SOLID WASTE MANAGEMENT AND DISPOSAL IN JHANSI CITY

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Abstract - *The government of India is looking for improving efficiencies in Solid Waste Management (SWM) and focusing on improving Solid Waste Management practices in Jhansi, Uttar Pradesh. The Jhansi is a historic city in the Indian state of Uttar Pradesh. It lies in the region of Bundelkhand on the banks of the Pahuj River, in the extreme south of Uttar Pradesh. Jhansi is the administrative headquarters of Jhansi district and Jhansi division called the Gateway to Bundelkhand, Jhansi is located at 25.4333 N 78.5833 E between the rivers Pahuj and Betwa at an average elevation of 285 meters (935 feet). It is about 415 kilometers (258 mi) from New Delhi and 99 kilometers (62 mi) south of Gwalior.*

The original walled city grew around its stone fort which crowns a neighboring rock. The ancient name of the city was Balwantnagar. From 1817 to 1854, Jhansi was the capital of the princely state of Jhansi which was ruled by Maratha Raja,s. The state was annexed by the British Governor-General in 1854; Damodar Rao's claim to the throne was rejected but Rani Lakshmibai ruled it from June 1857 to June 1858.

The total solid waste generated 250 tons/day in Jhansi City which comes out to be about 450 grams per capita per day

This report brings out the present situation of solid waste management at Jhansi and the proposals to improve the same. The project activity aims at: (i) For the systematic process that comprises of waste segregation and storage at source, primary collection, secondary storage, transportation, processing, and treatment. (ii) Modern and Scientific Technique Municipal Solid Waste Management, (iii) To effect behavioral change regarding healthy waste practices through IEC activities. (iv) Generate awareness about waste and its linkage with public health. (v) Capacity Augmentation for Municipal Area.

The existing Municipal Solid Waste Management system lacks in terms of vehicles, processing facilities, secondary storage cum segregation points. Also, the Municipal Solid Waste Management is based on old school technology. Hence new infrastructure viz vehicles (E-Rickshaw, street sweeping machine refuse compactor, wheelbarrows, etc). Automated mechanized compost plant, segregation cum secondary storage, the automated street sweeping machine have been proposed along with Integrated ICT components like RFID tagging for the door to door collection, transportation, waste bins, route optimization, GPS tracking, etc.

Key Words: Solid Waste Management, Characterization, Standards, Concentration

1. Existing Solid Waste Management Scenario

Jhansi city has quite robust solid waste management. The city maintains itself quite clean in some places and ward. Timely collection, segregation, transportation, and treatment have kept the waste managed and the city cleaner.

1.1 Collection:

a. 5 Private agencies have been entrusted with the task of D-D collection from residential as well as commercial areas.
b. User charges have been implemented for D-D collection and revenue collection efficiency is currently at 40%. An amount of Rs. 40 per month per household is collected for H2H waste collection.
c. Currently, the percentage of solid waste collected is 62%.
d. Hospital waste / Clinical waste is collected and disposed of by an NGO named Medical Pollution Control Committee, approved by the Pollution Control Board.

2.1 Sources of Waste Generation and its Management at Generation Point

Several sources of waste generation were identified in consultation with JNN. These include residential, commercial & industrial establishments, hospitals, and nursing homes, hotels and restaurants, slaughterhouses, street sweeping & construction and demolition sites. About 270.50 MT of solid waste is generated every day in the city, which comes out to be about 450 grams per capita per day.

- **Residential and Commercial Establishments**

This includes both wet waste and dry waste. Door to a Door collection facility for solid waste collection in residential areas is available in Jhansi City.

Currently, there are two composting plants for wet waste and one processing plant for dry waste (Plastic Waste Processing Plant).

- **Industrial Establishments**

Major Industry includes the stone cutter industry, fabricator industry, furnace industry, and rubber industry. The solid waste is primarily generated by industrial workers. The solid waste is dumped in nearby dustbins or open areas by the industries themselves.

• Hospital & Nursing homes

Jhansi city has about 250 hospitals and nursing homes. These include government hospitals. Most of the prominent hospitals including medical colleges and district hospitals are located in the center of the city. These medical institutions have a total number of 1110 beds with an average occupancy rate of 60 percent. The medical establishments in Jhansi city generate approximately 0.70 kg/bed/day of total waste of which 0.27 kg/bed/day is a bio-medical waste. Hence, the total estimated bio-medical wastes generated in Jhansi city is in the tune of 5-7 MT/day. The biomedical waste is lifted by an NGO viz. National Pollution Control Company (NPCC) and transported to the incinerator and for autoclaving at their plant located on the outskirt of city Bijoli.

• Slaughter Houses

The waste from slaughterhouses (Skin, horn, and bones) to processing and recycling units from where it is exported. The remaining waste such as flesh cuttings is thrown in open dumps.

