Critical Analysis of Municipal Solid Waste Management in Bhopal

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Abstract— Indiscriminate disposal of Solid Waste is causing severe damage to the environment and degrading natural resources. Waste management and diligent planning becomes critical for regulation of humongous solid waste being generated every day. With growing urbanization and rise of smart cities on the offing the issue of solid waste management becomes even more imperative. In past few decades, Bhopal has witnessed major transformation in the subject of urban development per say. This paper deals with various aspects of solid waste management such as current status of waste segregation, collection, transportation and disposal in Bhopal. The emphasis is to carry out current status and diagnose the major issues.

Keywords: Solid Waste Management, Bhopal

I. INTRODUCTION

All around the world cities are rapidly expanding leading to environmental and social challenges. The generation of waste is one of such concern.

India is the 2nd largest nation in the world, with population of 1.25 billion accounting for nearly 18% of world's population. Even though only 31% of Indian population resides in urban areas, this population of 377 million (Census of India, 2011) generates a gigantic 1,43,449 metric tonnes per day of municipal solid waste, as per the Central Pollution Control Board (CPCB), 2014-15 and these figures increase every day with an increase in population. To further add to the problem, the total number of towns (statutory and census) in the country have also increased from 5,161 in 2001 to 7,936 in 2011, thus increasing the number of municipal waste generation by 2,775 within a decade. Rapid increase in urbanization and per capita income in India has significantly led to an increase in municipal solid waste generation in the country.

Waste management refers to the activities and actions required to manage waste from its start till its disposal. This includes collection, transport, treatment and disposal of waste together with monitoring and regulation.
Solid waste encompasses the following waste components:

1) Construction and demolition waste – wastes generated in construction of new buildings, renovation and demolition work.
2) Plastic waste– includes polythene bags, plastic bottles, etc.
3) Biomedical waste – wastes involved in diagnosis, treatment and immunization such as human and animal anatomical waste, treatment apparatus such as needles and syringes and cytotoxic drugs.
4) Hazardous waste– wastes that cause immediate danger to exposed individuals or environment.
5) E-waste – includes discarded computer monitors, motherboards, cathode ray tubes (CRTs), printed circuit board (PCB), mobile phones and chargers, compact discs, headphones etc.

Madhya Pradesh is growing faster than the country's average. The total municipal solid waste generated in the Madhya Pradesh is approximately 8000 TPD.
The present status of the waste management is as follows:-

1	Total Waste Generated	8000 TPD
2	Total Collection	7500 TPD (93 %)
3	Total Waste Treated Compost Making Waste to Energy Material Recovery	6100 TPD (81 %) 5000 TPD 400 TPD 700 TDP
4	Total Waste Land Filled	1400 TPD (18%)

II. LITERATURE REVIEW

Bhopal with expanded planning area of 463 square kilometres, stands among 15 largest cities of India. The city is divided into 19 zones which are further subdivided into 85 wards. BMC is planning and implementing various solutions for proper waste disposal in Bhopal city.

A. Existing MSWM System of Bhopal City

1) Waste Segregation at Source

The new Solid Waste Management Rules (SWM), 2016 have mandated the source segregation of waste in order to channelize the waste to wealth by recovery, reuse and recycle. Waste generators would now have to segregate waste into three streams - Biodegradables, Dry (Plastic, Paper, metal, Wood, etc.) and Domestic Hazardous waste (diapers, napkins, mosquito repellents, cleaning agents etc.) before handing it over to the waste collector.

Institutional generators, market associations, event organizers and hotels and restaurants have been directly made responsible for segregation and sorting the waste in partnership with local bodies. All hotels and restaurants will also be required to segregate biodegradable waste and set up a system of collection to ensure that such food waste is utilized for composting / biomethanation.

The rules mandate that all resident welfare and market associations and gated communities with an area of above 5,000 square meters will have to segregate waste at source into material like plastic, tin, glass, paper and others and hand over recyclable material either to authorized waste-pickers and recyclers or to the urban local body.

