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Opportunities and Challenges in Municipal Solid Waste Management in Nagpur City, Maharashtra

Bhushan R. Ambade[1], Dr. D.K. Parbat[2], Vivek B. Dhait[3]

[1]*Department of Civil Engineering,Government Polytechnic Nagpur, Corresponding author.*
[2,3]*Department of Civil Engineering,Government Polytechnic Nagpur*

Abstract - Nagpur is second political city of Maharashtra having population 28,07,007. The city generates about 905 TPD of MSW. Due to urbanization, industrialization ad educational hub Nagpur is one of the fastest growing cities in Maharashtra. There is no arrangement for segregation of waste at source. The collection and transportation of MSW is carried out by the combination of municipal and private vehicles. A windrow composting plant of 800 TPD capacities is installed. Unscientific open dumping, threats of environmental pollution, absence of landfill gas (FLG) monitoring facilities are the most important hurdles for the city. There is an urgent need of source segregation, optimized transport facilities, LFG monitoring and improvement of plant processing capacity.

Keywords: Windrow composting, landfill gas, environmental pollution, leachate, municipal solid waste.

I. INTRODUCTION

Municipal Solid Waste includes commercial and residential wastes generated in municipal or notified areas, in either solid or semi-solid form excluding industrial hazardous wastes, but including treated bio-medical wastes [1].The generation of Municipal solid waste (MSW) is as old as the history of civilization. In ancient days the management of MSW had not much challenges. But due to urbanization, industrialization, globalization and population explosion now it continues to be major challenges for urban cities over the globe [2,3].

As urbanization and economic development increases in Asia, nowhere is the impact more obvious than in society's solid waste. Today, the urban areas of Asia produce about 760,000 tones of MSW per day, or approximately 2.7 million m3 per day. In 2025, this figure will increase to 1.8 million tons of waste per day, or 5.2 million m3 per day [4]. Local governments in Asia currently spend about US $25 billion per year on urban solid waste management. This amount is used to collect more than 90 percent of the waste in high income countries, between 50 to 80 percent in middle income countries, and only 30 to 60 percent in low income countries. In 2025, Asian governments should anticipate spending at least double this amount (in 1998 US dollars) on solid waste management activities [4].

The Energy and Resources Institute (TERI) has estimated that waste generation will exceed 260 million tons per year by 2047 more than five times the present level [5]. Though municipal authorities have held the responsibility of managing solid waste from their inception they could not get cognizable results due to many issues like appointment of junior officials (sanitary inspectors), no serious efforts are made to adapt latest methods and technologies, no clear plans to enhance their efficiency or improve working conditions through the provision of modern equipment and protective gear, absence of Community Participation, failed to mobilize the community and educate citizens on the rudiments of handling waste and proper practices of storing it in their own bins at the household,

lack of sufficient fund, etc [5,6]. Therefore, there is a need to perform post operative study of existing MSW management practices.

Nagpur, a city with 28,07,007 inhabitants in Maharashtra India, is one of the fastest growing cities in a country [7]. The population forecasting by incremental increase method in 2041is found to be 55,63,230. The generation of solid waste at the rate of 0.35 kg per capita per day in 2041 will be 1947 TPD. Hence proper measures should be taken to improve MSWM in future also.

In India, the MSW management practice and processing plan are established to provide the government and recovery on it. But it is found that most of plant are running under capacity, low efficiency and provide low quality product recovery [8].

Hence, it necessitates to evaluate the post operating study of such MSWM system and processing plant to identify the deficiencies in current practices. The effort should be made to improve the efficiency of the MSWM system and processing plant.

This paper focuses on existing MSW practices in Nagpur city and tried to find out shortcomings in it. This paper discusses the concern about environmental effects associated with MSW management. The recommendations are made to help overcome these limitations and for improving MSW management practices.