• Street Sweeping

There is two road sweeping machine which is used in some parts of the city for cleaning of roads. Sweepers are provided with brooms, pans, hoe, handcarts, panji, and gayti. They collect the waste from the roadside which is then transported to nearby dustbins and open dumps by handcarts.

• Construction and Demolition Sites

A major portion of this waste is used in the reconstruction of the filling up of low-lying areas. The individual generating construction waste generally engages the service of a private tractor to collect the construction waste and dump it elsewhere in the city for a nominal cost.

3. Population Projection and Waste generation

Jhansi is a Municipal city in the district of Jhansi, Uttar Pradesh. The city is divided into 60 wards. The Jhansi Municipality has a population of 505693 (as per the 2011 census). The project aims to improve the waste infrastructure in the City through proper waste management. Hence to arrive at the waste generation for the design years, population projection has been done as detailed below.

3.1 Planning Horizon

The planning horizon for the proposed sewerage system is 30 years, the base year being 2021, the Intermediate year 2036, and the Ultimate design year 2051.

3.2 Municipality area population

The Jhansi Municipality has a population of 505693 (as per the 2011 census). The population growth of Jhansi is as follows:

Table 1: Details of Decadal Population Growth Rate of Jhansi City

S.No.	Year	Population	The decadal difference in Population	Growth Rate
1.	1981	231300		
2.	1991	300850	69550	30.07%
3.	2001	426198	125348	41.66%
4.	2011	505693	79495	18.65%

The average decadal increase is 30.13 %. However, the last decadal (2001-2011) growth is only 18.65 %.

3.3 Population Projections

Population projection has been carried out for project areas based on different methods with census population for the year 2011 and past decades. Population projection has been done for 30 years with the Year 2021 as the base year. Population projections have been done by arithmetical progression method, incremental increase method, and geometric increase method Table 4.

Table 2: Projected Population of Jhansi Municipal Area

Project Horizon	Year	Arithmetic Progression	Geometric Growth	Incremental Increase	Average of all Methods
Base Year	2021	597157	650220	602130	616502
After 10 years from Base Year	2031	688622	836053	703539	742738
Intermediate Year	2041	780086	1074997	809921	888335
Ultimate Year	2051	871550	1382231	921275	1058352

From the trend of the projected population for various methods, an average of all methods best represents the expected future growth of the town. Hence, the same has been adopted for the population projection of the town.

Table 3: Adopted Population

Project Horizon	Projected Population	Percentage Growth
Base Year	616502	
After 10 years from Base Year	742738	20.48%
Intermediate Year	888335	19.6%
Ultimate Year	1058352	19.14%

Ward No.	Ward Area (Ha.)	2019	2021	2031	2041	2051
1	137.81	4.25	4.36	5.01	5.88	6.75
2	145.9	4.88	4.98	5.57	6.35	7.13
3	22.41	3.68	3.70	3.81	3.96	4.11
4	63.53	3.19	3.26	3.65	4.17	4.69
5	27.52	4.55	4.57	4.68	4.83	4.98
6	47.7	4.36	4.40	4.60	4.87	5.14
7	350.94	5.15	5.41	6.96	9.01	11.05
8	35.4	5.23	5.26	5.38	5.54	5.71
9	14.57	2.20	2.22	2.34	2.51	2.67
10	3338.69	12.92	14.78	25.76	40.28	54.79
11	46.62	4.93	4.96	5.13	5.36	5.60
12	32.29	2.17	2.22	2.51	2.91	3.30
13	593.24	5.43	6.02	9.54	14.19	18.84
14	7.6	3.16	3.16	3.21	3.27	3.32
15	4195.41	14.83	17.16	30.96	49.20	67.45
16	167.42	5.42	5.53	6.13	6.93	7.73
17	111.3	4.00	4.09	4.65	5.38	6.12
18	15.38	3.70	3.71	3.79	3.89	3.99
19	24.5	3.48	3.50	3.63	3.81	3.98
20	15.13	3.87	3.88	3.95	4.05	4.14
21	42	4.31	4.34	4.52	4.76	5.00
22	257.11	4.86	5.05	6.19	7.69	9.20
23	1261.42	7.86	8.84	14.69	22.43	30.17
24	138.18	3.89	4.02	4.75	5.73	6.70
25	49.88	3.70	3.74	4.00	4.33	4.67
26	813.83	6.31	7.13	11.99	18.41	24.83
27	568.32	5.31	5.90	9.37	13.96	18.55
28	13.87	2.87	2.89	2.98	3.10	3.21
29	581.5	6.94	7.25	9.10	11.55	13.99
30	15.44	3.72	3.73	3.81	3.91	4.01
31	1205.74	8.09	8.78	12.89	18.32	23.76
32	9.33	5.29	5.30	5.33	5.37	5.41
33	24.4	4.33	4.34	4.45	4.59	4.72
34	3.72	2.99	2.99	3.01	3.04	3.07
35	12.41	2.25	2.27	2.37	2.51	2.65
36	13.93	3.49	3.51	3.58	3.68	3.77
37	102.92	3.90	3.99	4.51	5.21	5.90
38	16.63	4.02	4.04	4.11	4.21	4.31
39	26.33	4.36	4.38	4.49	4.64	4.79
40	19.48	3.65	3.67	3.76	3.89	4.02
41	185.88	6.54	6.63	7.17	7.89	8.62
42	83.1	3.59	3.67	4.13	4.73	5.34
43	71.7	3.63	3.69	4.08	4.59	5.10
44	101.77	6.28	6.33	6.63	7.03	7.43
45	259.97	7.48	7.59	8.26	9.15	10.03
46	16.95	4.47	4.48	4.55	4.64	4.74
47	78.98	3.68	3.75	4.17	4.73	5.28
48	35.26	2.52	2.57	2.84	3.20	3.56
49	29.62	3.23	3.26	3.43	3.66	3.89
50	23.73	2.58	2.61	2.78	3.01	3.24
51	38.12	3.00	3.04	3.29	3.61	3.93
52	106.98	3.57	3.67	4.28	5.10	5.91
53	12.8	2.67	2.69	2.77	2.89	3.01
54	93.65	4.13	4.21	4.65	5.23	5.82
55	38.28	2.39	2.45	2.76	3.19	3.61
56	15.81	3.39	3.41	3.49	3.61	3.72
57	8	4.08	4.08	4.12	4.17	4.21
58	16.3	3.89	3.90	3.98	4.08	4.18
59	33.55	2.99	3.02	3.24	3.52	3.80
60	11.03	2.87	2.88	2.95	3.04	3.14
Total Waste Generated		270.50	281.23	344.76	428.77	512.79

