste O&M cost to replace Sanitary Landfills for 30% waste for 5 years TPD, Rs 500 PT.								11.48
Grand Total								143.04

Cost Estimates for Vehicles, tools and Equipment for MSWM and SLF-South MCD

Item & unit cost	Numbers Required				Total Cost in crores				
	Cen.	West	South	Naja	Cen.	West	South	Naja	Total
Door to Door Collection Vehicles @1 per 10,000 pop. Rs 5.5 lakhs	58	254	273	136	3.19	13.97	15.02	7.48	39.66
Containerized Tricycle for collection in narrow lanes (20%) of area. 5 per SqKm, Rs 16,000	25	129	250	332	0.04	0.20	0.40	0.53	1.17
Handcarts for street Sweepings 2 @ per 1000 population, Rs 8000	1156	2730	5466	2730	0.925	2.184	4.373	2.184	9.67
Mechanical Road Sweepers 2@ for 1 Million zones, Rs 65 lakhs	1	5	6	3	0.65	3.25	3.90	1.95	9.75
Secondary Storage containers (1.1 m3) for street Sweepings and inerts(30% waste), Rs 20,000	121	534	573	286	.024	0.116	0.114	.057	0.311
Equipment for Pre-processing. Rs 31 lakhs	12	50	51	29	3.72	15.50	15.81	8.99	44.02
Preprocessing Centres at Dhalaos Rs 4 crores	1	5	2	3	4	20	8	12	54
Total									148.58
C&D waste O&M cost to replace Sanitary Landfills for 30% waste for 5 years TPD, Rs 500 PT.	1	5	6	3	7.75	38.78	46.53	23.26	116.32
Total					20.30	94	94.15	33.19	
Grand Total									264.90

Cost Estimates for Vehicles, tools and Equipment for MSWM and SLF-East MCD

Item	Numbers Required		Unit cost (in Rs)	Total Cost in crores		
	Shahdara North	Shahdara South		Shahdara North	Shahdara South	Total
Door to Door Collection Vehicles @1 per 10,000 population.	154	240	550000	8.470	13.200	21.670
Containerized Tricycle for collection in narrow lanes (20%) of area. 5 per Sq Km	50	60	16000	0.080	0.096	0.176

Handcarts for street Sweepings 2 @ per 1000 population	3080	4800	8000	2.460	3.840	6.640
Mechanical Road Sweepers 2@ for 1 Million zones	2	2	650000	1.300	1.300	2.600
Secondary Storage containers (1.1 m3) for street Sweepings and inerts(30% waste)	361	560	20000	0.072	0.112	0.184
Compactors for Transportation	35	50	310000	10.850	15.500	26.350
Transfer Stations for 50% Waste	3	5	4000000	12.000	20.000	32.000
Total	3685	5717		35.230	54.048	89.280
Sanitary Landfills for 25% waste for 5 years 270/425 TPD	3	5	Rs 500 PT for 5years	23.260	38.780	62.040
Total				58.490	92.830	
Grand Total						151.320

Cost Estimates for Vehicles, tools and Equipment for MSWM and SL---NDMC

Item	Numbers Required	Unit cost (in Rs) lakhs	Total Cost in lakhs	
	New Delhi Municipal Council		New Delhi Municipal Council	Total In Lakhs
Door to Door Collection Vehicles @1 per 10,000 population.	254	550000	1397	1397
Containerized Tricycle for collection in narrow lanes (20%) of area. 5 per Sq Km	43	16000	6.88	6.88
Handcarts for street Sweepings 2 @ per 1000 population	508	8000	40.64	40.64
Mechanical Road Sweepers 2@ for 1 Million zones	1	650000	6.50	6.50
Secondary Storage containers (1.1 m3) for street Sweepings and inerts(30% waste)	76	20000	15.20	15.20
Compactors for Transportation	10	310000	30.00	30.00
Transfer Stations for 50% Waste- 150 TPD	5 required	4000000	200.00	200.00
Total			1696.22 lakhs	1696.22
Sanitary Landfill Charges for 25% waste for 5 years 75 TPD		Rs 500 PT for 5years	0.375	0.375
Grand Total			1696.60 / 16.97 Cr	

Cost Estimates for Vehicles, tools and Equipment for MSWM and SLF-DCB

Item	Numbers Required	Unit cost (in Rs)	Total Cost in lakhs	
	Cantonment		Cantonment	Total
Door to Door Collection Vehicles @1 per 10,000 population.	10 available/ 12 required	550000	66.00	66.00
Containerized Tricycle for collection in narrow lanes (20%) of area. 5 per Sq Km	-	16000	--	

Handcarts for street Sweepings 2 @ per 1000 population	-	8000	---	
Mechanical Road Sweepers 2@ for 1 Million zones	1 Available/ 1 required	650000	6.50	6.50
Secondary Storage containers (1.1 m3) for street Sweepings and inerts(30% waste)		20000		
Compactors for Transportation	8 Available / 8 required	310000	24.80	24.80
Transfer Stations for 50% Waste-40.73 TPD	1 required	4000000	40.00	40.00
Total				137.30
Sanitary Landfill Charges for 25% waste for 5 years 20.7 TPD		Rs 500 PT for 5Years	0.105	0.105
Total				137.41
Grand Total				

4. Recommended Cost Sharing for MSWM Activities

The total estimate of investment required for MSWM in Delhi is approximately Rs 10690 crores. Figs. 11 A and 11B below, indicates the cost sharing proposed for all the MCD's in Rs crores. The Table-3E series details the cost sharing for various MSW activities.