B. Waste Classification (Source: BMC Solid Waste Management Bye-Laws, 2018)

Bio-degradable Waste / Wet Waste	Recyclable Waste / Dry Waste
Kitchen waste Garden and leaf litter Soiled paper House dust after cleaning Coconut shell Ashes	Papers Books and magazines Glass Metal objects Leather Rexene Rubber Wooden furniture

1) Waste Collection

"Collection" means collection and lifting of solid waste from source of waste, collection points or any other location.

In Bhopal, Door to Door collection of solid waste is done in all 85 wards to collect garbage from every household, including slums and informal settlements on daily basis. In order to collect garbage from every household, area wise specific time slot is set. The time for house to house garbage collection is set from 6 a.m. to 11 a.m. To collect garbage from trading establishments, shops in commercial areas or any other institutional waste generator the time is from 7 a.m. to 12 noon and in evening from 4 p.m. to 11 p.m.

In present scenario, the per capita waste generated is 383 gms (per person / day) out of which 214 gms (per person / day) is wet waste and 169 gms (per person / day) is dry waste, as per report of BMC 2020.

The door to door collection is done through the use of partitioned vehicles. There are three separate collection bins for wet, dry and domestic hazardous waste in each tipper. These tippers carry the waste from households to the transfer station from where the waste is transported to the trenching ground in hook loaders. All vehicles used in the collection and transportation system are monitored by a GPS enabled tracking system. The GPS system is constantly monitored by the monitoring cell. Any root deviation by particular driver is penalized and multiple deviations are also ground for termination.

The wet waste from semi bulk generators generating 50 to 100 kg of waste is collected through bulk collection system. The bulk collection vehicles consists of a dumper which is used to collect wet waste and a compactor which is used to collect dry waste, these vehicles move in pairs as per predefined deployment plan. These vehicles on completing their collection route transport the waste straight to the central processing plant.

2) Transportation of Waste

Collected segregated bio-degradable waste from residents and other areas is transferred to composed plants, biomethanation plants and other waste processing facilities.

The waste is collected in segregated form by partitioned tippers from domestic generator. The wet and dry waste is collected by these vehicles in separate chambers. The domestic hazardous waste is collected in a separate bin that is attached at the back of the tipper. The tipper on completing their collection routes, move to their designated GTS and offload their waste in the designated compactor. The compact compresses the waste and it is loaded on the hook loader to be transported to the central processing plant. The waste from the bulk generator is collected through the bulk collections system wherein two vehicles are deployed to collect wet waste and dry waste separately. The bulk generator is further divided into two categories as per the quantity of waste generated. The first category consists of generators that generate 50 to 100 kg of waste. These are small semi bulk establishments like coffee shops, small eateries, etc.. From these generators both wet and dry waste is collected in segregated form by dumpers and compactors that move

C. Ward – wise Solid Waste generation in Bhopal (Source: SolidWasteManagement Efficiency: Bhopal,2018)

Sr. No.	Zone Name	Ward Name	Ward No.	Waste Generated (TPD)
1)	North	Mahatma Gandhi	1	10.77
2)	West	Airport	2	9.64
3)	West	Bhori	3	8.81
4)	West	Hemu kalani	4	10.2
5)	West	Shadhuvashwani	5	8.94
6)	North	Mahaveergiri	6	9.88
7)	North	Kohefiza	7	10.7
8)	North	Royal market	8	10.48
9)	North	Bag munshihussinkha	9	8.02
10)	North	idgah hills	10	8.85
11)	North	Babu jag jeevan ram	11	10.82
12)	North	Nariyalkheda	12	10.75
13)	North	Geetanjali	13	9.36
14)	North	Shajhanabad	14	10.53
15)	North	J.P Nagar	15	10.77
16)	North	Motilal Nehru	16	8.09
17)	North	Ibrahim ganj	17	8.81
18)	North	Ram mandir	18	10.11
19)	North	LalBahadurshastri	19	10.45
20)	North	Mahaveer Swami	20	8.01
21)	North	Jain mandir	21	10.4
22)	North	Moti Masjid	22	8.21
23)	North	Islampura	23	8.09
24)	West	Rani Kamlapati	24	8.74
25)	West	Swami vivekanad	25	8.89
26)	West	Dr.Aambedkar	26	8.37
27)	West	GoswamiTulsidas	27	10.4
28)	West	Rani Awantibai	28	10.05

