

## Introduction to Pune (India)

### Urbanization and Land-use Characteristics

Pune is the second largest city in Maharashtra and 8<sup>th</sup> in country. As per the Census 2001 the population of the city is 2.7 million. The reported average population density as per the 2001 census was 11500 persons per Sq. Km. However the city's urban body, Pune Municipal Corporation (PMC), estimated the population to have grown to about 3 million in the year 2006, with the population density of 13200 persons per Sq. Km. This effectively means a phenomenal increase of 11% in terms of population in 5 years.

The growth in the city is peripheral. The growth rate in the core part of the city is about 2 – 2.5% per year and the annual growth rate in peripheral wards is about 4.4%.<sup>1</sup> The driving force for growth is mainly the development of IT industry as well as the economic boom in the automobile sector which forms a major portion of the industries in and around Pune. The peripheral growth has resulted into the increased residential areas and area under transportation network and facilities. The development plan presently in use for Pune was prepared in 1987. In the year 1997 the city expanded in area with the addition of 36 villages in the peripheries of the city. With this addition the area of the city has been reported to be 243.96 sq km.<sup>2</sup> **Table 1** shows the land-use distribution as per 1987 DP and as on 2006<sup>3</sup>.

**Table 1: Land-use Distribution in Pune 1987 and 2006<sup>4</sup>**

Land-use	Area sq km			Distribution in %		
	1987 DP	New Areas	Total	Old	New Areas	Total
Residential	50.58	53.16	103.74	36.55	50.35	42.52
Commercial	2.35	1.57	3.39	1	1.49	1.61
Industrial	7.26	2.62	9.88	5.25	2.48	4.05
Public and semi public	15.22	1.45	16.67	11	1.37	6.83
Public Utilities	1.38	0	1.38	1	0	0.57
Transport	22	9.81	31.81	15.9	9.29	13.04

1 Report on Water Supply System Design and Report on Centrally sponsored scheme for solid waste management and drainage for IAF Airfield Town of Pune by HUDCO

2 Initially in 1997, 36 villages were merged into PMC limits, but later in year 2001 few villages were removed again

3 Environmental Status Report for Pune, 2006

4 City Development Plan, PMC, 1987 and Jawaharlal Nehru National Urban Renewal Mission (JNNURM), Pune City Development Plan, PMC, 2006.

Land-use	Area sq km			Distribution in %		
	1987 DP	New Areas	Total	Old	New Areas	Total
Reserved, Forest and Agriculture	2.35	26.7	29.05	1.7	25.29	11.91
Water Bodies	12.04	2.48	14.25	8.7	2.35	5.95
Hill and Hill Slopes	12.45	0	12.45	9	0	5.11
Recreational	12.73	7.79	20.52	9.2	7.38	8.41
Total	138.38	105.58	243.96	100	100	100

The analysis of the land-use indicates that the major portion of the additional areas has been utilized for the residential purposes. It can be seen from **Table 1** that there has been an increase of about 50% in the residential area. The increase in the overall standard of living and employment opportunities in the city can be seen in terms of the increase of 7.35 % in the recreational areas and 1.5% in commercial areas. This rise has led to an increased pressure on the basic amenities.

## Demographic Profile

The waste generation as well as its characteristic is a function of the population. The population is often taken as a reliable surrogate for developing generation factors. The review of the available data on the demographics presents a rapid change in the growth rate in the past decades. **Table 2** presents the population trend of Pune over the past 5 decades. **Figure 1** presents the decadal growth rate over the same period of time.

**Table 2: Population Trend in Pune City<sup>5</sup>**

Census	Population	Decadal Change	Growth Rate (%)
Year	Total		
1951	488419		
1961	606777	118358	24.23
1971	856105	249328	41.09
1981	1203363	347258	40.56
1991	1691430	488067	40.56
2001	2538473	847043	50.08

<sup>5</sup> Environmental Status Report of Pune, 2006

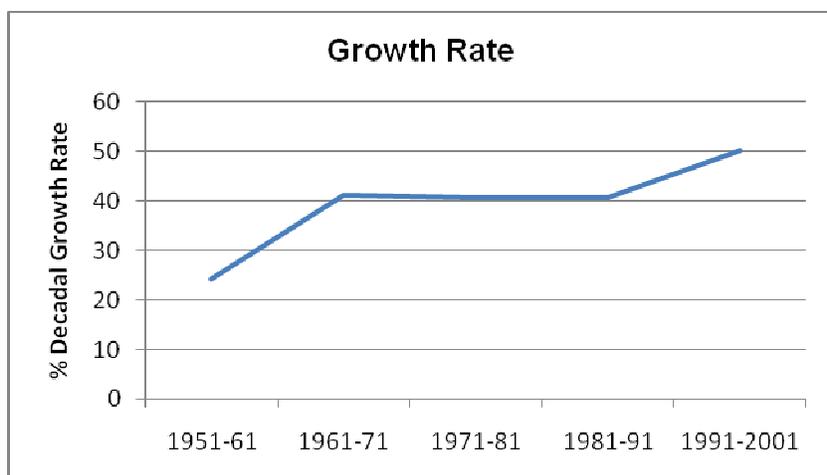


Figure 1: Trend of Decadal Growth Rate<sup>6</sup>

The ward-wise population for the year 2001 is presented in **Table 3**. The population density in various wards along with the socio-economic profile drawn on the basis of establishments (bungalows, societies and hutments) is presented in **Figure 2**.

Table 3: Ward-wise Population for the year 2001<sup>7</sup>

Ward	Population 2001
Aundh	179886
Bhavani Peth	218306
Bibwevadi	239532
Dhole Patil Road	100059
Ghole Road	201527
Hadapsar	205009
Karve Road	204316
Kasaba Peth	239370
Sahakar nagar	161665
Sangamwadi	213718
Tilak Road	211103
Vishrambagwada	251100
Warje Karvenagar	116985
Yervada	154425

<sup>6</sup> PMC, Environmental Status Report, 2006 and Report on Centrally Sponsored Scheme for Solid Waste Management and Drainage for IAF Airfield Town of Pune

<sup>7</sup> Data obtained from PMC

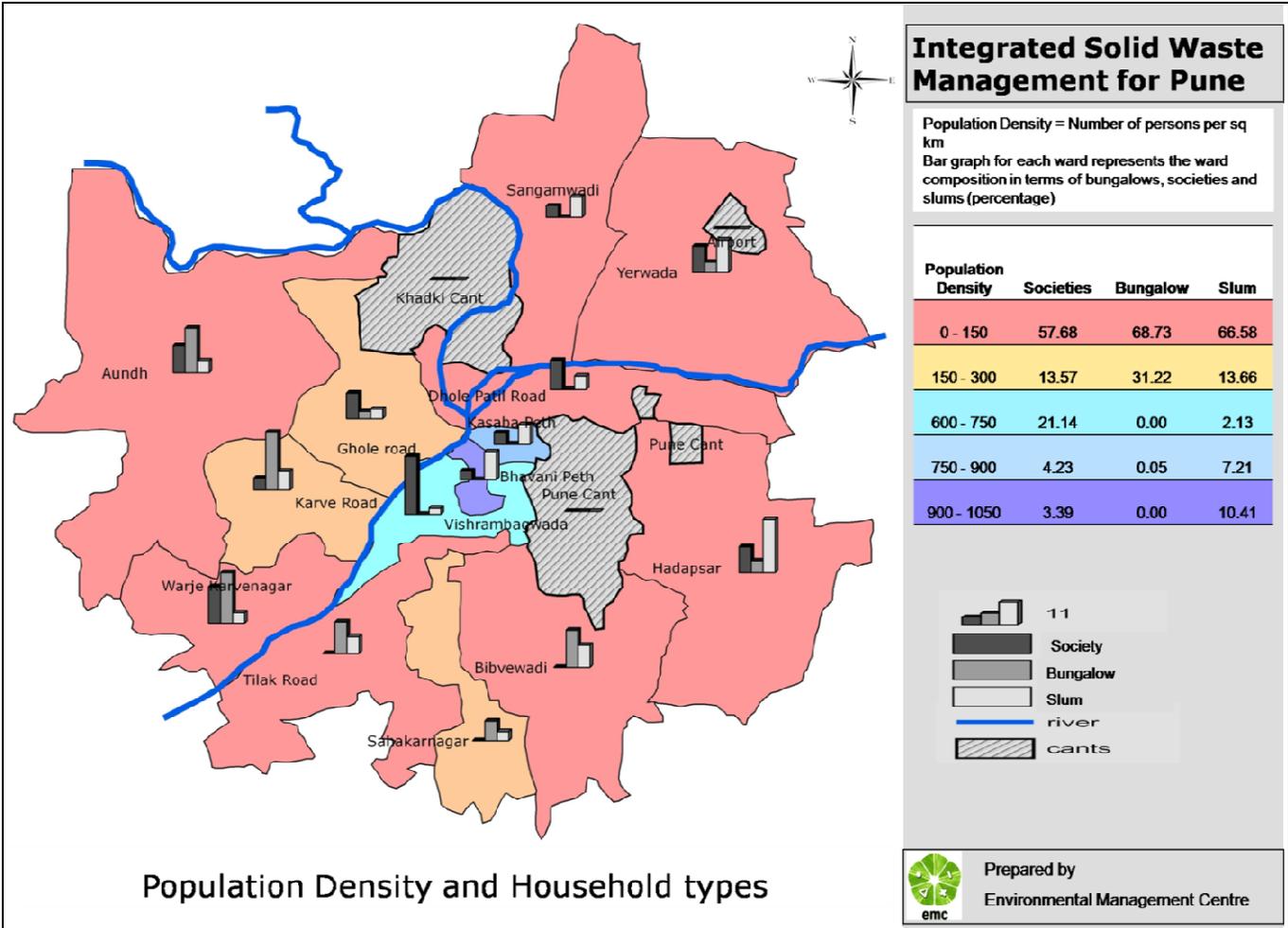


Figure 2: Population Density and Socio-Economic Profile

# 1

## Baseline Data (2006)

The municipal solid waste data collection and analysis for Pune was undertaken by local staff of the Project Team, who were trained for this purpose through a series of workshops and field training based on the ISWM Guidelines “*Developing Integrated Solid Waste Management Plan – Training Manual - Volume 1: Waste Characterization and Quantification with Future Projections*”

The team carried out source identification, quantification and characterization of all the different types of waste from different sectors such as industrial, municipal and commercial sectors. Additionally, projections for future waste generation were also included.

## 2

## Waste Generation: Quantification and Characterization

With the city expanding, Pune has a rapidly changing waste quantity. Along with the quantities, the diversity in characteristics of the solid waste is a major concern. The changing waste quantity and quality exerts pressure on the existing waste management systems.

The following section explains the pressures on the solid waste management scenario of Pune in the context of the various forms of the solid waste generated.

### 2.1 Municipal Solid Waste Generation

PMC holds about 225 sq km area under its governance. The total population in PMC limits is 30 lakh generating the total solid waste 1093 MT per day<sup>8</sup>. The average per capita waste generated in Pune city is 364 gm per day<sup>9</sup>. The per capita generation varies between 229 to 504 gm/day amongst different wards.

**Figure 3** explains the per capita waste generated in various Indian cities. The range is very wide from 0.19 kg generated at Nashik to 0.67 kg at Kochi. The average per capita waste generation calculated from the present data amounts to 0.41 kg. The waste generation for Pune city is reported to be 0.46 kg/capita/day<sup>10</sup>. Thus there is a disparity in the various available published data.