II. STUDY AREA

Nagpur city got its name from the Nag River or Nag people and is known since prehistoric times. Nagpur city's foundation was laid by the Gond King of Deogad "Bakht Buland Shah" in the year 1703. In 1743 it becomes the capital of Bhonsle's Kingdom. The city was annexed in 1817 by British. The Municipal Council for Nagpur was established in 1864. At that time, the area under the jurisdiction of the Nagpur Municipal Council was 15.5 sq. km and the population was 82,000. The duties entrusted to the Nagpur Municipal Council were to maintain cleanliness and arrange for street lights and water supply with government assistance. In 1922, the Central Provinces & Berar Municipalities Act was framed for the proper functioning of the Municipal Council [9].

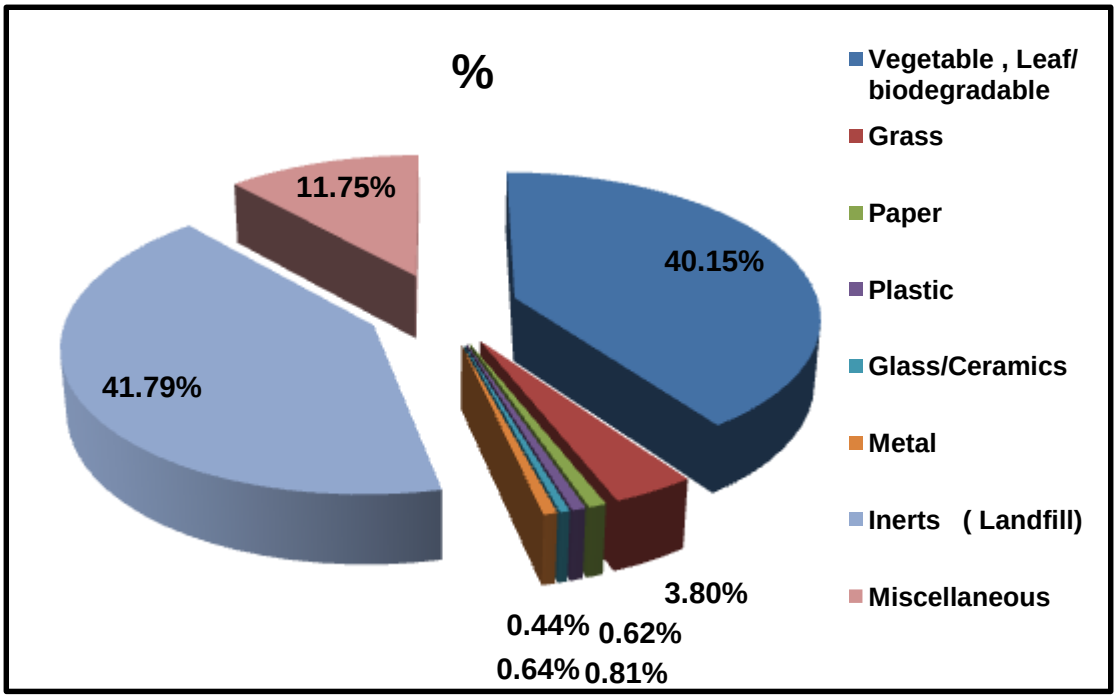
It was a capital of Central Provinces in mid-19th century. British rulers considered Nagpur as the center of India and hence identified this point and constructed the zero mile stone [10]. Nagpur is also called as Orange City, is currently emerging as the largest trading carter of certain goods and services.

III. MSWM IN NAGPUR CITY

Presently the MSW generation within the municipal limits of the Nagpur city was found to be 905 tons per day (TPD). The rate of generation of MSW was about 0.35 kg per capita per day. The city is divided in 10 zones.

3.1. MSW Characteristics

Fig. 1 shows the physical composition of MSW during March-2014. The quantity of paper, plastic, glass, and metal is noted as less than 1% each, the inert matters is found in about equal %, whereas miscellaneous matters as about 12%. Biodegradable fraction of MSW indicates that composting is suitable for MSW processing.