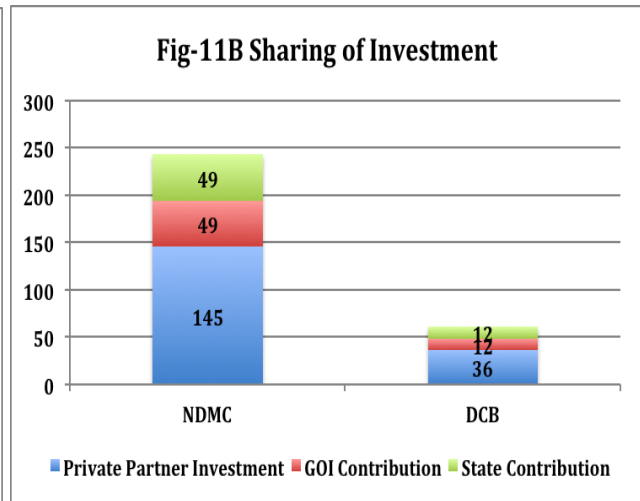
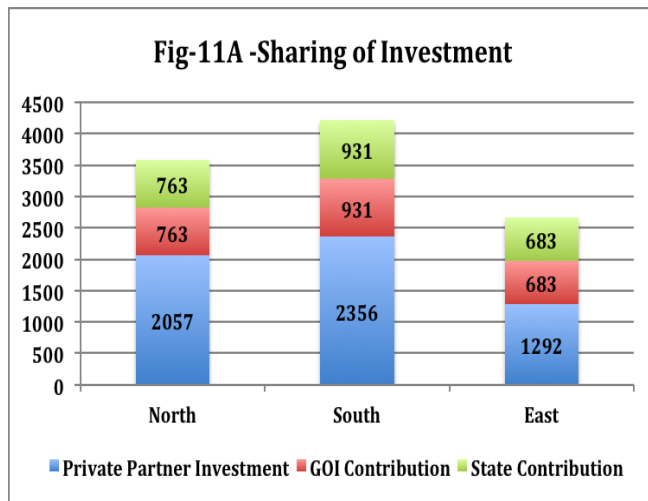


Table 3E. Cost Sharing for MSWM activities.-North MCD

S.No	MSWM Activity	Total Investment in crores	Investment By private partner (%) Cr.	GOI share (%) Cr.	State Share (%) Cr.	South MCD Share (%) in kind
1	Collection Storage and Transportation etc	131.56	50% 61.28	20% 24.51	20% 24.51	10% Existing vehicles
2	MSW processing such as bio-CNG, green diesel & C&D waste elimination	3195	60% 1917	20% 639	20% 639	Land for processing plant
3	C & D Waste Processing	11.48	60%	20%	20%	Existing

			78.738	26.246	26.246	facilities
4	Support to Non functional plants		-	-	-	Nil
5	Support to regional CSL		-	-	-	
6	Reclamation & Remediation of Narela dump Site -21 acres	147	nil	50% 73.5	50% 73.5	Handover of dump site
	Total	3485.04				--

Cost Sharing for MSWM activities.-South MCD

S.No	MSWM Activity	Total Investment in crores	Investment By private partner (%) Cr.	GOI share (%) Cr.	State Share (%) Cr.	South MCD Share (%) in kind
1	Collection Storage and Transportation etc	146.94	50% 73.47	20% 29.39	20% 29.39	10%Existing vehicles
2	MSW processing such as bio-CNG, green diesel & C&D waste elimination	3688	60% 2213	20% 738	20% 738	Land for processing plant
3	C & D Waste Processing	116.32	60% 69.79	20% 23.26	20% 23.26	Existing facilities
4	Support to Non functional plants	-	-	-	-	Nil
5	Support to regional CSL	-	-	-	-	
6	Reclamation & Remediation of Okhla dump Site -40 acres	280	nil	50% 140	50% 140	Handover of dump site
	Total	4231	2356	930.65	930.65	--

Cost Sharing for MSWM activities.- East MCD

S.No	MSWM Activity	Total Investment in crores	Investment By private partner (%) Cr.	GOI share (%) Cr.	State Share (%) Cr.	East MCD Share (%) in kind
1	Collection Storage and Transportation etc	90	50% 45	20% 18	20% 18	10%Existing vehicles
2	MSW processing such as bio-CNG, green diesel & C&D waste elimination	2015	60% 1209	20% 403	20% 403	Land for processing plant
3	C & D Waste Processing	62	60% 38	20% 12	20% 12	Existing facilities
4	Support to Non functional plants	-	-	-	-	Nil
5	Support to regional CSL	-	-	-	-	
6	Reclamation & Remediation of Ghazipur dump Site	500	nil	50% 250	50% 250	Handover of dump site
	Total	2666	1292	683	683	--

Cost Sharing for MSWM activities.- New Delhi Municipal Council

S.No	MSWM Activity	Total Investment in crores	Investment By private partner (%) Cr.	GOI share (%) Cr.	State Share (%) Cr.	NDMC Share (%) in kind
1	Collection Storage and Transportation etc	17	50% 8.5	20% 3.4	20% 3.4	10% Existing vehicles
2	MSW processing such as bio-CNG, green diesel & C&D waste elimination	219	60% 131.4	20% 43.8	20% 43.8	Land for processing plant
3	C & D Waste Processing	9	60% 5.4	20% 1.8	20% 1.8	Existing facilities
4	Support to Non functional plants	-	-	-	-	Nil
5	Support to regional CSL	-	-	-	-	
6	Reclamation & Remediation of Okhla dump Site	-	nil	50%	50%	Handover of dump site
	Total	245	145.3	49	49	--

Cost Sharing for MSWM activities.- Delhi Cantonment Board

S.No	MSWM Activity	Total Investment in crores	Investment By private partner (%) Cr.	GOI share (%) Cr.	State Share (%) Cr.	East MCD Share (%) in kind
1	Collection Storage and Transportation etc	1.37	50% .685	20% .274	20% .274	10% Existing vehicles
2	MSW processing such as bio-CNG, green diesel & C&D waste elimination	57.04	60% 34.22	20% 11.41	20% 11.41	Land for processing plant
3	C & D Waste Processing	2.24	60% 1.34	20% 0.45	20% 0.45	Existing facilities
4	Support to Non functional plants	-	-	-	-	Nil
5	Support to regional CSL	-	-	-	-	
6	Reclamation & Remediation of Okhla dump Site	-	nil	50%	50%	Handover of dump site
	Total	60.65	36.25	12.13	12.13	--