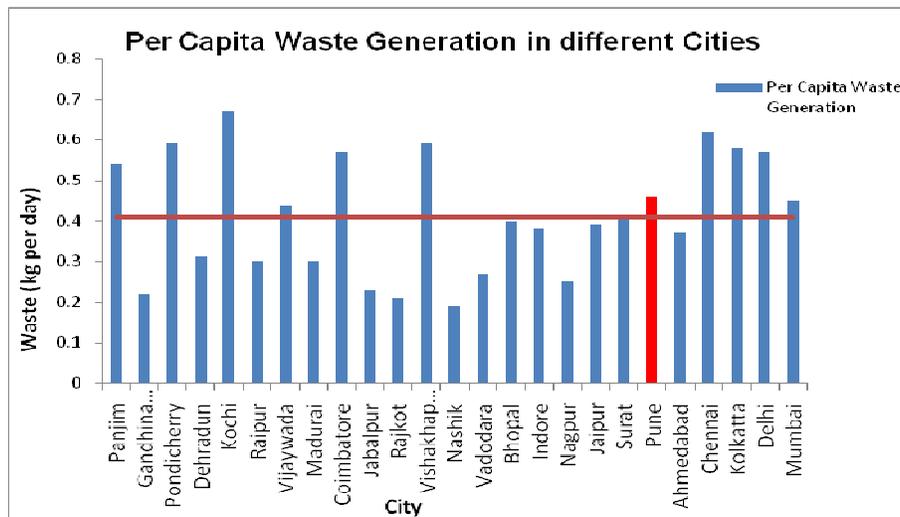


Figure 3: Per Capita Waste Generation across Different Cities in India<sup>11</sup>.

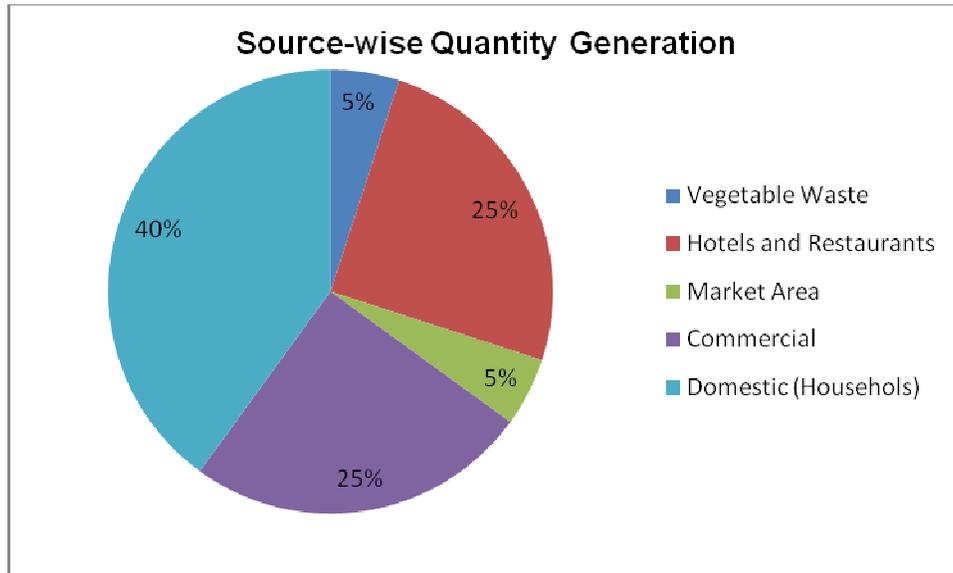
8 Report on Centrally Sponsored Scheme for Solid Waste Management and Drainage for IAF Airfield Town of Pune

9 IBID and [http://www.cpcb.nic.in/pepdiv\\_plan4.htm](http://www.cpcb.nic.in/pepdiv_plan4.htm)

10 Assessment of Status of Municipal Solid Waste Management in Metro Cities and State Capitals. MPCB and NEERI, as referred from [http://www.cpcb.nic.in/pepdiv\\_plan4.htm](http://www.cpcb.nic.in/pepdiv_plan4.htm) on February, 2007

11 IBID

Analyzing the available city wide information, the contribution of MSW from the various sources can be presented as in **Figure 4**.



**Figure 4: Source wise Quantity of Waste Generation in Pune<sup>12</sup>**

**Figure 4** demonstrates that the commercial sector combining the hotels and the commercial areas amounts to 50% of the total waste. Looking at the extent of contribution from this sector, options such as decentralized treatment should be looked at.

The reported quantum of data from the various wards is shown in **Figure 5**. This **Figure** classifies the wards in terms of their waste generation potential with respect to the entire city and thus highlights the major contributors to the waste generation. It can be seen that the major contributing wards for Pune city are Tilak Road, Vishrambaugwada and Bibvewadi.

<sup>12</sup> Report on Centrally sponsored scheme for solid waste management and drainage for IAF Airfield Town of Pune by HUDCO

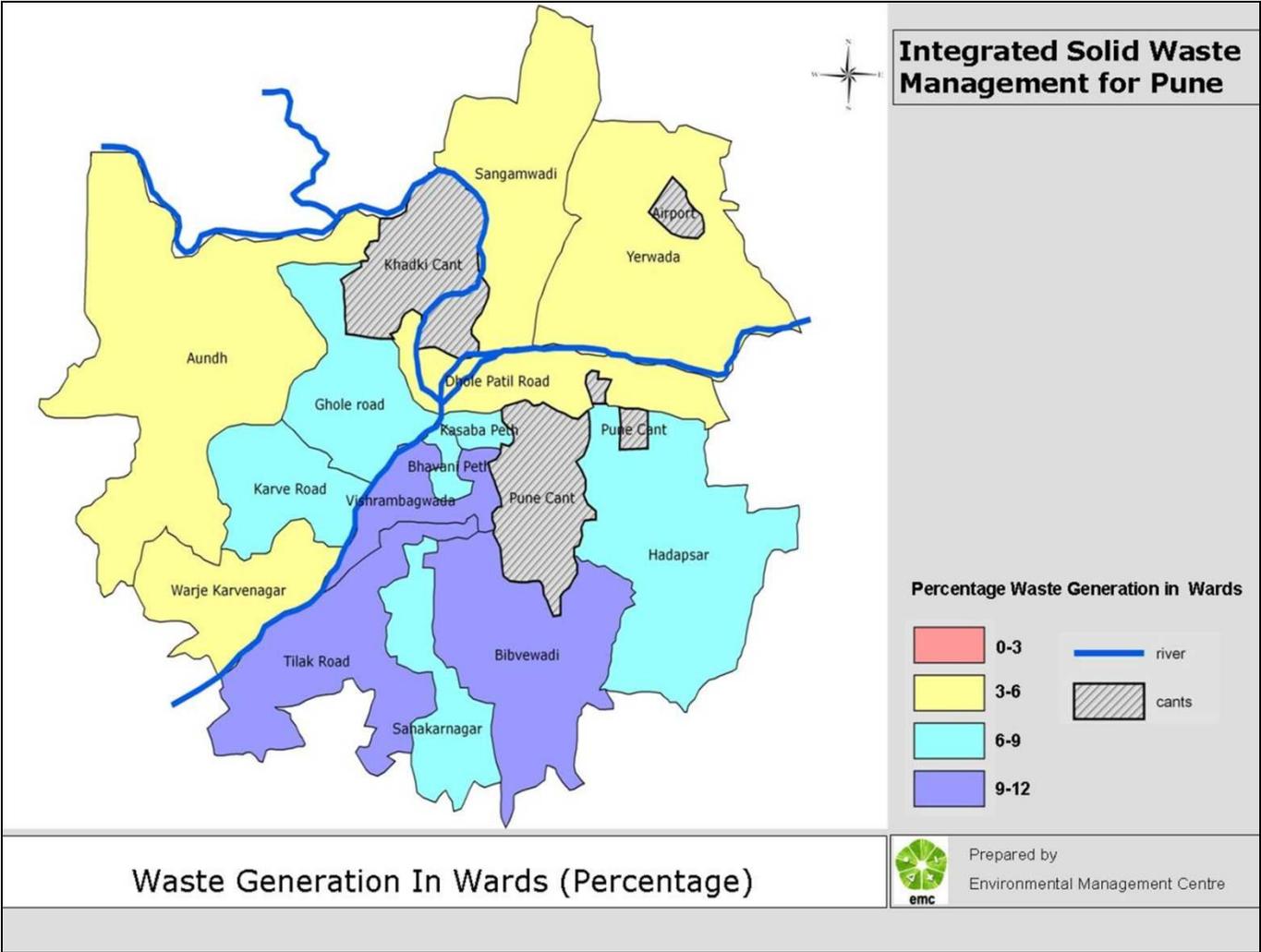


Figure 5: Percentage Waste Generation in Different Wards

## 2.2 Waste Characteristics

Typically the Municipal Waste is characterized as Dry Waste and Wet Waste. It is observed that the tropical countries show higher percentage of wet waste than dry. The **Figure 6** explains the dry and wet waste characteristics in different cities including Pune.

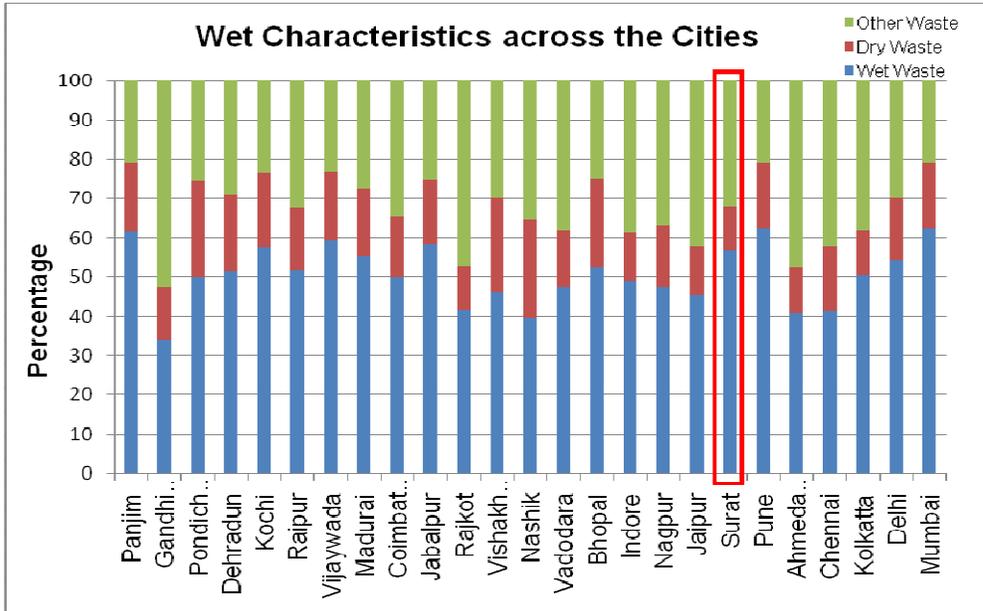


Figure 6: Waste Characteristics (Dry and Wet) Across the Cities in India<sup>13</sup>