Source: NMC

Fig. 1: Physical composition of MSW in Nagpur city

3.2 Collection and storage of MSW

The Nagpur city is divided in 136 wards in 10 zones and two additional zones has been proposed. The MSW is collected and stored by door-to-door collection and community bin collection method. Kanak Resources Management Infrastructure Pvt. Ltd. is authorized by NMC for collection of MSW. NMC deployed 901 swachhata doot, 182 lifting labors, 218 drivers, 38 mechanic/helpers, 46 supervisors, 11 staff ad 14 incharges for managing MSW collection. Street sweeping operations are carried out in morning and evening in two shifts. Temporary collection depot are used for temporary collection of MSW.

3.3 Transportation of MSW

In Nagpur city, NMC deployed various tools and plants for collecting and dumping of waste public private partnership with Kanak Resources Management Infrastructure Pvt. Ltd. Tricycle, tractor, handcart, dumper, J.C.B. etc. are also available for collecting and transporting the solid waste from Nagpur city to Bhandewadi landfill site.

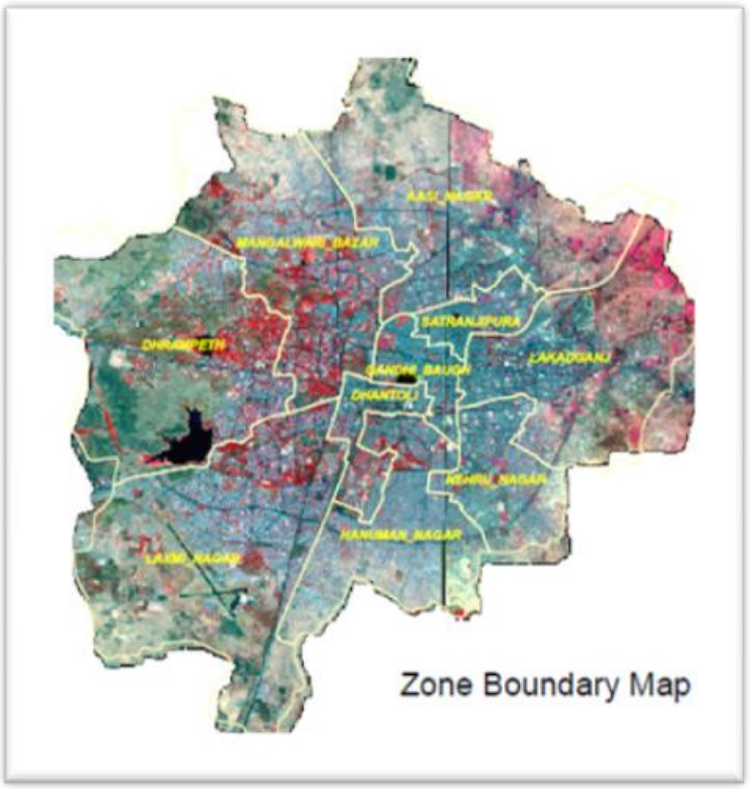


Fig. 2: Zone map of Nagpur city

Table 1: Details of Nagpur city (vehicle)

ZONE NO.	ZONE NAME	NO. OF PRABHAG	TATA ACE	TATA ACE SUPER	TATA DI 207	ASHOKA LEYLAND DOST	LOAD KING	TATA 407	DUMPER PLACER	COMPACTOR	HOOKLOADER	PRIVATE VEHICLES
1	Laxmi Nagar	7	9	3	4	0	2	1	2	1	1	0
2	Dharampeth	6	7	1	0	1	0	1	2	1	0	0
3	Hanuman Nagar	8	8	2	0	0	1	1	1	1	0	0
4	Dhantoli	6	6	1	0	0	1	2	2	1	0	0
5	Neharu Nagar	7	13	1	0	0	1	0	2	1	1	0
6	Gandhibagh	7	7	0	0	0	1	0	2	1	1	3
7	Satranjipura	8	4	1	0	0	0	0	2	1	0	2
8	Lakadgang	8	12	0	1	0	0	0	1	1	0	1
9	Ashi Nagar	8	7	0	0	0	0	2	1	0	0	1
10	Mangalwari	7	6+1	2	0	0+1	0	3	2	2		0
	Total	72	80	20	05	02	06	10	17	10	03	07