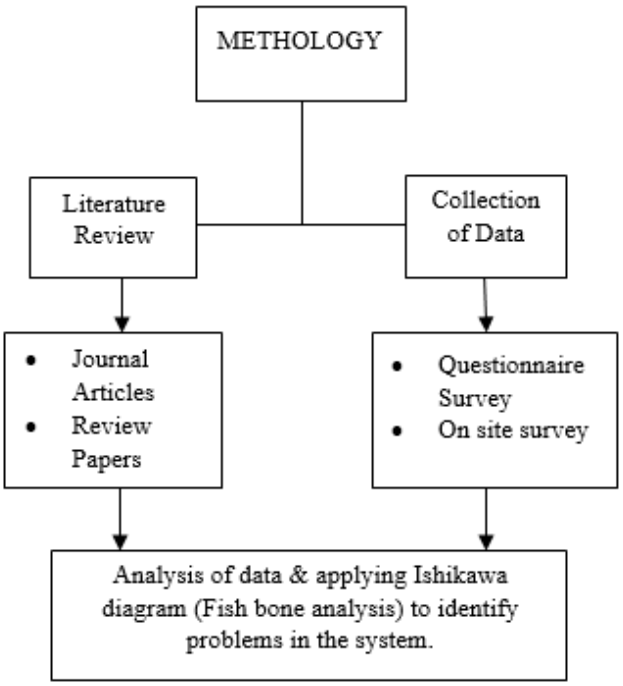
29)	South	Maulana Abdul kalamazad	29	9.57
30)	south	Kushabhauthakre	30	8.81
31)	North	ChatrpatiShivaji	31	8.25
32)	West	Jhawaharlalnehru	32	8.57
33)	North	PanditMadanmohanMalviya	33	8.69
34)	North	Ravindranathtagor	34	10.32
35)	North	Jhagirabad	35	9.99
36)	North	Chandbad	36	9.48
37)	North	Kapdamil	37	10.6
38)	North	Semra	38	9.85
39)	North	Naveen nagar	39	9.27
40)	North	Aishbaag	40	8.02
41)	East	Bag Fharhatafza	41	8.71
42)	North	RaniLaxmibai	42	8.16
43)	East	MaharanaPratap	43	8.2
44)	North	Shubhashchandrabose	44	9.36
45)	East	Indira gandhi	45	9.7
46)	East	PanditRavisankarshukla	46	8.84
47)	South	Dr.RajendraPrashad	47	8.61
48)	South	Arera colony	48	9.37
49)	East	Asha niketan	49	9.66
50)	South	Gulmohar	50	10.58
51)	South	Shahpura	51	8.24
52)	South	Misrod	52	8.11
53)	South	Jatkhedi	53	8.61
54)	East	Barkatullha	54	8.49
55)	East	Bagmugaliya	55	8.06
56)	East	Barkhedapathani	56	9.89
57)	East	Saket Shakti	57	9.12
58)	East	Kashturba	58	10.79
59)	East	Barkheda B.H.E.L	59	10.49
60)	East	Govindpura	60	10.3
61)	East	Khajuri kala	61	10.75
62)	East	Hathaikheda	62	10.3
63)	East	gautumbudha	63	8.97
64)	East	Sonagiri	64	8.18
65)	North	Govindpuraudhoygikkshetra	65	10.47
66)	East	Narelashankari	66	10.8
67)	East	Indrapuri	67	8.78
68)	North	Ayodhyanagar	68	10.81
69)	North	Guru nanak dev	69	9.7
70)	East	Panjabi bag	70	10.69
71)	North	Dusheramedanashokagardan	71	9.13
72)	North	Rajeev gandhi	72	8.97
73)	North	Bhopal memorial hospital	73	10.27
74)	north	Bhanpur	74	10.7
75)	North	Badbai	75	10.78
76)	North	Chola	76	10.62
77)	North	Rushalli	77	10.37
78)	North	Karond	78	10.79
79)	North	Navibag	79	10.62
80)	South	Sharvdham Kolar	80	8.32
81)	South	Kanhakunj	81	8.47
82)	South	Danish kunj	82	8.43
83)	South	Sankhedi	83	6.9
84)	South	Ratanpursadak	84	7.63
85)	East	Katara	85	7.01