The **Figure 7** showcases the present scenario about waste characteristics

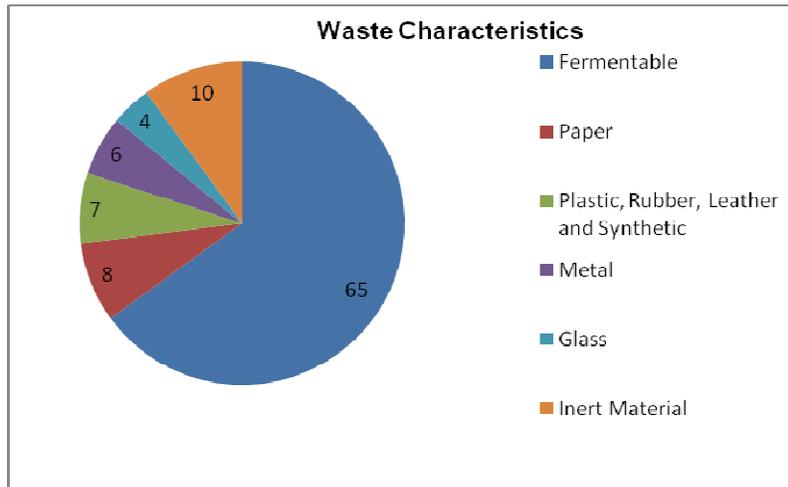


Figure 7: Waste Characteristics for Pune<sup>14</sup>

<sup>13</sup> Assessment of Status of Municipal Solid Waste Management in Metro Cities and State Capitals. MPCB and NEERI, as referred from [http://www.cpcb.nic.in/pcpddiv\\_plan4.htm](http://www.cpcb.nic.in/pcpddiv_plan4.htm) on February, 2007

<sup>14</sup> City Development Plan 2006 & Report on Centrally sponsored scheme for solid waste management and drainage for IAF Airfield Town of Pune by HUDCO

This split up classifies the total waste in terms of Bio-degradable, Recyclable and inert compositions. This information will be used for identifying the potential usage of various waste components for decentralized treatments or recycle and reuse. Although plastics contribute to only 7% of the total waste in Pune, the problem of disposal of plastics is grave due to their non-biodegradability and high visibility in the waste streams. The grim situation of plastics management can be understood through **Box 1**.

**Box 1: The Dilemma of Plastic Waste<sup>15</sup>**

Plastics have become a major threat owing to their indiscriminate usage, non-biodegradability and lack of efficient end of life management. Plastic waste is prevalent in a variety of range. Film packaging and polymer plastic bags are some of the most significant type of plastic wastes finding its way to the disposal sites. Although recycling of plastics offers itself as a promising solution for the management of plastic wastes, the plastic recycling scenario in India is pretty unique. The plastic recycle units are dispersed between the formal and the informal sector. Polybag recycling is predominantly carried out by the informal sector which is plagued by outdated technologies, unskilled labour, and poor health and safety conditions for the workers.

The lack of a defined policy and legislation with respect to mitigating the plastic wastes in the country further aggravates the problem. The only existing comprehensive rule on plastic waste in India is the *Recycled Plastic Manufacture and Usage Rule, 2003*. This rule attempts to address the problem of littering through reuse and recycle of polybags. However, no effort has been made in order to reduce the production of plastics. Hence the failure to incorporate long-term solution to the problem of littering has been the key limitation to existing policies. Another key concern is the absence of any quality guideline for recycled plastics. Attention is not paid to the quality of the product made through recycling. Since plastics are not sorted according to the contamination they have acquired in the first life span, the probability of contaminants adhering to the recycled products and further damaging the stored substances cannot be overlooked at.

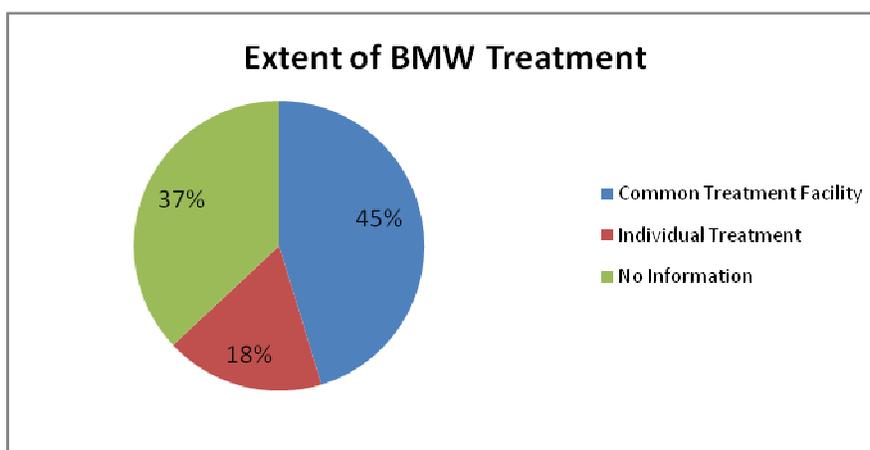
After the Mumbai floods of 2005, and the probable role of plastics in the same, PMC has proposed a ban on the plastic bags. Under the Maharashtra State non-biodegradable garbage control ordinance norm of minimum 50µ of thickness for polythene bags has been set in the city. As an alternative to the plastic bags National Chemical Laboratory (NCL), Pune has successfully started the production of biodegradable polythene bags which can be used commercially. Other usage of plastics includes the generation of petrol and diesel. However the technological feasibility and financial viability of such refuse derived fuel largely depends on the extent of segregation and is yet to be studied in the context of Pune City.

<sup>15</sup> Analyzing Plastic Waste Management in India Case Study of Polybags and PET Bottles, Priya Narayan, IIIIEE Reports, 2001

## 2.3 Generation and Characteristics of Bio-Medical Waste

A detailed inventORIZATION of Bio-Medical Waste (BMW) has not been done for the city of Pune. However based on the analysis of the reports available with PMC, Pune has over 565 Health Care Facilities (HCFs) roughly amounting to 6829 beds. Owing to the absence of any data on the total quantum of waste generation, a preliminary estimate using the accepted estimation method<sup>16</sup> of accounting 0.375 Kg of BMW per bed has been used. Thus the generation from these hospitals would be around 2560 kg/day.

A common treatment facility for treating BMW has been provided by the PMC. As per the details provided by the service provider, approximately only 1200 kg/day of Bio-Medical waste is currently being treated. Other than the common treatment facility, BMW generated by two prime hospitals amounting to 1250 beds (470kg/day) are treated at their own treatment plants. The extent of treatment of BMW in Pune can be shown in **Figure 8**. No information on the current treatment facility for 37% of BMW is available. This figure thus reinstates the need for inventORIZATION and proper enforcement of BMW rules.



**Figure 8: Extent of BMW Treatment in Pune**

Although the percentage of type of waste is not available for Pune city, using the World Health Organization's study<sup>17</sup> on developing countries, the estimates for average distribution of health-care wastes with respect to Pune out of the total BMW generation of 2650 kg/day are shown in **Figure 9**.

<sup>16</sup> "Manual on Municipal Solid Waste Management" Central Public Health & Environmental Engineering Organization

<sup>17</sup> Report on "Safe management of wastes from health-care activities" by WHO published in 1999

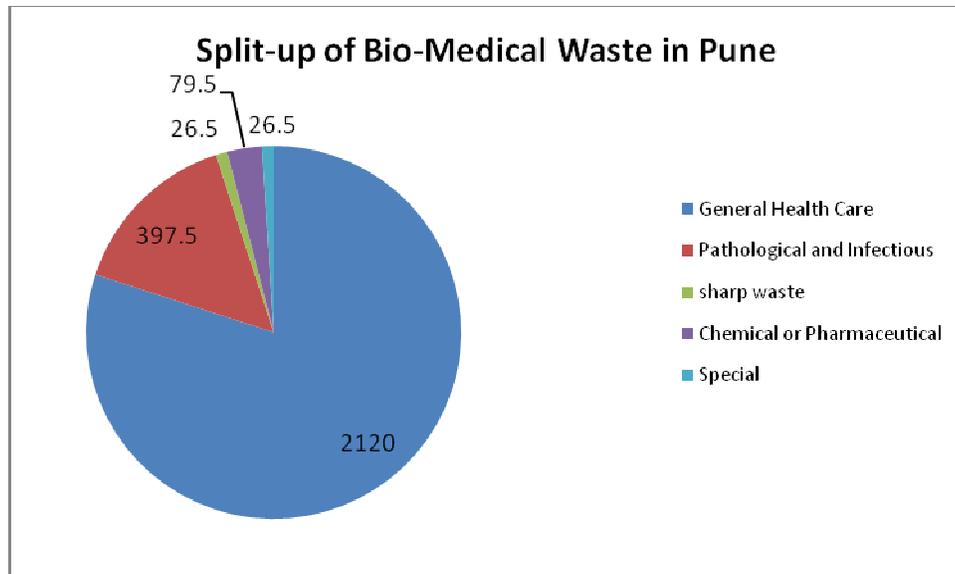


Figure 9: Split of Bio-Medical Waste in Pune

## 2.4 Construction and Demolition Waste (C&D Waste)

With the rapid expansion and infrastructural development of the city, new construction and modification of existing infrastructure is going to be a sure event. No extensive study has been done in order to quantify and characterize the C&D waste in the city. However with the increasing population, job opportunities and other infrastructural developments, the C&D waste is bound to increase in near future.

As per a recent report<sup>18</sup> the present generation of C&D waste including inert has been reported to be 40.6 % of the total garbage generated. A look at the past data for C&D waste quantities over the years shows an increasing trend in the past years. Also the look at future projections as predicted by the study indicates a steady increase in the generation over the years. This trend of C&D generation is presented in **Figure 10**.

The report has assumed the C&D waste quantum as a direct function of the increasing population. Although the population is a significant driver for this waste generation, the trend may not be linear but exponential looking at other factors such as infrastructural developments, city planning aspects.

<sup>18</sup> Report on the Centrally Sponsored Scheme for Solid Waste Management and Drainage for IAF Airfield Town of Pune by HUDCO

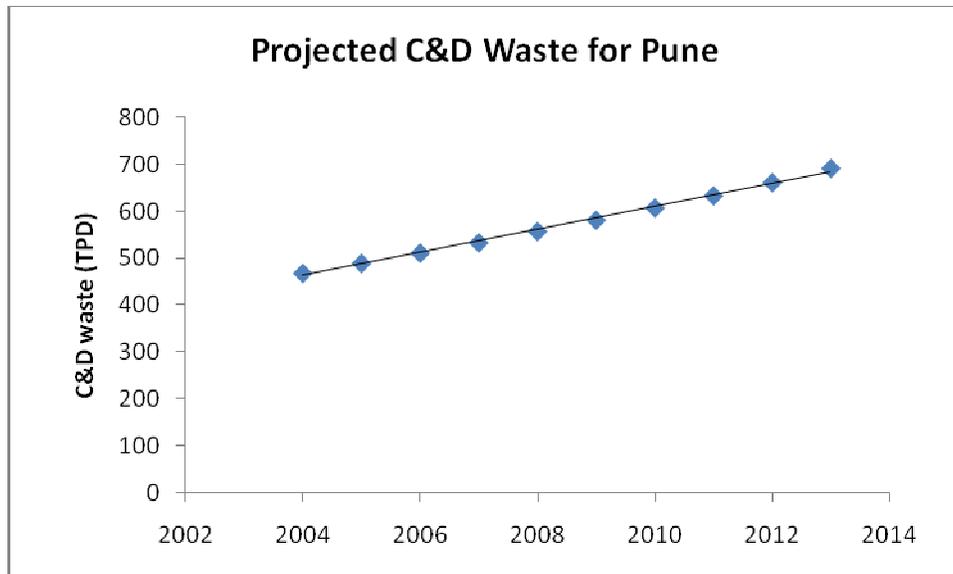


Figure 10: Trend of generation of C&D Waste<sup>19</sup>

## 2.5 Industrial Solid Waste

Industrial Hazardous Waste for the city of Pune is being managed by the MPCB regional office. A detailed inventory of Hazardous Waste (HW) generating bodies has been prepared for the Pune region. To understand the spread of hazardous waste generation in the city, the ward wise distribution of industries generating solid hazardous waste has been reviewed and presented in **Figure 11**.