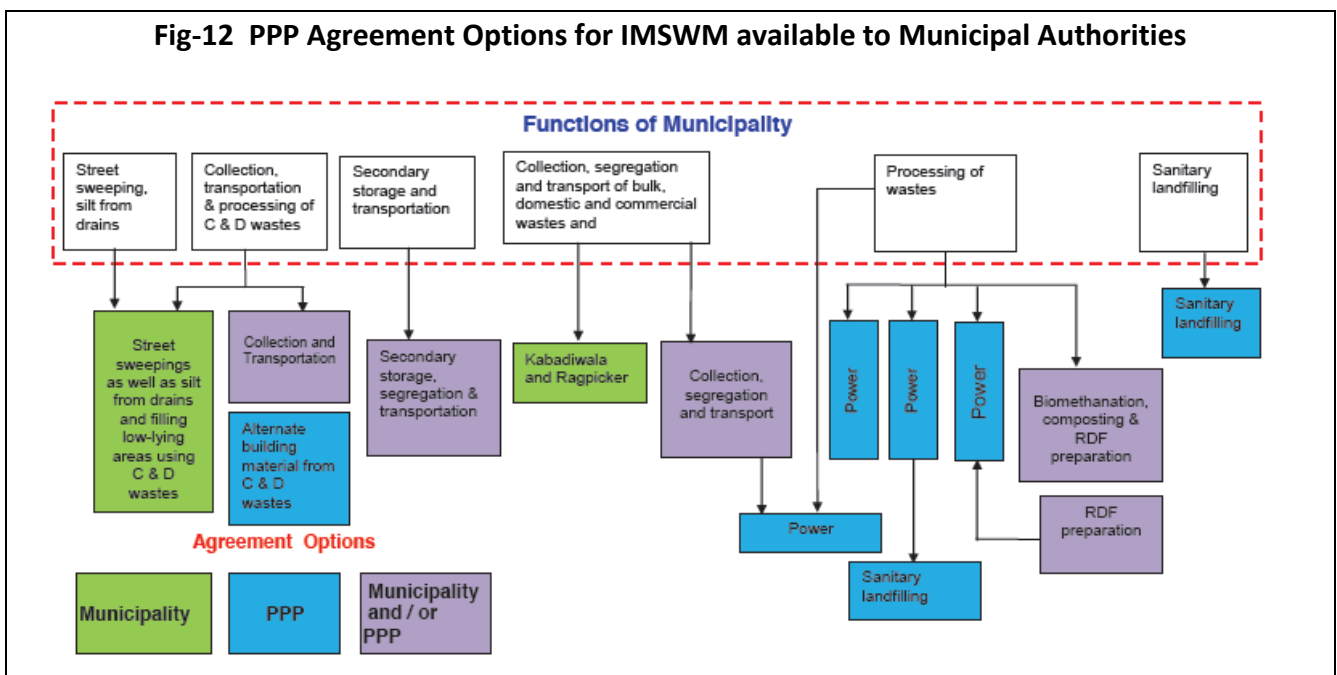
5. PPP Agreement Options for IMSWM available to Municipal Authorities.

The public-private partnership (PPP) is a mechanism through which Government authorities and private entities come together for setting up specified facilities or for the delivery of specified services on mutually agreed terms and conditions. Through **these partnerships, the benefits of the private sector's dynamism, access to finance**, knowledge of technologies, managerial efficiency, and entrepreneurial spirit become available to local authorities who on their part retain oversight and control over all critical elements of performance and outcomes expected from the private entity and make performance based payment to the private sector partner. As per the MSW Rules 2016, it is the responsibility of the municipal authorities to ensure scientific collection, segregation, transportation, processing and disposal of MSW. Keeping in view the current status of MSW management in India, the Task Force of the Planning Commission has envisaged that the MSW

functions of municipal authorities could be classified under three groups for formulation of PPP projects:

- i. The functions that could be best performed by the municipal authority only (green box in Figure 12)
- ii. The functions that could be performed by the municipal authority and / or private sector (purple box in Figure 12)
- iii. The functions that could be best performed by the private sector only (blue box in Figure 12)

However in all the three scenarios the Municipal authority shall remain accountable for efficient delivery of service.



6. Overall Financial Structure of the Project

The E t E waste collection to elimination scheme based on modern Technological Options (WTG1XG) has been recommended to Manage MSW.

The Economic feasibility of the End to End waste collection to elimination Scheme based on the Technological Options to Manage MSW is in Table 4, 4A and 4B for the three MCD’s. Economic feasibility , Quantum of Value added products(VAP) and revenue generated zone wise based on the technology and Processing of waste recommended for North , South and East MCD is as indicated in these tables.

Table 4 :-Economic feasibility of the Integrated solid waste elimination project using WTG1XG technology.

Waste Elimination Capacity of the Project		4500 TPD Solid Waste per day	
NORTH MCD			
1. Cost of project plant and machinery, taxes, installation, commissioning-	3500	cr	
2.Available organic matter in the incoming waste-	2627 TPD		
3.Renewable CNG generation @ 10% of OM-	263 TPD		
4.Available non-organic matter in the incoming waste-	440 TPD		
5.Renewable Green Diesel generation@ 30% of NOM-	131 TPD		
6.Bio-fertilizer generation @ 40% of OM	1050 TPD		
7.Bio-fertilizer generation per year		367640	TPY
8.Clean-fuel generation per day	394 TPD		
9.Clean-fuel generation per year		137830	TPY
10.Renewable bitumen generation per day @40% of NOM	175 TPD		
11.Renewable bitumen generation per year		61215	TPY
12. Economic Benefits from the waste to clean fuel Project			
Revenue from sale of Clean-fuel at rate of Rs.40 per kg	Rs. 551.3	Cr. per year	
Revenue from sale of Bio-fertilizer at rate of Rs. 5 per kg	Rs. 183.8	Cr. per year	
Revenue from sale of rBitumen at rate of Rs. 50 per kg	Rs. 306	Cr. per year	
Gross Revenue Generation per year		Rs. 1041	Cr
Annual maintenance and operation costs @10% / 20% of project cost:	Rs. 350Cr / 700	Cr/	
Annual profit from the project		Rs. 691Cr / 345	Cr/
ROI from the project		%	
Waste collection & logistic costs shall be covered from user fees payable by the citizens			

Waste Elimination Capacity of the Project		5100 TPD Solid Waste per day	
South MCD			
1.	Cost of project plant and machinery, taxes, installation, commissioning-	4230	cr
2.	Available organic matter in the income waste-	3032	TPD

3.	Renewable CNG generation @ 10% of OM-	300 TPD
4.	Available non-organic matter in the income waste-	505 TPD
5.	Renewable Green Diesel generation@ 30% of NOM-	152 TPD
6.	Bio-fertilizer generation @ 40% of OM	1213 TPD
7.	Bio-fertilizer generation per year	424550 TPY
8.	Clean-fuel generation per day	452 TPD
9.	Clean-fuel generation per year	158200 TPY
10.	Renewable bitumen generation per day @40% of NOM-	202 TPD
11.	Renewable bitumen generation per year	70700 TPY
12. Economic Benefits from the waste to clean fuel Project		
Revenue from sale of Clean-fuel at rate of Rs.40 per kg Rs. 632 Cr. per year		
Revenue from sale of Bio-fertilizer at rate of Rs. 5 per kg Rs. 212 Cr. per year		
Revenue from sale of rBitumen at rate of Rs. 50 per kg Rs. 353.5 Cr. per year		
Gross Revenue Generation per year Rs. 1197.5 Cr		
Annual maintenance and operation costs @10% / 20% of project cost: Rs. 423 Cr/846		
Annual profit from the project Rs. 774.5 Cr/351.5		
ROI from the project		
Waste collection & logistic costs shall be covered from user fees payable by the citizens		