in pair collecting waste along their route. In second category, the generator generating more than 100 kg waste has been placed. These generators are hotels, marriage garden, RWAs, etc. Only dry waste is collected from these generators as they treat the wet waste generated by them on site.

1) Disposal of Waste

In Bhopal the solid waste is disposed by dumping in low lying areas. Present solid waste is being disposed at Bhanpur village site, which is situated at about 16 km north of Bhopal city, in an unscientific manner. The site which is in use for over 30 years is spread over an area of 57.80 hectares and serves high density community in the north of the city. Electronic weighing bridge cum record room is used to weigh the vehicles at the entrance and a washing area is provided for the vehicles by the BMC.

III. METHODOLOGY



A. ISHIKAWA DIAGRAM (FISH BONE ANALYSIS)

Fish bone analysis is a tool that can help us perform a cause and effect analysis for a problem we are trying to solve. This type of analysis enables us to discover the root cause of a problem.

How to create a cause and effect diagram:

Cause and effect diagram can be created in 6 steps

1) Draw problem statement
2) Draw major cause categories
3) Brainstorm causes
4) Categorize causes
5) Determine deeper causes
6) Identify root causes

After analysing the data following conclusions were drawn

B. PROBLEM IDENTIFICATION

Aim is to find problems and their possible causes in waste management

C. CAUSES FOUND IN FISHBONE ANALYSIS

1) MAN

– Lack of Motivation
– Health issues

2) MATERIAL

– Open bins that litter waste

3) MANAGEMENT

– Lack of monitoring
– Recycled products not easily available to people for use.

4) ENVIRONMENT

– Emission of CO2
– Consumption of plastic bags by animals

5) MACHINE

– Lack of latest technologies and equipments (bins, etc.)
– Excessive downtime

IV. RESULTS AND CONCLUSIONS

Bhopal MSWM has problems which are identified using Fishbone analysis.

Problems identified are:

1) Community collection points and waste piles in Bhopal appear ugly with unpleasant / bad odour attracting vermin and diseases.
2) Being open topped, bins are exposed to rainfall, thus accelerating the generation of leachate.
3) Although BMC provides protective equipment to sanitary workers engaged in in collection and transfer of MSW. They rarely use it due to lack of awareness about general health and safety measures.
4) Burning of MSW is also a common practice at some collection points in city. This results in low temperature incineration of MSW that can cause significant atmospheric pollution.
5) The existing weighbridge at Bhanpur site is in ruined state.

REFERENCES

[1] Central Pollution Control Board (CPCB) 2014-2015 report.
[2] M.L. Patel, Rajnikant Jain and J.S. Chouhan, "Environmental status and Municipal Solid Waste management in Bhopal, the capital city of Madhya Pradesh, India", International journal of Environmental Engineering and Management.
[3] S. D. Diwevdi and Sheeraz Ahmad Wagay, "Solid Waste Management in Bhanpur Bhopal : Status and Need – a case study" , Chemical and Process Engineering Research.
[4] Parihar, Ahmed, Barenda Sharma & Ravi Kiran, "MSWM in Bhopal city : A critical analysis and proposed raodnap for its sustainable management", Institute of Civil Engineering
[5] Smartcities.data.gov.in/catalogue
[6] Bhopal Municipal Cooperation Solid Waste Management Bye – Laws, 2018