Source: NMC

Table 2: Details of Nagpur city (vehicle)

ZONE NO.	ZONE NAME	NO. OF PRABHAG	JCB MACHIN	TIPPER	RICKSHAW
1	Laxmi Nagar	7	1	6	76
2	Dharampeth	6	0	3	55
3	Hanuman Nagar	8	1	1	47
4	Dhantoli	6	1	3	57
5	Neharu Nagar	7	0	2	69
6	Gandhibagh	7	1	3	73
7	Satranjipura	8	1	1	72
8	Lakadgang	8	0	2	40
9	Ashi Nagar	8	0	0	75
10	Mangalwari	7	1	2	79
	Total	**72**	**06**	**23**	**643**

Source: NMC

3.4 Municipal Solid Waste Processing and Disposal

The 800 TPD capacity windrow composting plant was established at Bhandewadi in collaboration with Hanjar Biotech Energies Pvt. Ltd. The segregation of waste has been done along with production of compost. The automatic segregation unit is provided to segregate the smaller and larger sized MSW. The flowchart of segregation unit is depicted in Fig 3.

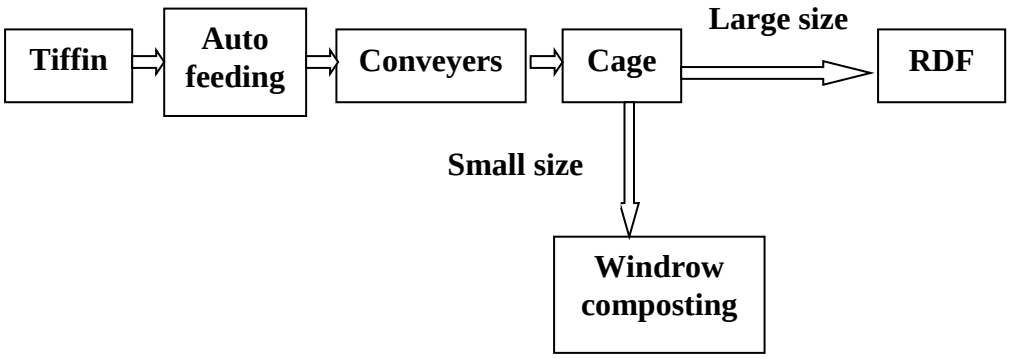


Fig 3: Flow chart of segregation of MSW

The closed windrow composting method is applied to process the MSW. Four windrows in a row were used with size 70 m x 12 m x 2.5 m. The watering was done by spraying water through the showers mounted on crane. Inoculums was added about 50 kg in a windrow to accelerate microbial activities. Windrows were turned four times in a week with the help of crane mounted shovel so that

windrows were aerated. The moisture content and aeration was monitored to maintain the thermophillic temperature within the windrows. After 30 days the MSW should be kept at maturation yard for a week. Then it was segregated through 18 mm and 13 mm tromels. Finally it was segregated through 4 mm and 3 mm tromel to separate compost and inert matters. The compost was collected in 50 kg bags and the inert matter was sent for land filling. The production of manure was found to be about 1000 bags per day (50 TPD). The Total expenditure on operation and maintenance of plant was about 17 – 18 lakh per month and the revenue generated from selling of compost was about 30 lakhs per month. But while visit to the plant it was found to be inoperative since 2 months due to fire.

The segregated waste and inert matter has been land filled at Bhandewadi landfill site spread over 55 acres area about 15 km from zero mile. The liner was provided at the bottom of landfill site and the fraction of MSW has been dumped. The life of one dumping site has been over and it has been covered and planted. It is now found to be very near to the city.