Waste Elimination Capacity of the Project East MCD	3000 TPD Solid Waste per day
Cost of project plant and machinery, taxes, installation, commissioning- 2666 cr	
Available organic matter in the income waste-	1600 TPD
Renewable CNG generation @ 10% of OM-	160 TPD
Available non-organic matter in the income waste-	276 TPD
Renewable Green Diesel generation@ 30% of NOM-	83 TPD
Bio-fertilizer generation @ 40% of OM	640 TPD
Bio-fertilizer generation per year	230400 TPY
Clean-fuel generation per day	243 TPD
Clean-fuel generation per year	87480 TPY
Renewable bitumen generation per day @40% of NOM-	110 TPD
Renewable bitumen generation per year	39600 TPY
Economic Benefits from the waste to clean fuel Project	
Revenue from sale of Clean-fuel at rate of Rs.40 per kg Rs. 350 Cr. per year	
Revenue from sale of Bio-fertilizer at rate of Rs. 5 per kg Rs. 115 Cr. per year	
Revenue from sale of rBitumen at rate of Rs. 50 per kg Rs. 198 Cr. per year	
Gross Revenue Generation per year Rs. 663 Cr	
Annual maintenance and operation costs @10% / 20% of project cost: Rs. 226 Cr/ 533.20 Cr.	
Annual profit from the project Rs. 437 Cr / 129.80	
ROI from the project 14%	
Waste collection & logistic costs shall be covered from user fees payable	

NDMC	
1. Cost of project plant and machinery, taxes, installation, commissioning-	245 cr
1. Available organic matter in the income waste-	180 TPD
2. Renewable CNG generation @ 10% of OM-	18 TPD
3. Available non-organic matter in the incoming waste-	30 TPD
4. Renewable Green Diesel generation@ 30% of NOM-	9 TPD
5. Bio-fertilizer generation @ 40% of OM	72 TPD
Bio-fertilizer generation per year	25200 TPY
Clean-fuel generation per day	27 TPD
Clean-fuel generation per year	9450 TPY
Renewable bitumen generation per day @40% of NOM-	12 TPD
Renewable bitumen generation per year	4200 TPY
<u>Economic Benefits from the waste to clean fuel Project</u>	
Revenue from sale of Clean-fuel at rate of Rs.40 per kg	Rs. 3.78 Cr. per year
Revenue from sale of Bio-fertilizer at rate of Rs. 5 per kg	Rs. 1.26 Cr. per year
Revenue from sale of rBitumen at rate of Rs. 50 per kg	Rs. 2.10 Cr. per year
Gross Revenue Generation per year	Rs. 7.12 Cr
Annual maintenance and operation costs @10% / 20% of project cost:	Rs. 0.71/1.42 Cr
Annual profit from the project	Rs. Cr / Cr.
ROI from the project	%
Waste collection & logistic costs shall be covered from user fees payable	

As can be seen from Table-4 , the processing suggested for New Delhi Municipal Council is not financially viable. Hence the waste should be transported to SMCD processing plants.

1. Waste Elimination Capacity of the Project	
	100 TPD Solid Waste per day
DCB	
1. Cost of project plant and machinery, taxes, installation, commissioning-	60.65 cr
1. Available organic matter in the income waste-	50 TPD
2. Renewable CNG generation @ 10% of OM-	5 TPD
3. Available non-organic matter in the incoming waste-	9 TPD
4. Renewable Green Diesel generation@ 30% of NOM-	3 TPD
5. Bio-fertilizer generation @ 40% of OM	20 TPD
Bio-fertilizer generation per year	7000 TPY
Clean-fuel generation per day	8 TPD
Clean-fuel generation per year	2800 TPY
Renewable bitumen generation per day @40% of NOM-	4 TPD
Renewable bitumen generation per year	1400 TPY
<u>Economic Benefits from the waste to clean fuel Project</u>	
Revenue from sale of Clean-fuel at rate of Rs.40 per kg	Rs. 1.12 Cr. per year
Revenue from sale of Bio-fertilizer at rate of Rs. 5 per kg	Rs. 0.35 Cr. per year
Revenue from sale of rBitumen at rate of Rs. 50 per kg	Rs. 0.70 Cr. per year
Gross Revenue Generation per year	Rs. 2.17 Cr
Annual maintenance and operation costs @10% / 20% of project cost:	Rs. 6.05 /13.10 Cr
Annual profit from the project	Rs. -3.88 Cr / -11.93 Cr.
ROI from the project	%

Waste collection & logistic costs shall be covered from user fees payable

As can be seen from the Table, the processing suggested at Cantonment is not financially viable. Hence the waste should be transported to SMCD processing plants.

7. Resource generation through Integrated Solid waste elimination Scheme

Table 4A :-Resource generation through Integrated Solid waste elimination project using WTG1XG technology ward wise (4500 TPD Capacity).

North MCD

Zones /No. of wards	Population In Lakhs	Waste Quan. to be Treated 100%	Available Organic Matter TPD	R. CNG @ 10% of OM ,TPD	Non Org. Waste TPD	Green diesel @ 30% NOM, TPD	Bio-fertilizer @40% of OM, TPD	Clean Fuel-- R-CNG + G.Diesel TPD	R-bitume n.@ 40% of NOM TPD
Civil lines-31	18.61	1302.7	781.2	78.12	130.2	39.0	312.4	117.2	52.08
Rohini-36	14.98	1048.6	629.16	62.9	104.9	31.5	251.6	94.4	42.0
Narela-10	9.62	673.2	403.91	40.4	67.32	20.1	161.6	60.5	26.8
Koral bagh-16	9.15	640.8	384.47	38.4	64.08	19.2	153.6	57.6	25.63
City-8	4.9	343.0	205.6	20.6	34.30	10.2	82.4	30.8	13.60
Sadar Paharganj -8	5.28	369.32	221.59	22.2	36.93	11.1	88.8	33.3	14.8
Total TPD		4377	2627	262.7	437	131.1	1050.4	393.8	174.9
Gen. TPY							367640	137830	61215

Resource generation through Integrated Solid waste elimination project using WTG1XG technology ward wise (5100 TPD Capacity).