It can be observed from the figure that, Hadapsar ward has maximum number of industries generating hazardous waste followed by Yerwada ward and Bibvewadi ward; where as solid hazardous waste is not generated from Sangamwadi and Vishrambaugwada wards.

The total quantum of hazardous waste generated amounts 2780<sup>20</sup> tons per annum. Besides the quantified hazardous waste, about 1,980 batteries and containers are also reported to be generated.

<sup>19</sup> City Development Plan 2006 & Report on Centrally sponsored scheme for solid waste management and drainage for IAF Airfield Town of Pune by HUDCO

<sup>20</sup> Data adapted from MPCB inventoriatioin of industries in Pune Region

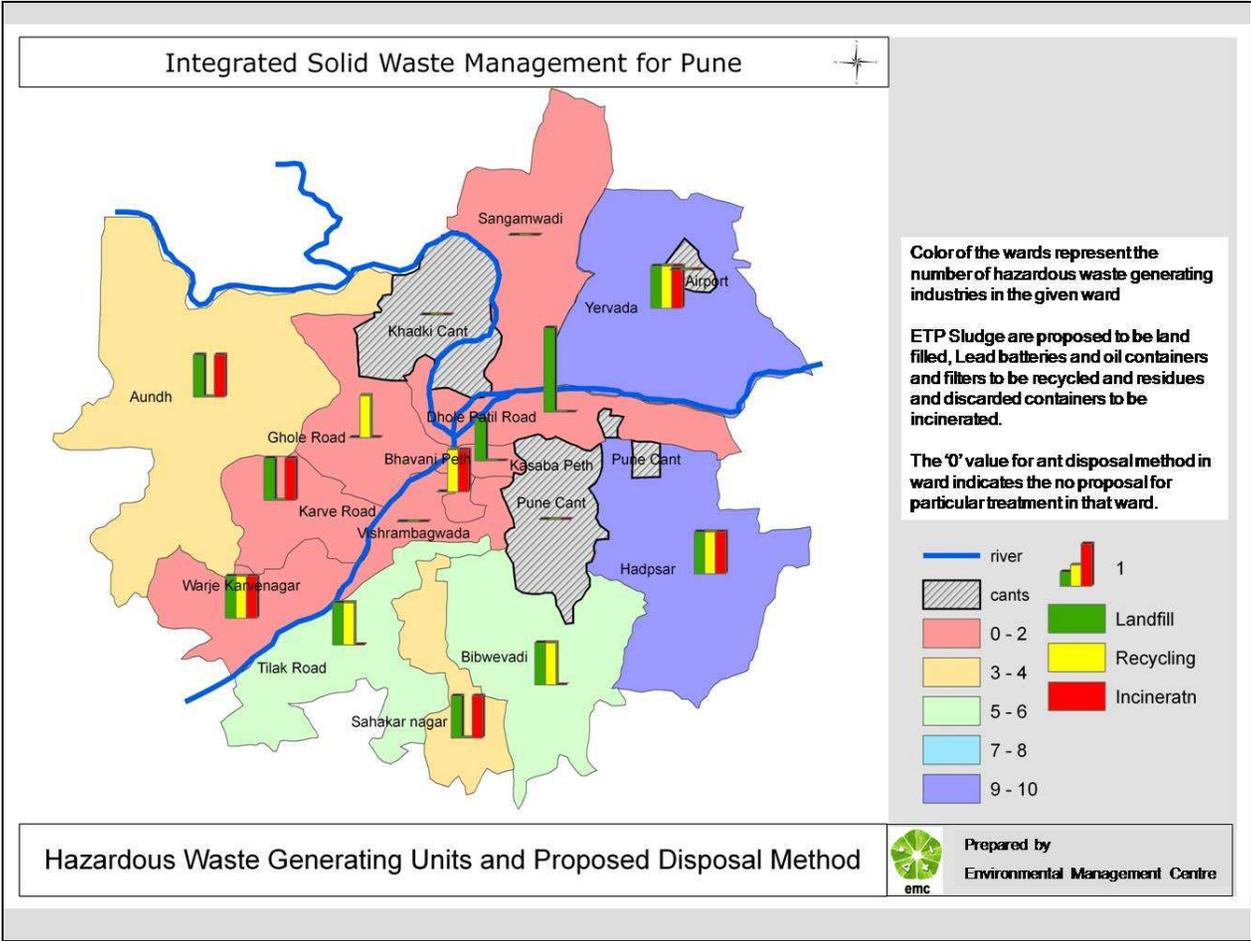


Figure 11: Ward wise Number of Solid Hazardous Waste Generating Units.<sup>21</sup>

21 Data adapted from MPCB inventorization of industries in Pune Region

The detailed analysis of the type of HW generated as per the MPCB inventory in various wards is provided in **Annexure 2**.

## 2.6 Electronic Waste (E-Waste)

Pune city has emerged as Information Technology (IT) destination in the country. As a result many IT companies have established their offices and they are expanding. Also the large number of educational and commercial institutions also use IT and communication equipments. Like elsewhere, with rapid development happening in these areas, it can be expected a similar scenario for Pune. However in the absence of any reported studies on quantification and characterisation of e-waste, no figures are available for reporting.

The MPCB has conducted inventory studies to quantify E-waste, under the project “Rapid Assessment of E-waste in the Mumbai-Pune Region”<sup>22</sup> sponsored by UNEP. This would be first reported data on e-waste for Pune. As per this report the total annual E-Waste generation of the city amounts to 2584 tonnes<sup>23</sup>.

The concern for E-waste is increasing due to the hazardous contents such as Lead, Cadmium, Mercury, Hexavalent Chrome, Plastic including PVC, Brominated Flame Retardants, Barium, Beryllium, Toners, Phosphor and Additives etc.<sup>24</sup>

E-waste mainly comprises of old, end-of-life electronic appliances such as computers, laptops, TVs, DVD players, mobile phones, mp3 players etc.

Three categories of E-waste account for almost 90% of the generation in various Indian cities including Pune<sup>25</sup>:

- Large Household appliances: 42.1%
- Information and Communications Technology equipment: 33.9%
- Consumer Electronics: 13.7%

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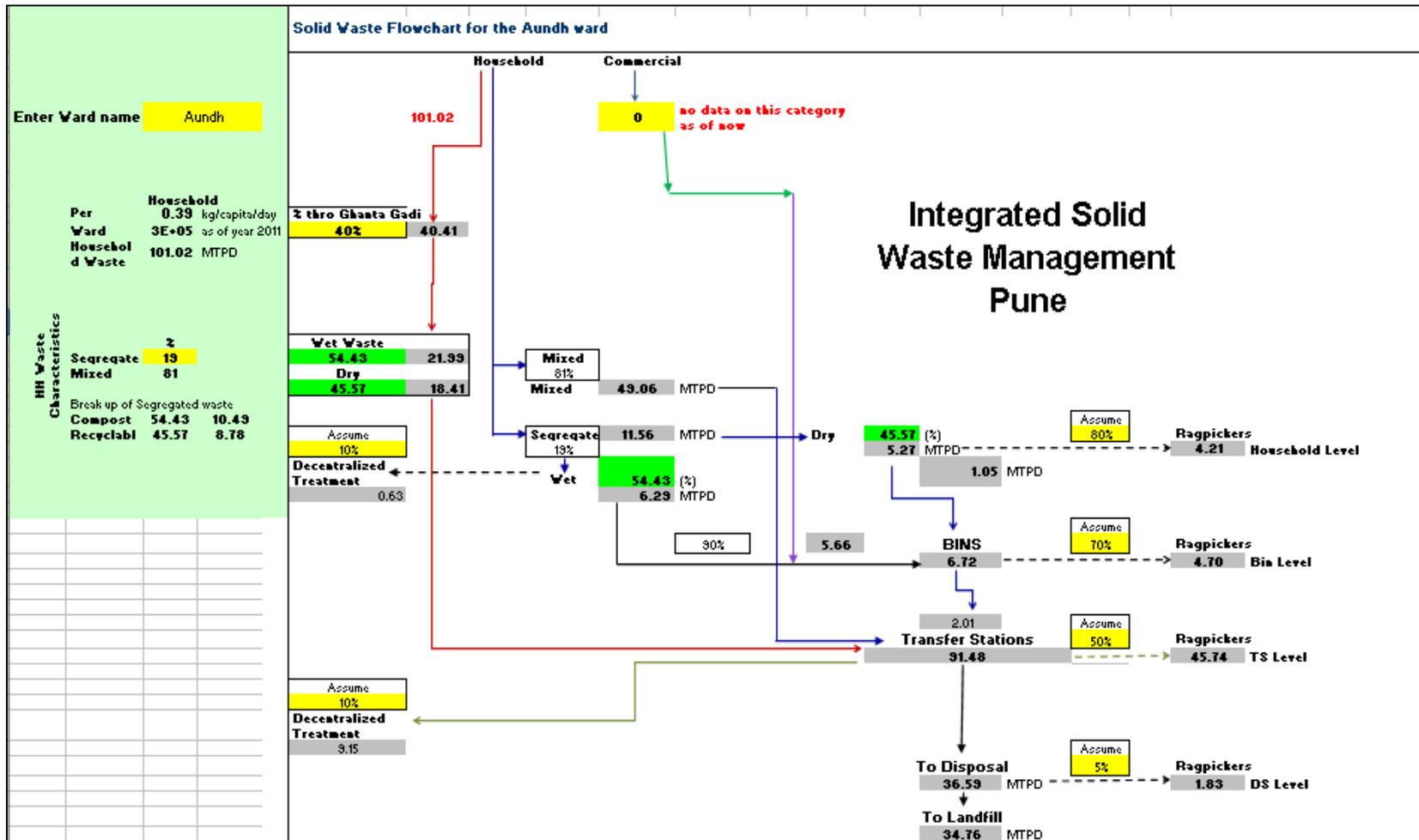
22 [http://www.unep.fr/pc/pc/waste/e\\_waste\\_in\\_India.htm](http://www.unep.fr/pc/pc/waste/e_waste_in_India.htm)