Fig 4: MSW landfill site Bhandewadi, Nagpur

IV DEFICIENCIES IN MSWM IN NAGPUR CITY:

4.1 Deficiencies in MSW collection and Transportation:

- The MSW collection is not properly monitored as the result of this the waste has been observed littering at various parts of the city.
- Door to door collection system has not reach in every ward.
- The collection bins are corroded and not properly maintained.
- The MSW is littered around the bins.
- The vehicles deployed by NMC are old and the fuel efficiency has not monitored.
- The transportation route is not optimized.
- Personnel protection clothes and equipments are not provided to workers during working hours.
- It is observed that no any statistical data is maintained by NMC for MSWM practices.

4.2 Deficiencies in MSW processing and disposal:

- The segregation of waste is done but it was found inefficient.
- 905 tons of MSW has been generated daily and the plant of 800 TPD capacity has been operated thus, more than 100 tons per day MSW goes to landfill site without processing.

- The MSW has been dumped in dumping yard in unscientific way. Compaction of waste and daily cover has not practiced.
- The windrow composting machinery was found idle due to fire. No processing work has been observed during visit.
- Two incidence of outbreak of fire has been observed.
- Record of daily MSW received at plant and transported to landfill site has not monitored.
- Domestic and wild animals were entered un-authorizely in the site resulting in serious effects on their health.
- Rag pickers carry out rag picking in a haphazard and hazardous way.
- No Landfill gas (LFG) collection and monitoring facilities were provided for landfill gas management.

V. CONCLUSION

The generation of large quantities of MSW in Nagpur city has become a serious environmental issue. NMC, though committed to the services, is finding this issue difficult to manage properly due to the growing magnitude of problems. The major problems in MSWM in Nagpur city are due to the lack of MSW segregation at source, low operational efficiency of MSW transportation system with old vehicles and an inefficient informal recycling system. Nagpur Municipal area generates 905 metric tons of MSW per day, whereas, no data was maintained for receiving it at landfill site, demonstrating the need for augmentation of the present collection and transportation system.

To achieve a target of 100% collection, transportation, treatment and disposal, NMC, would first need to prepare a micro plan which would identify the quantity of waste generated in the city and the broad strategy to be adopted to manage the system. The existing handcarts used for collection of solid waste, are to be replaced by tricycle carts. Capacity improvements to the existing MSWM framework need to be stressed. For collection system, emphasis should be on segregation at the household level and 100% door-to-door collection.

As per the physical characteristics of MSW generated the nature of waste indicates that among all recovery options composting would be the most appropriate. The biodegradable, inert and recyclable wastes from households, commercials and institutions should be collected in separate bins.

The existing windrow composting plant is operational for processing of 800 t/d MSW whereas; the MSW generation is 905 tons/d. More than 100 t/d MSW is land filled without treatment. Hence the capacity of plant should be improved.

The MSW processing plant was observed idle due to outbreak of fire. This creates load on landfill site. Hence, the plant should be run continuously to recover the byproducts, to improve the life of landfill site and to prevent the environmental and health hazards.

The fraction of MSW land filled should be compacted and covered daily with soil. The quality standards of the compost should be monitored to use it for agriculture or horticulture purposes. The collection and extraction of LFG will lead to revenue recovery, further improving the efficiency of landfill site. Personnel protection cloths and equipments should be given to the workers and regular health check up for them should be done. Further, polythene bags of size below 20 micron affect the process of stabilization of MSW in composting as well as in land filling. The landfill site becomes very near to the city now, thus there may be a chance of pollution of water sources due to contamination of leachate. Hence regular water monitoring should be done. Two incidences of outbreak of fire have been reported at Bhandewadi landfill site due to disposal of hazardous and inflammable materials. Only non-biodegradable reaction of MSW should be land filled.

Unauthorized entry of animals and rag pickers should be restricted at landfill site. Soil and ground water monitoring should be done periodically and curative measures should be done accordingly. The record of all sort of data regarding MSWM should be maintained in NMC and it

should be strictly monitored by Heath officer, Environmentalists, sanitary inspectors and accounts officer.

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