South MCD

Zones /No. of wards	Population In Lakhs	Waste Quan. to be Treated 100%	Available Organic Matter TPD	R. CNG @ 10% of OM ,TPD	Non Org. Waste TPD	Green diesel @ 30% NOM, TPD	Bio-fertilizer @40% of OM, TPD	Clean Fuel-- R-CNG + G.Diesel TPD	R bitume n. @ 40% of NOM TPD
West -28	25.43	1780	1068	107	178.0	53.40	428	160.40	71.2
South -24	27.33	1913	1147.8	115	191.3	57.39	460	172.39	76.5
Najafgarh -21	13.65	955	573	57	95.5	28.65	228	85.65	3.82
Central-	5.78	405	243	25	40.5	12.15	100	37.15	16.2

31									
Total TPD		5053	3031.8	303	505.3	152	1216	455	202
Gen. TPY									
							424550	158200	70700

Resource generation through Integrated Solid waste elimination project using WTG1XG technology of 3000 TPD Capacity. East MCD

Zones /No. of wards	Population In Lakhs	Waste Quantity to be Treated 100%	Org. Matter TPD	R. CNG @ 10% of OM ,TPD	Non Org. Waste TPD	Green diesel Gen. @ 30% NOM,TPD	Biofert. Gen. @40% of OM, TPD	Clean FuelGen. R-CNG + G.Diesel TPD	R Bitumen Gen. @ 40% of NOMTPD
Shahdara North/33	15.45	1081	648	64	108	30	259	94	43
Shahdra South/ 31	23.98	1679	1008	100	168	53	400	153	67
Total TPD	39.44	2760	1656	164	276	83	659	247	110
Gen. TPY									
							230400	87480	39600

Resource generation through Integrated Solid waste elimination project using WTG1XG technology of 300 TPD Capacity- NDMC

Zones /No. of wards	Population In Lakhs & Waste*	Waste Quantity to be Treated 100%	Org. Matter TPD	R. CNG @ 10% of OM ,TPD	Non Org. Waste TPD	Green diesel Gen. @ 30% NOM,TPD	Bio-fert. Gen. @40% of OM, TPD	Clean Fuel-Gen R-CNG + G.Diesel TPD	R Bitumen Gen. @ 40% of NOM TPD
NDMC	2.54 300	300	180	18	30	9	72	27	12
Total TPD		300	180	18	30	9	72	27	12
Gen. TPY									
		105000	63000	6300	10500	3150	25200	9450	4200

* As per NDMC communication.

Resource generation through Integrated Solid waste elimination project using WTG1XG technology of 100 TPD Capacity

Zones /No. of wards	Population In Lakhs & Waste 0.70 Kg /D	Waste Quantity to be Treated 100%	Org. Matter TPD	R. CNG @ 10% of OM ,TPD	Non Org. Waste TPD	Green diesel Gen. @ 30% NOM,TPD	Biofert. Gen. @40% of OM, TPD	Clean FuelGen. R-CNG + G.Diesel TPD	R Bitumen Gen. @ 40% of NOM TPD
Canton-	1.16	81.45	50	5	9	3	20	8	4

ment / 9	81.45								
Total TPD		81.45	50	5	9	3	20	8	4
Gen. TPY	28570.5	17500	1750	3150	1050	7000	2800	1400	

8. Economic feasibility of the Integrated Solid Waste elimination Scheme

Table:-4B. Economic feasibility of the Integrated solid waste elimination project using WTG1XG technology of 4500 TPD Capacity / Cost of Rs 3500 Crores- North MCD

S.No	Product to be sold	Rate per Kg (Rs)	Quantity TPY	Revenue per Year (Rs)
A	Clean Fuel	40	137830	551.3
B	Bio-Fertilizer	5	367640	183.8
C	R Bitumen	50	61215	306
Gross Revenue per Year Rs in Crores				1041 Cr
Annual O & M cost @ 10% /20% of Project Cost			Rs. 350Cr / 700 Cr	
Annual Profit				
ROI				
Waste Collection & Logistics costs shall be covered from user Fees payable by Citizens in the Zone. *TPY is taken as TOD x 350				

Economic feasibility of the Integrated solid waste elimination project using WTG1XG technology of 5100 TPD Capacity / Cost of Rs 4490 Crores-South MCD

S.No	Product to be sold	Rate per Kg (Rs)	Quantity TPY	Revenue per Year (Rs)
A	Clean Fuel	40	158200	632.8 Crores
B	Bio-Fertilizer	5	424550	212.3Crores
C	R Bitumen	50	70700	353.5 Crores
Gross Revenue per Year Rs in Crores				1198 Crores
Annual O & M cost @ 10% /20% of Project Cost			423 / 846 Crores	
Annual Profit				775 / 352 Crores
ROI				
Waste Collection & Logistics costs shall be covered from user Fees payable by Citizens in the Zone. *TPY is taken as TOD x 350				

Economic feasibility of the Integrated solid waste elimination project using WTG1XG technology of 3000 TPD Capacity / Cost of Rs 2666 Crores-East MCD

S.No	Product to be sold	Rate per Kg (Rs)	TPD (north + south)	TPY (north + south)*	Revenue per Year (in Cr. Rs)
A	CleanFuel (rCNG+GDiesel)	40	247	86450	345.80
B	Bio-Fertilizer	5	659	230650	115.32
C	R Bitumen	50	110	38500	192.50
Gross Revenue per Year Rs in Crores					653.62
Annual O & M cost @ 10% / 20% of Project Cost (does not include salary of MCD employees)					226.60 / 533.20
Annual Profit					437 / 129
ROI					14% /4.50%
Waste Collection & Logistics costs shall be covered from user Fees payable by Citizens in the Zone. *TPY is taken as TOD x 350.					

Economic feasibility of the Integrated solid waste elimination project using WTG1XG technology of 100 TPD Capacity / Cost of Rs 60.65 Crores /6065 lakhs---NDMC

S.No	Product to be sold	Rate per Kg (Rs)	TPD (New Delhi Municipal Council)	TPY (New Delhi Municipal Council)	Revenue per Year (in lakhs. Rs)
A	Clean Fuel (rCNG+GDiesel)	40	27	9450	378
B	Bio-Fertilizer	5	72	25200	126
C	R Bitumen	50	12	4200	210
Gross Revenue per Year Rs in lakhs					714
Annual O & M cost @ 10% / 20% of Project Cost in lakhs(does not include salary of MCD employees)					71.4 lakhs /142.8
Annual Profit					642.6/571.2
ROI					
Waste Collection & Logistics costs shall be covered from user Fees payable by Citizens in the Zone. *TPY is taken as TOD x 350.					