23 Report on Assessment of Electronic Wastes in Mumbai-Pune Area, MPCB (2007), <http://mpcb.mah.nic.in>

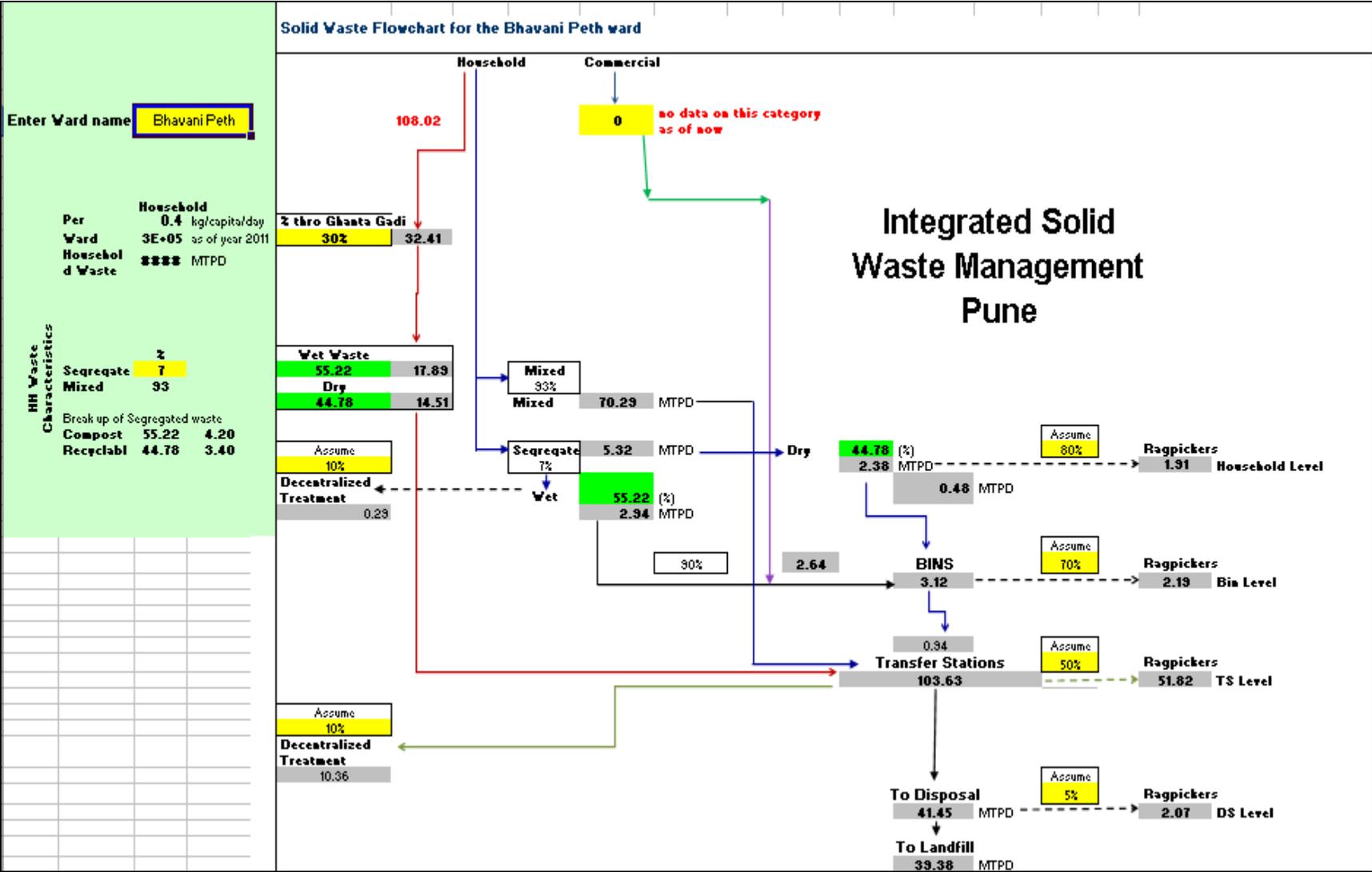
24 Exporting Harm report prepared by Basel Action Network with Toxic Link.

25 [http://www.e-waste.in/weee\\_basics/weee\\_statistics/](http://www.e-waste.in/weee_basics/weee_statistics/)

## Annexure 2: Excel Based Material Balance for Pune City

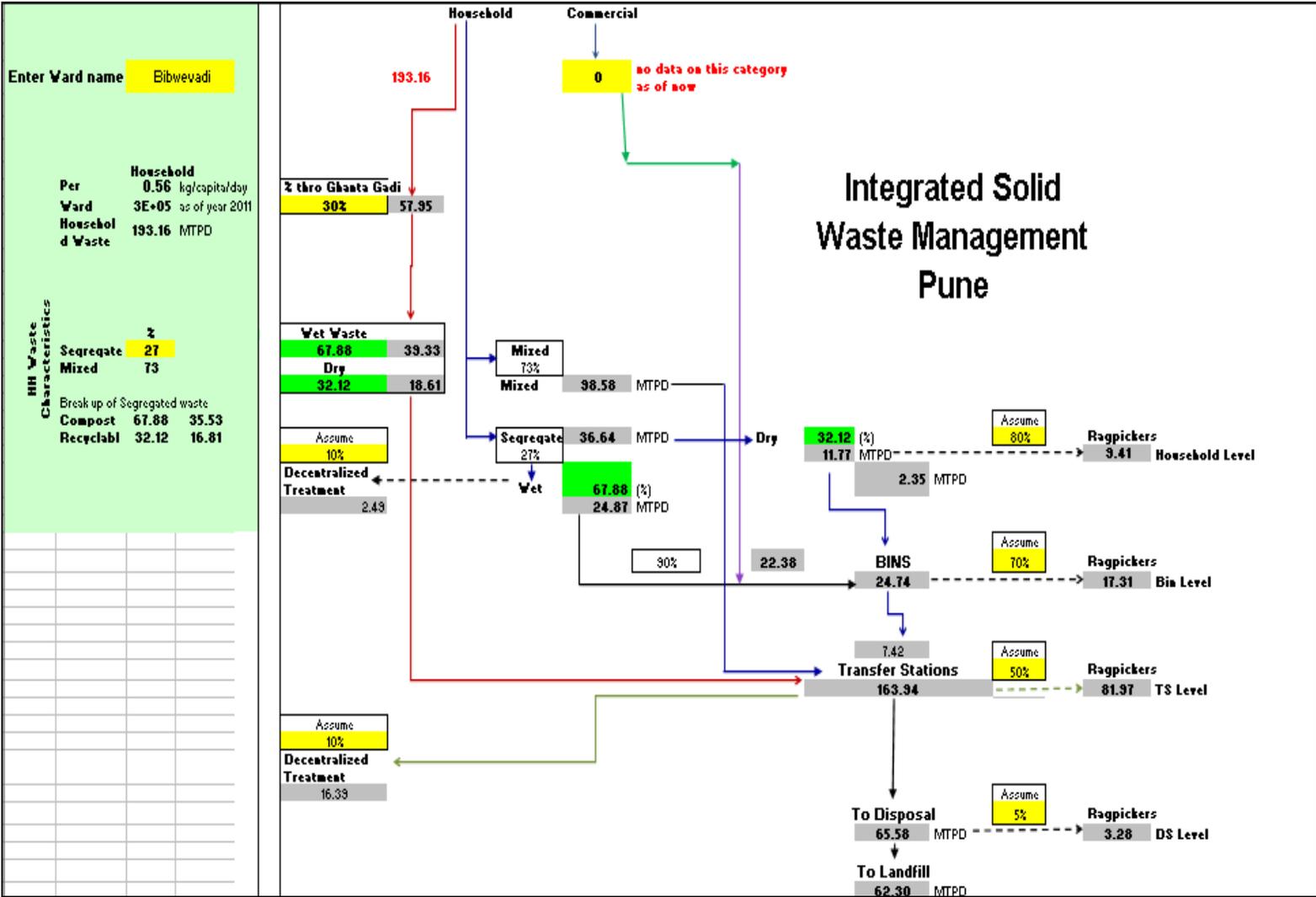


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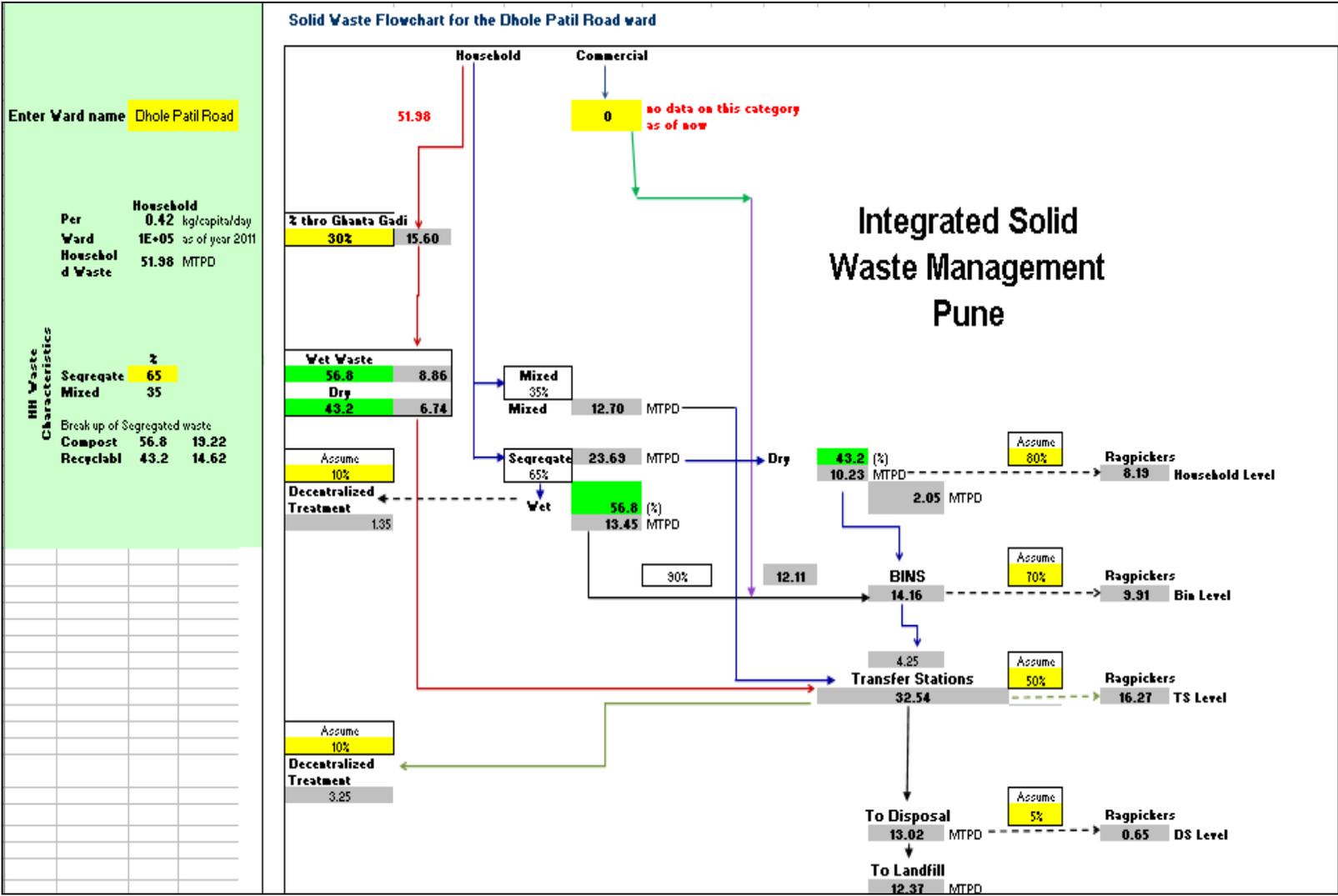