As per the population projection, about 270.50 tonnes and 512.79 tons of waste will be generated in the intermediate and ultimate years respectively.

3. Proposed Management of Solid Waste

The proposed Solid Waste Management is Zero Waste Model. Waste is considered as material not waste. Segregation at the source is a prerequisite. Waste segregated into three parts-

- Dry Waste
- Wet Waste and
- Hazardous Waste

Segregated waste is collected to be transported in a segregated manner. Vehicles have different compartments to carry wet, dry, and hazardous waste. Mechanical Road Sweeping. Transfer Stations and Compactors

4. Proposed Technology

4.1 Mechanized Composting

The composting machine at the community level is an Automatic Organic Waste Converter machine which reprocesses all type of Organic waste into compost by re-using the nutrients of the waste through the natural process within the machine.

It is very easy to run the machine which processes all type of organic waste into compost at the source of generation.

Process:

1) Segregation:

The team has to ensure that there is proper segregation of organic waste and non-organic waste. To ensure more effectiveness and efficiency, we provide the client with the below graphical board to ensure that there is no mistake.

2) Putting the Waste in the Grinder

After the segregation is completed, the team puts the segregated organic waste into the machine for shredding/grinding the material into a small powder form. When the waste material is being ground/ shredded into small powder form, the moisture and the nutrients of the organic waste is being shifted to the composter tank with the help of the conveyer belt. It is to make sure that the complete process is environmentally friendly and it also enhances the by-product.

3) Rolling/Mixing in the Composter Tank

After the grinding process, the last and final process is to mix the powder material with the nutrient and moisture that was created during the grinding process and mix that with the material so that the organic compost can be formed. It's a 24-48 hours process depending on the material's moisture level. The machine is designed in such a way that when the output

is ready to come out, the machine will indicate that the product is ready to come out of the machine.

One of the exciting features that the Composter machine has is that when the composter tank process is happening and the grinder tank is empty and not working, then the electricity consumption will be only of the composter tank and not of the complete machine.

Input	Mixed Bio-Degradable Waste Wet & Dry
Output	Dry Organic Compost, with test results and parameters matching to compost standards mentioned in MSW Rules 2000, Govt. of India, amended SWM 2016
Reduction by volume	85 to 90% Depends on Material
Composting Method	High Temp. Microbes Supported Natural digestion/ Composting
Power Supply	440V, 3 PHASE,50Hz
Shredder	Twin Shaft Shredder
Mixing Arrangement	Should be Made of SS 304 High-Quality Material
Handles & Locks	Standard Handles & Locks
Indicators	Forward & Reverse Cycle, Heater with ON & OFF Sign., Overload & Auto Unloading Switch
Switches	Emergency stop & Manual Operation
Loading & Operation	Mechanical loading & Fully Automatic operations
Curing	Not required for Machine Operation
Leachate	No Leachate generation from machine
Harmful Gases	No toxic gas generation from OWC
Removals/ Unloading	Once in a week (mechanically auto unloading by machine)
Safety Feature	Emergency switch, overload indication function, and Safety Switch Safety feature: Internal mixing blades automatically stop when input door is opened

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