Economic feasibility of the Integrated solid waste elimination project using WTG1XG technology of 100 TPD Capacity / Cost of Rs 60.65 Crores /6065 lakhs- DCB

S.No	Product to be sold	Rate per Kg (Rs)	TPD (Cantonment)	TPY (Cantonment)	Revenue per Year (in lakhs. Rs)
A	Clean Fuel (rCNG+GDiesel)	40	8	2800	112
B	Bio-Fertilizer	5	20	7000	35
C	R Bitumen	50	4	1400	70
Gross Revenue per Year Rs in lakhs					217
Annual O & M cost @ 10% / 20% of Project Cost in					60.65 lakhs

lakhs(does not include salary of MCD employees)			/121.30
Annual Profit			211/205
ROI			
Waste Collection & Logistics costs shall be covered from user Fees payable by Citizens in the Zone. *TPY is taken as TOD x 350.			

9. Zone wise Revenue Generation

Table-4C. Zone wise Revenue Generation-North MCD

S.No	Zone	No.of Wards	Waste Treated -OM & NOM,TPD	Revenue Zone wise Yearly in Crores	Value Added Products Rev.in Crores Per Year			
					Biodegradable Comp.		NON-Biodegradable Comp.	
					rCNG Rev.	Bio-Fert. Rev.	G.Diesel Rev.	R.Bitumen Rev.
1	Civil lines	31	912	309.89	109.48	54.67	54.60	91.14
2	Rohini	36	734	249.69	88.06	44.03	44.10	73.50
3	Narela	10	471	159.88	56.56	28.28	28.14	46.90
4	Karol bagh	16	448	152.37	53.76	26.88	26.88	44.85
5	City	8	240	81.34	28.84	14.42	14.28	23.80
6	S. Pahar ganj	8	264	88.06	31.08	15.54	15.54	25.90
	Total	109	3069	1041.23	367.76	183.8	183.6	306

Zone wise Revenue Generation-South MCD

S.No	Zone	No.of Wards	Waste Treated , OM & NOM,TPD	Revenue Zone wise Yearly in Crores	Value Added Products Rev.in Crores Per Year			
					Biodegradable Comp.		NON-Biodegradable Comp.	
					rCNG Rev.	Bio-Fert. Rev.	G.Diesel Rev.	R.Bitumen Rev.
1	West	28	1068 + 178	422.23	148.32	74.90	74.41	124.6
2	South	24	1147 + 191	453.47	159.4	80.50	80.57	133
3	Najaf-garh	21	537 + 95.5	224.71	79	39.90	39.312	66.5
4	Central	31	243 + 40 + 450 + 75*	97.00	34.65	17.50	16.85	28
	Total	104		1197.5	421.37	213.1	211	352

Zone wise Revenue Generation- East MCD

S.No	Zone	No.of Wards	Waste Treated , OM + NOM (in	Value Added Products Rev.in Crores Per Year		Revenue Zone wise Yearly
				Biodegradable Comp.	NON-Biodegradable Comp.	

			TPD)	rCNG Rev.	Bio-Fert Rev.	G.Diesel Rev	R.Bitumen Rev.	in Crores
1	Shahdara North	33	648+108	90.72	45.36	45.36	75.60	257.04
2	Shahdara South	31	1008+168	141.12	94.08	70.56	117.60	423.36

10. Institutional Strengthening and Capacity Building.

To facilitate the municipal authorities improving solid waste management practices and the construction of waste processing and disposal facilities, an institutional support mechanism is recommended at national and state level which envisages having an Authority or Mission at the National level and a special technical cell under it, designated as the reference point, to guide and support the states and municipal authorities in problem solving and facilitation including advise on appropriate technologies for processing and disposal of waste, allocate funds to improve MSW management, support the programmes of training and capacity building of municipal authorities, etc.

1.Capacity Building of Municipal Personnel

Efforts must be made to strengthen the technical knowledge of the engineering staff within Department of MSW Management. A long-term view, therefore, will have to be taken by municipal authorities who will need to build and strengthen professional relationships with academic and research institutions in the State / region. More importantly, the State MSW Management Authority will have to take the leadership role in capacity building of municipal staff in the State and conduct training courses, workshops, conferences and awareness drives at different levels. Through training it must be ensured that municipal authorities, both, technical and administrative as well as the elected representatives in municipalities and Local Self-Governments should understand rules and regulations related to MSW management and recognize the importance of appropriate treatment and disposal of MSW - especially in the context of the potential threat MSW can pose to ground water, surface water resources and create public health disaster.

2. Capacity Building for Success of PPP Approaches

An "independent engineer" should be appointed and made responsible to ensure smooth functioning of the MSW management tasks undertaken by the municipal authorities through PPP mode.

The private sector participation in MSW sector is new and emerging. The management should take pragmatic view while initiating action against the concessionaires and make efforts to build the sector by promoting healthy competition and sustainable partnership.

On any dispute arising between the municipal authority and concessionaire, the latter should remember that this is a dispute between the partners and it should be resolved amicably, subject to protecting the public interest. The municipal authority should desist from imposing its will upon the concessionaire and should involve a third party mediator such as commissioner/director of municipal administration to find a fair solution to the dispute. Several disputes are currently pending in various Courts of Law in the country and hence special efforts will have to be made to avoid arbitration or litigation.

11. Viability Gap Funding (VGF)

Viability of waste processing technologies on PPP mode is a matter of great concern. It is considered essential to bridge the viability gap through financial support from government of India,

state government and municipal authorities. After carefully examining the viability gap, it is felt that private sector may be given viability gap funding to the extent of 40% towards capital expenditure by the central government upfront or 20% viability gap funding each for capital investments and O&M costs linked to performance and another 10% by the state governments for the sustainability of such projects. **The GOI has recently announced 35% VGF for MSW projects.**

The municipal authorities should facilitate private sector in availing viability gap funding and avail themselves the support for improving collection and transportation on the lines recommended in the chapter on public private partnership (PPP).