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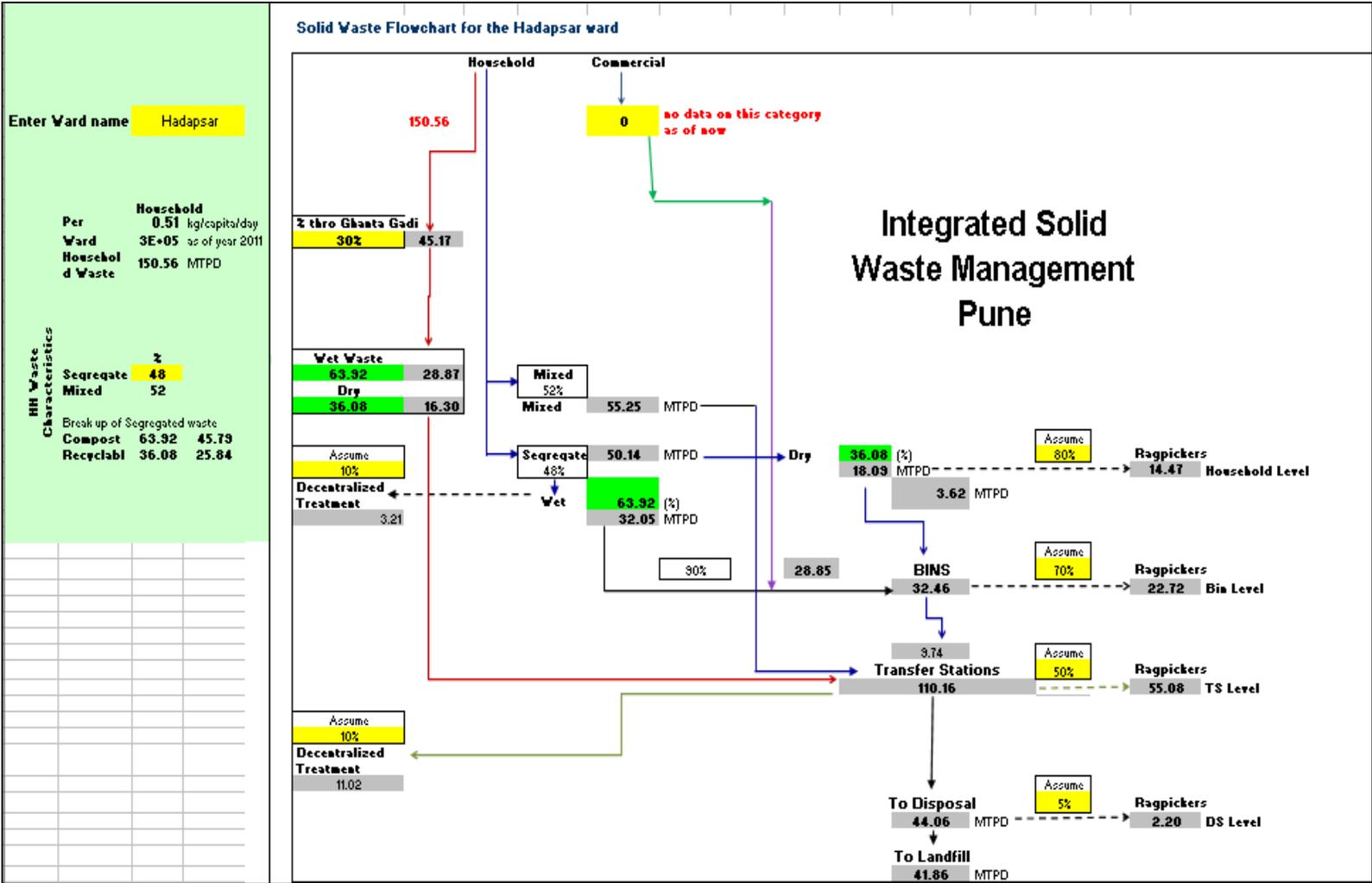
Extract from the report "Strategic Action Plan for Integrated Solid Waste Management Plan, Pune (Volume I)"