12. Incentives for MSW Management

- i. Tax Exemption of Certain Bonds Issued by Local Authorities.(section10(15) of the I Tax Act)
- ii. Tax Holiday for the Project Entity for Solid Waste Management
- iii. Tax Exemption for Income of Infrastructure Capital Funds and Companies (. Section 10(23G) I T Act)
- iv. Inclusion as Eligible Investments of Charitable Funds for Urban Infrastructure: Section 1(5) (ix) of the Income Tax Act.
- v. Availability of Funds by Sale of Carbon Credits

13. Tarriff and User Charges

It is of paramount importance for sustainable financing to strengthen project revenues and that the projects are planned in such a way that they are self-sustainable and can deliver desired outcomes for a longer period. MSWM operations usually depend on SWM taxes or fees and charges. It is desirable to levy a dedicated tariff for Sale of products and by-products – like compost, RDF, landfill gas, or waste to energy (applicable if the projects have electricity generation unit). Introduction of SWM service fee and charge,Rationalization of Property Tax , Sale of recyclables can be thought of as source of Revenue Generation from Solid Waste Management Projects. An attempt has been made to work out norms for levy of User charges in the Report.

Following basic principles have been considered, while prescribing norms for levying user charge and service fee for SWM services.

- Polluter pays principle: Those responsible for waste generation should pay for its collection and safe disposal.
- Proportionality: The user fees should be in proportion to the quantity of waste generated and level of service provided to waste generators. Variable rates may be prescribed for different categories of waste generators, keeping in view their waste generation pattern. A fair user fees will facilitate better compliance.
- Capacity to pay: Affordability of tax payers should be considered

14. Smart Waste Management and Decision Support System (DSS)

Keeping in view the advancement in science and technology application of “smart municipal solid waste management” concepts may be introduced by the municipal authorities to keep a complete track on the operation of MSW management.

- i. The use of Information Communication Technology (ICT) in MSW management will reduce the manual effort and enhance the efficiency of collection, transportation, and identification of dumping site, manpower management, resource management and addressing citizen’s complaints.
- ii. Use of technology in synchronization of waste vehicle tracking and quality monitoring

should help to ensure better performance of the system.

iii. A Pilot SM-WMS project be initiated and systems /equipment be standardized enabling cost reduction and easy replication

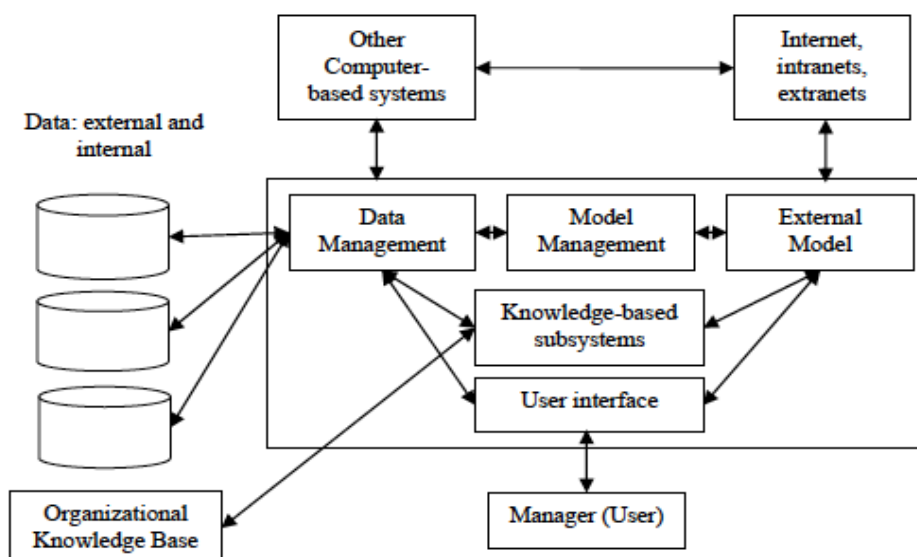
Decision Support System (DSS)

Decision Supports System (DSS) is a computer-based information system designed in such a way that help local bodies/ Municipality/ Managers to select one of the many alternative solutions to a problem. It is possible to automate some of the decision-making processes in a computer-based DSS, which is sophisticated and analyzes large amount of data and technical details. It helps municipalities in DPR preparation, reduces costs, increases coverage and enhances quality. The nature of problem itself plays the main role in the process of decision-making.

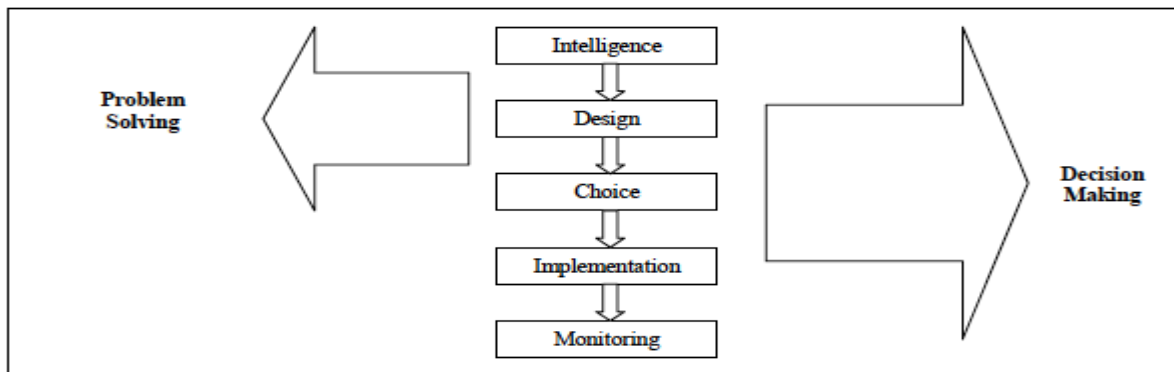
DSS is an interactive computer based information system with an organized collection of models, procedures, software, databases, telecommunication, and devices, which helps decision makers to solve unstructured or semi-structured execution problems.

The Decision Support System (DSS) utilizes decision rules, models, coupled with a comprehensive database and the decision maker's own insights, leading to specific, implementable decisions in solving problems that would not be amenable to management science models. Thus, a DSS supports complex decision-making and increases its effectiveness. A schematic view of DSS, indicating the major components / subsystems and Decision making and Problem Solving process is depicted in the two diagrams below.

Components of Decision Support System (DSS)



Decision Making and Problem Solving Process



Source:-KP Tripathi/ Indian Journal of Computer Science and engineering (IJCSE)

15. 5 R's Reduce, Reuse, Recycle, Recover and Re-Manufacture.