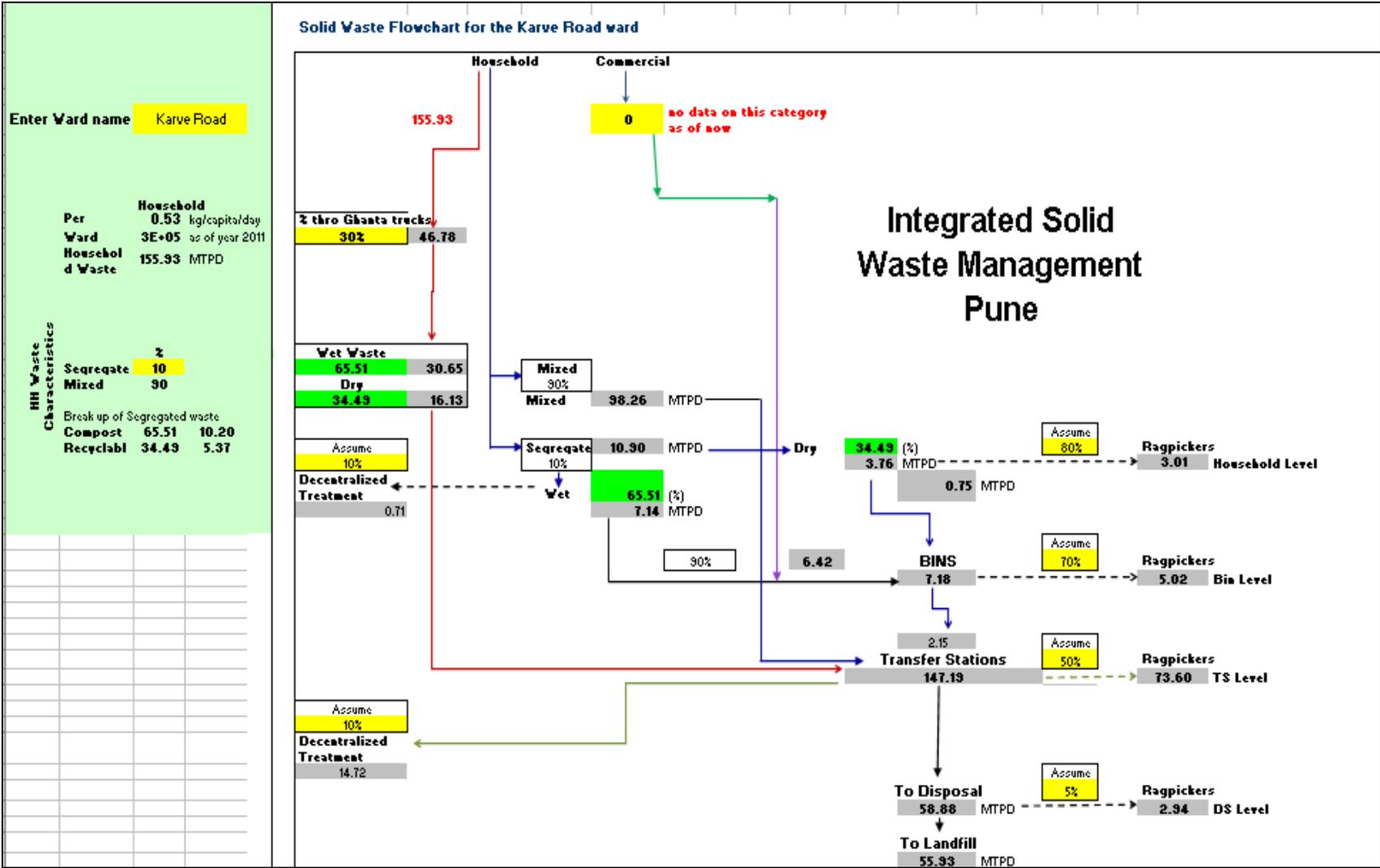
For Bibwewadi



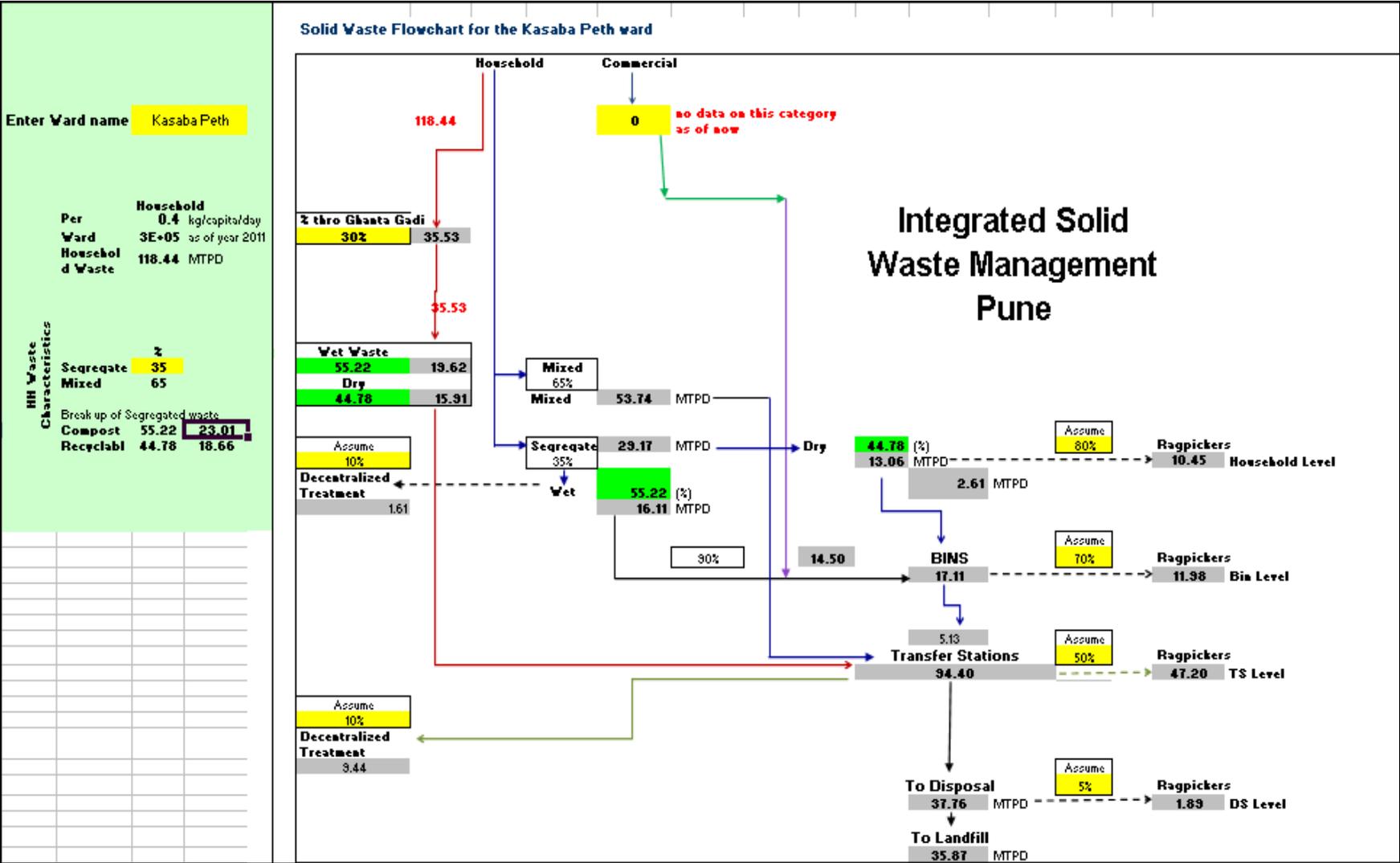
For Dhole Patil Road



For Hadapsar Ward

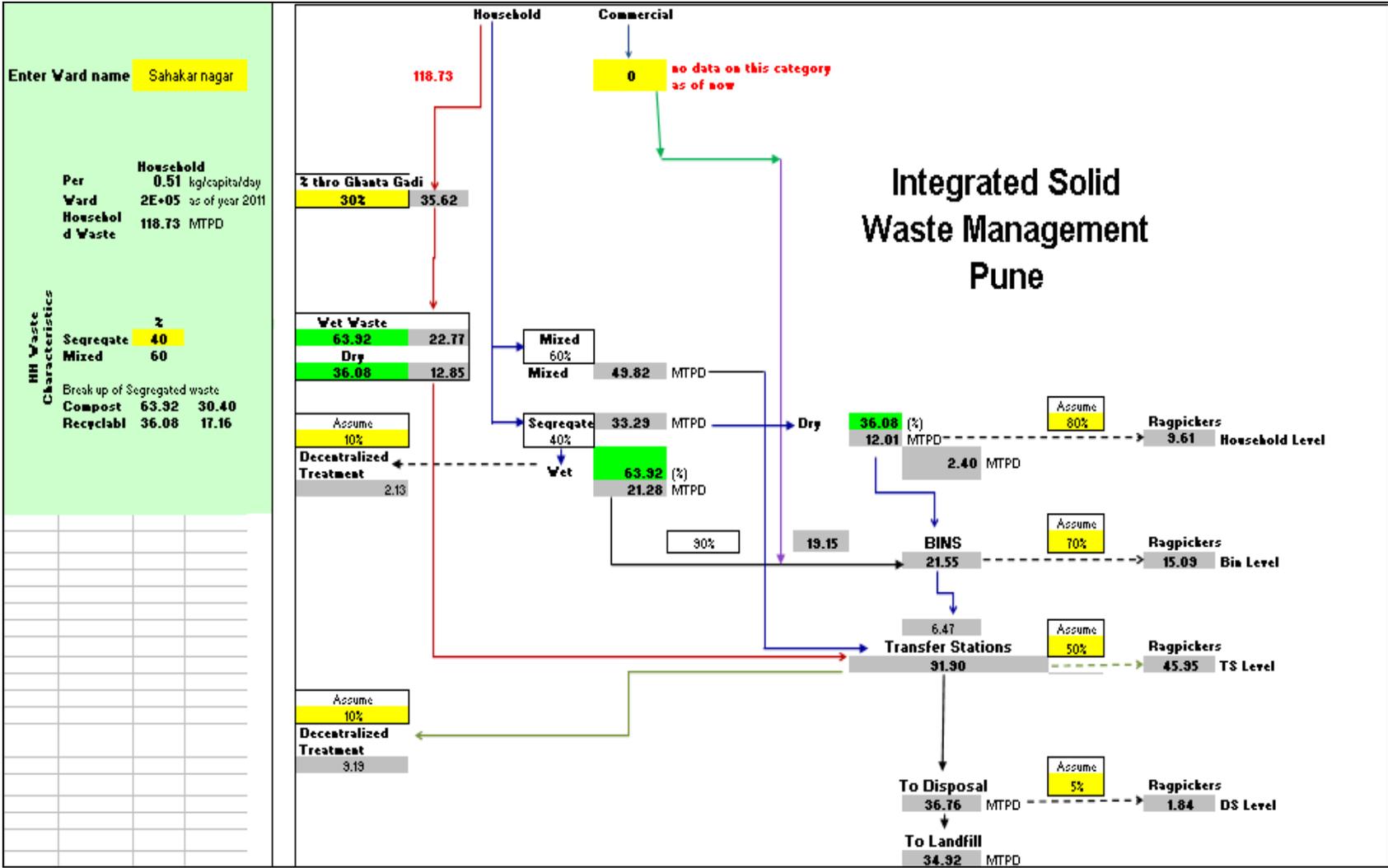


For Karve Road Ward

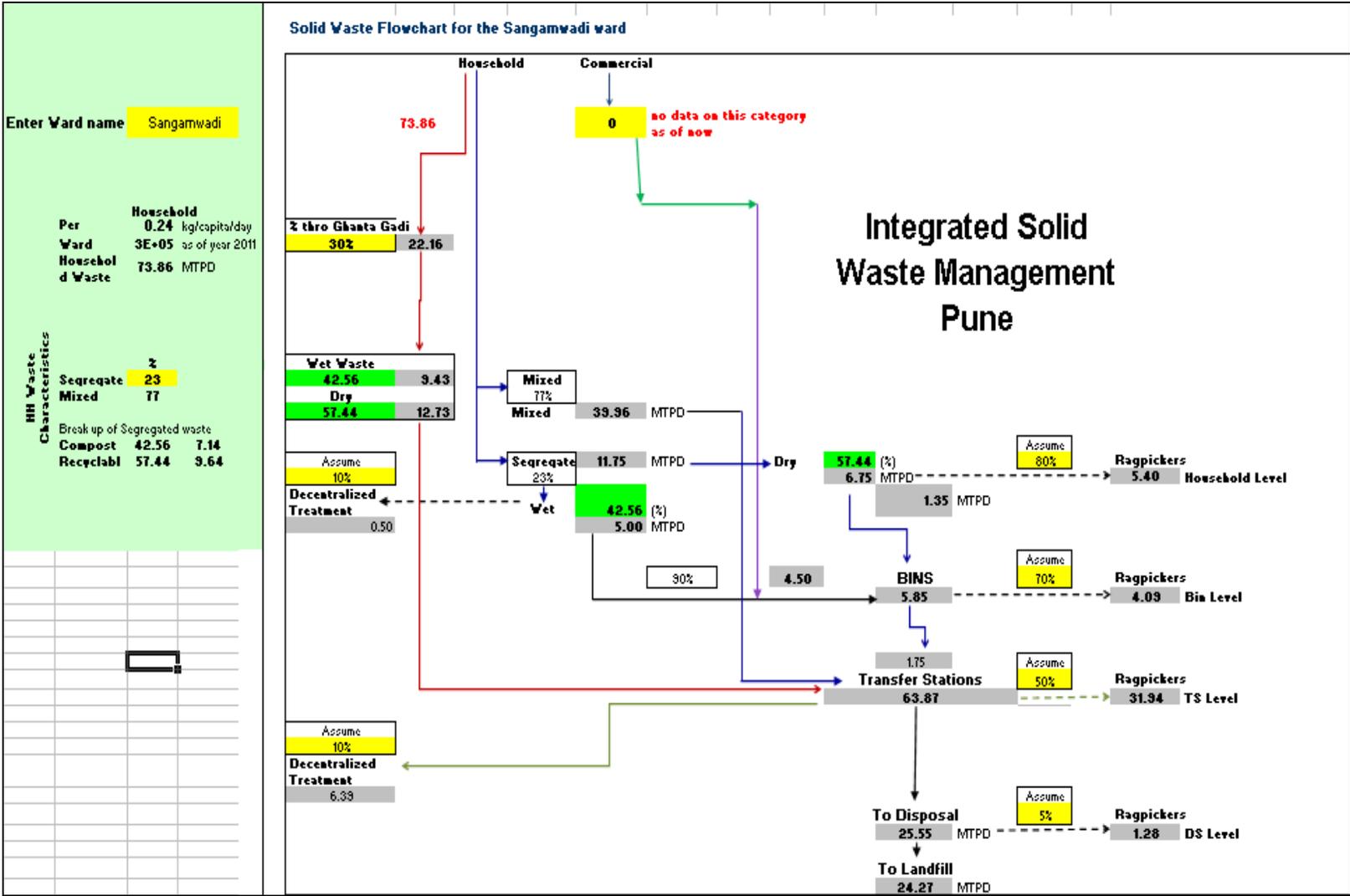


For Kasaba Peth Ward

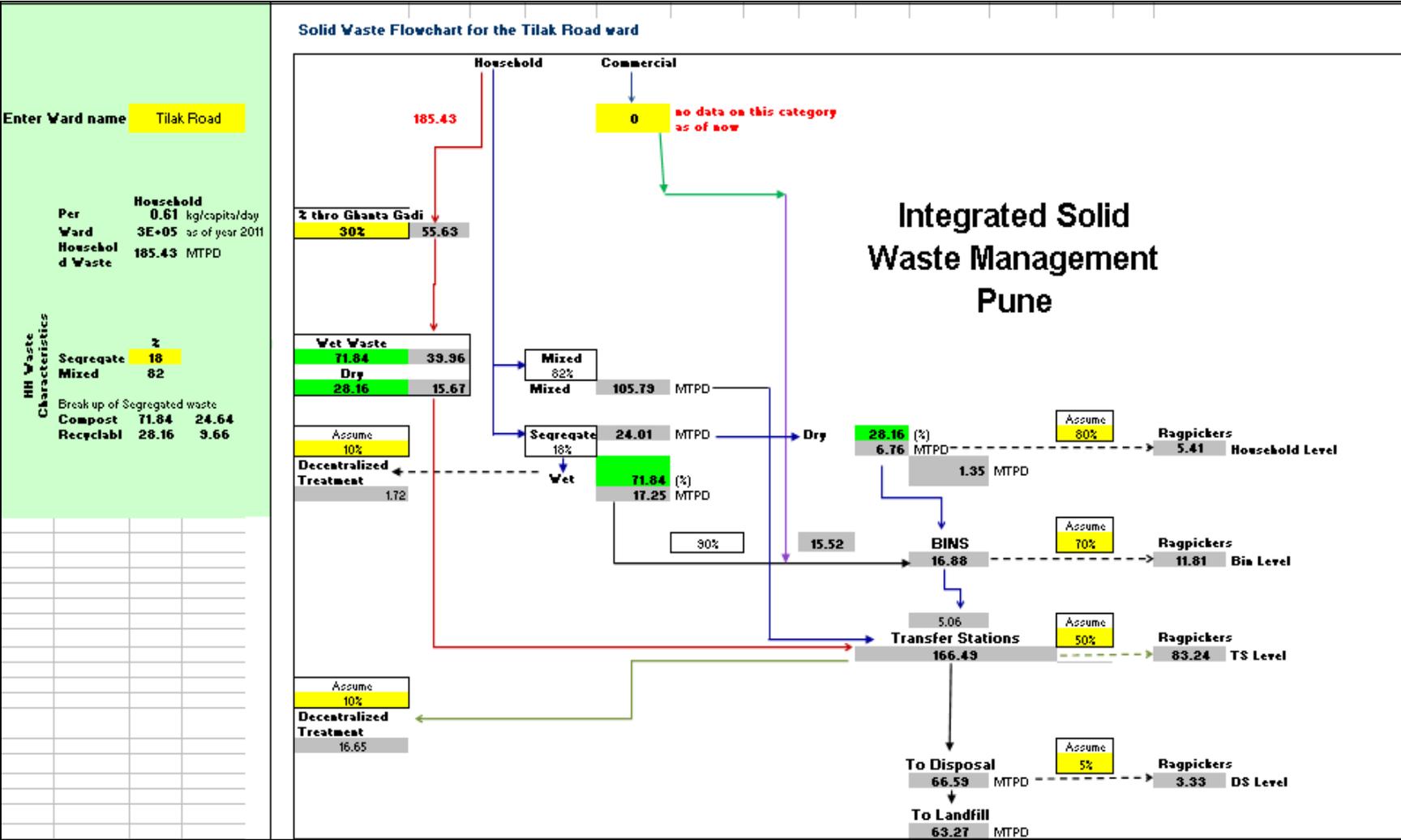
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For Sahakarnagar Ward