Various components of MSW have an economic value and can be recovered, reused or recycled cost effectively. Currently, the informal sector picks up part of the resources from the streets and bins to earn their living. However, a sizeable portion of organic waste as well as recyclable material goes to landfills untreated. Over 81% of MSW annually is disposed at open dump sites without any treatment. With planned efforts to **Reduce, Reuse, Recover, Recycle and Remanufacture (5Rs)** and appropriate choice of technology, the MCD can profitably utilize about 65% of the waste in producing energy and/or compost and another 10 to 15% to promote recycling industry and bring down the quantity of wastes going to landfills/ dumps under 20%. Table-18 classifies and defines the recyclable materials in MSW, Plastic, Industrial and C&D wastes.

As a strategy, it would be prudent to make efforts to motivate the waste generators to reduce generation in the first place and reuse the waste to the extent possible, guide and enable industry and commerce to enhance recovery of materials and intermediates during manufacturing, promote segregation of recyclables at source and re-use the material in remanufacturing of products and intermediates, transitioning towards achieving the goal of optimum utilization of recyclable material.

The percentage of wet biodegradable waste is high in Indian waste and is a source of contamination of soil, water and air, if disposed indiscriminately. Biodegradable waste has a good potential for generating biogas, which can serve as fuel, can also be converted to energy as well as to compost which can improve soil health and lead to increased agriculture production. This wet waste must therefore be processed either through biomethanation or composting technology for generating biogas, electricity or compost for use as nutrient and prevent such wastes reaching the landfill.

Considering that reusable and recyclable wastes form 20-25% of the actual waste generated (which does not include the wastes collected by the kabadiwalas from source of generation). Plastics, paper and glass constitute 17% of the recyclable wastes. Plastic wastes including composites are high calorific value material and crucial ingredient for MSW based W to E plants. This material also needs to be fully recovered and profitably utilized.

The next step should be to strengthen segregation of the non-recyclable dry combustible MSW at secondary storage depots/transfer stations and optimally utilize this material in the form of RDF which can be fed to WtE power plants and as auxiliary fuel in cement and metallurgical industry. Setting up of small to large plastic waste to liquid fuel plants, thereby utilizing the plastic not picked up by kabadiwalas and rag pickers, also needs to be encouraged

16. Reclamation and Remediation of MSW Dump sites.

Rehabilitation and Remediation of abandoned landfills including capping of dumpsites (Ghazipur) should be initiated on priority where water table is generally high and/ or the amount of waste being deposited is large. Scientific assessment of contamination of soil and groundwater should be undertaken and extent of damage and possibilities of remediation needs to be ascertained. Based on the outcome and cost implications, a strategic decision regarding remediation and or capping should be taken. Capping should be planned to minimize further damage and release of the part of the land by scraping and accumulating scattered waste and using it for sanitary landfills or putting it to a profitable use. Need to consider remediation to release precious land is therefore recommended. The financial support proposed to be extended is as under:

- i. 50% cost by the Central Government and,
- ii. 20% cost by the State Government may be considered
- iii. 30% cost by the private sector

17. Sanitary Landfill facility.

As per the PC TF report, 2014, Cities above one million populations generating over 100 TPD residual wastes for disposal should set-up their own Sanitary landfill and permit all cities and towns within 50km periphery of the city to use that facility for disposal of their inert waste. Shahdara South and Shahdara North have a population of 23.98 lakhs and 15.45 lakh respectively and generate 2760 tons per day of waste of which 1300 is incinerated in the waste to energy plant at Ghazipur and remaining i.e more that 50% is dumped near the plant.

East MCD has one recognised open dumping ground which has already been exhausted. The collected waste from all the wards goes directly to the dumping ground. Almost, 50% of the waste collected is dumped and these dumps pose potential threat to ground water and are likely to cause deterioration of the ambient air quality. It is therefore necessary to **develop 8 sanitary landfill facility(SLF) of 680 MT capacity**, adjacent to the WtE/compost facility. The detailed design such as sanitary landfill design life / standards for land filling / planning and design process / landfill layout plan / landfill soil properties / leachate drainage, collection and removal system / liner system and final cover system of the proposed sanitary landfill facility is required to be worked out. Clearances that are required for setting up SLF is indicated in Table-19.

18. Zero waste strategy

Zero Waste is a goal that is strategic and economical and a set of practical tools , that guides people in changing their lifestyles and practices to emulate sustainable natural cycles and guides officials in ensuring that all discarded materials become resources for every one to use.

Zero Waste means designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, conserve and recover all resources, and not incinerate /burn or bury or landfill them. Implementing Zero Waste will eliminate all discharges to land, water or air that are a threat to planetary, human, animal or plant health. Zero Waste maximizes recycling, minimizes waste, reduces consumption and ensures that products are made to be reused, repaired or recycled back into nature or the marketplace.

Strategy suggested.

1. Waste Prevention and segregation.
2. Separate Collection and inclusion of waste collectors(Rag pickers)
3. Minimise transportation
4. Decentralised processing of Biodegradable waste close to generation.
5. Maximise Recycling of waste
6. Centralised /Regional WtE facilities including SLF for inerts.
7. Landfills and Incinerators to be progressively phased out.
8. Reclaim and monetize MSW dump sites

19. Summary of Recommendations

1. Sustainable MSWM Strategy-5R's –Reduce, Reuse, Recycle, Recover and Re-manufacture
2. Financial Sustainability-Cost Sharing Pvt 50%, Center20%, State20%- SDMC-10%(sharing of facilities available)
3. Management Strategy- PPP Model
4. Technological Sustainability- The End to End -waste collection to elimination scheme based on modern Technological options (WTG1XG) suggested to Process and Manage MSW.
5. Social Sustainability-Inclusion of Rag Pickers , collectors/associations and recyclers.
6. Environmental Sustainability.-100% door-door Segregated waste Collection, Est.Transfer stations, Near elimination of Dhalao's,.
7. Smooth disbursement of funds:- MoUD should be designated the single point of support. The support of Ministry of Agriculture, Ministry of New and Renewable Energy, CPCB etc could be channelized through MoUD in a well-coordinated manner.
8. Automatic On-line real Time Monitoring System based on GPS /RFID and Mobile Application.
9. A decision support system (DSS) for MSWM needs to be developed
10. In order to meet both Capex and O & M cost introduction / increase of Service fee, user charges, possible rationalization of property tax could be thought off. Revenue could also be generated through sale of by products and recyclables

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