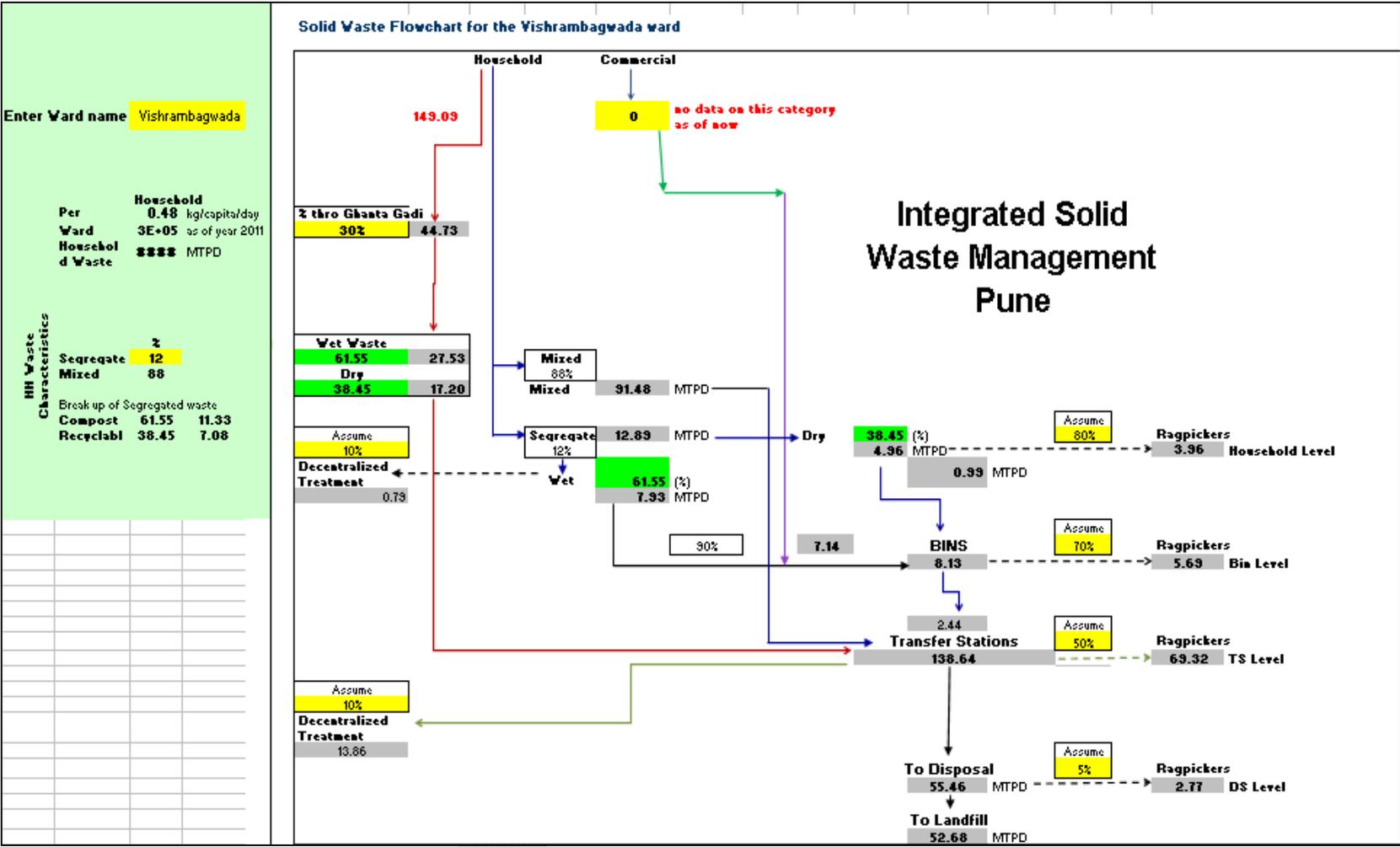


For Sangamwadi ward

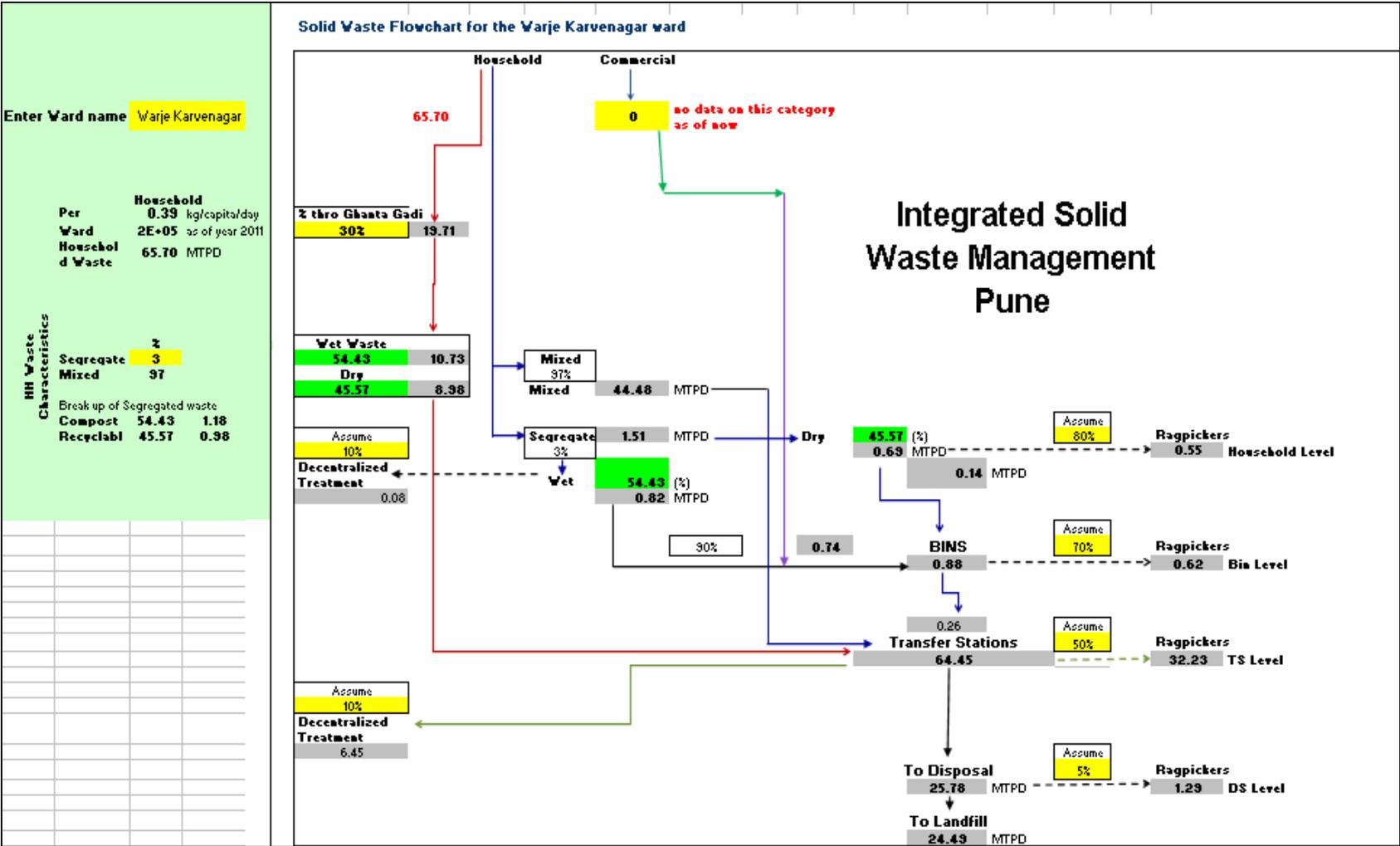


For Tilak Road Ward

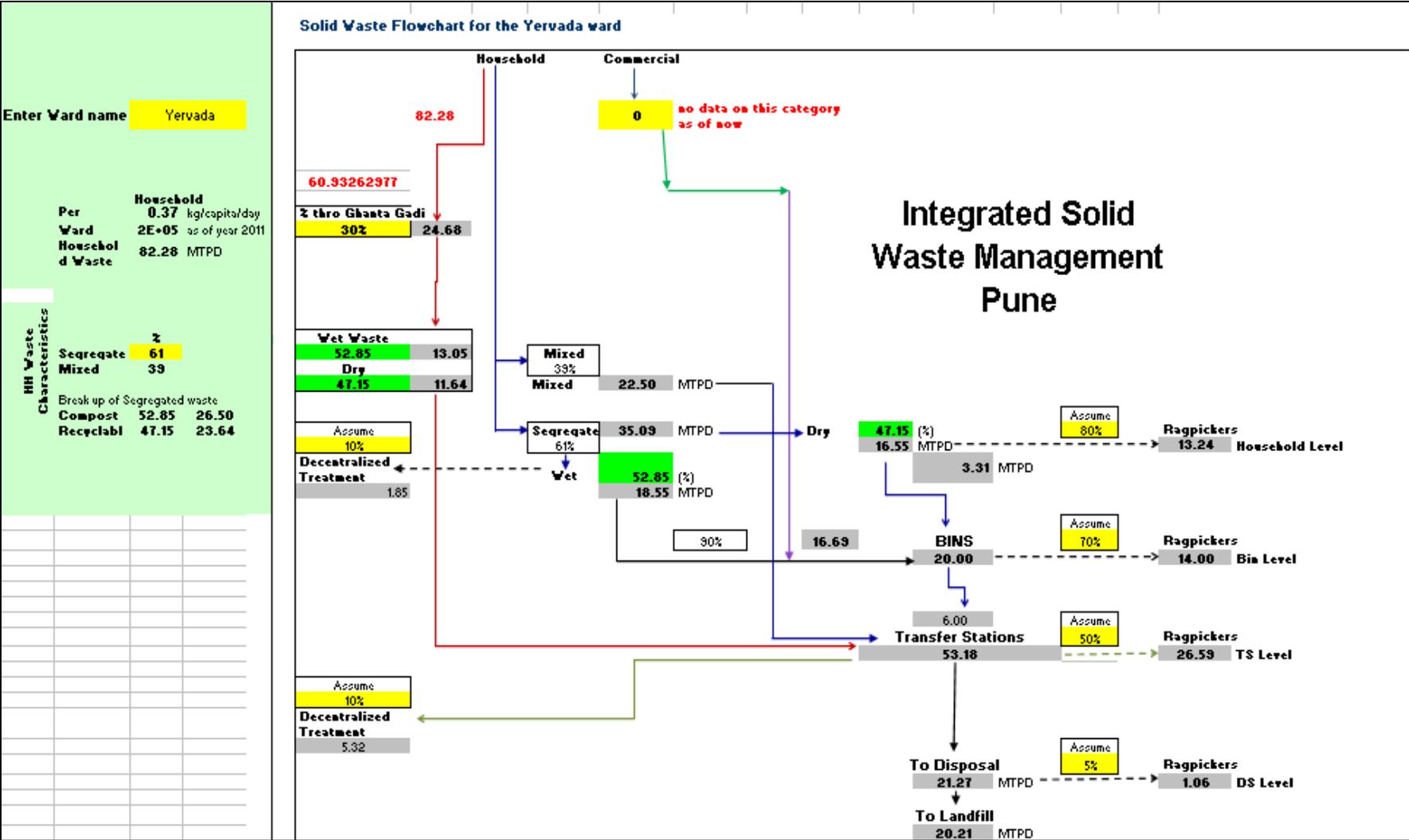
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For Vishrambagwada Ward



For Warje-Karve Nagar Ward



For Yervada Ward

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