PLASTIC WASTE QUANTIFICATION & CHARACTERISATION REPORT

&

ASSESSMENT OF WASTE MANAGEMENT PRACTICES REPORT

FOR AGRA AND FARIDABAD

Submitted to

United Nations Environmental Programme
Division of Technology, Industry and Economics
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CHAPTER - I
1 INTRODUCTION

1.1 Background

The United Nations Environmental Programme (UNEP), through the International Environmental Technology Centre (IETC), Division of Technology, Industry and Economics (DTIE) is implementing Integrated Solid Waste Management (ISWM) in developing countries.

To build local capacity and to support transfer of technology, under Bali Strategic Plan, IETC has developed a project on “Converting Waste Plastics into a Resource” to build local capacity on assessment of waste plastics and development of demonstration projects based on environmentally sound technologies and supportive policy framework.

The project was initiated by UNEP with following objectives:

1. To facilitate and support identification, assessment, and adaptation of technologies to convert waste plastics into diesel fuel thus leading to eventual transfer of technologies from developed to developing countries.
2. To raise awareness in developing countries on plastic waste and its possible reuse for conversion into diesel fuel and other applications.
3. To identify and assess technologies for other uses of waste plastic such as making roof tiles for low cost housing, making more weather resistant and long lasting roads etc.
4. Promote reuse of waste plastic thus providing alternative solutions to waste plastic disposal and simultaneous reduction in GHG emissions.

The specific objectives of baseline survey and this phase are:

1. To apply the Guidelines for Assessment of Waste Plastics and make necessary recommendations for development of training module, based on ground situations.
2. To understand and assess the plastic waste management system in 2 cities.
3. To quantify and characterize the plastic waste generated in both the cities.

1.2 Selection of cities

Selection criteria based on project requirements were identified for shortlisting of cities for baseline survey on plastic waste assessment. Based on the criteria, 3 cities were shortlisted. After interactions with relevant authorities and other stakeholders and experts, Agra in Uttar Pradesh and Faridabad in Haryana were selected for the baseline survey.
1.3 Methodology for baseline survey

The Guidelines for Assessment of Waste Plastics provided the base structure for designing the baseline survey methodology. However, based on the findings of the recce visits conducted in both the cities, the methodology was modified in response to local circumstances in terms of data availability and applicability and relevance of the suggested guidelines.

The methodology adopted includes a combination of secondary literature review, primary data collection and data analysis. The key components are:

> Consultation meetings with respective municipal authorities in Agra and Faridabad

Discussions and interactions were held with key officials of Agra Nagar Nigam and Municipal Corporation of Faridabad to seek support in terms of access to information for the project.\(^1\)

> Interaction with other stakeholders:

Key stakeholders involved in waste management, especially in the context of plastic waste, were identified and interactions were held with them for a holistic understanding of the systems and value chains. Some of the stakeholders are enlisted below:

- Hotels
- Scrap Dealers
- Rag pickers
- Commercial Establishments
- Sanitary inspectors/ workers

> Secondary literature review

The secondary literature review proved to be an important asset in the absence of access to information available with the Municipal Corporations. The major source of information was the City Development Plans developed for sourcing funds under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) programme.

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\(^1\) Though an initial positive response was obtained from the Municipal Commissioner of Agra, the municipality officials have subsequently not been forthcoming with information.

In Faridabad, a positive response was obtained, but the unfortunate transfer of the Municipal Commissioner caused inordinate delay in initiating the study. Interactions with the incumbent Municipal Commissioner have been initiated while starting with the baseline survey in parallel.
Recce Visit

Different waste streams – residential, commercial, industrial, construction and WEEE were explored. Based on the findings of the visit, the methodology was streamlined and residential and commercial streams were selected for detailed survey.

General observation from recce visit:

- Segregation of waste is not practised in either of the two cities. The unsegregated waste is disposed off at common collection points (municipal waste bins) or open dumps.
- The cities are not distinguished into clearly defined residential, commercial or industrial areas, and therefore, the waste generated cannot be specifically identified as originating from these sectors. Hence, the sampling sites have been selected to include localities that may be identified as primarily residential or commercial, but exhibit considerable overlap. Consequently, the collection points receive waste from all sectors.

Primary survey

Collection Point Survey

Both designated and informal collection points were identified in key residential and commercial areas for baseline survey. The sample sites were selected from across the geographical spread of the cities to include adequate representation of localities with different demographic and economic profile.

Dumpsite / Landfill site Survey

Primary surveys were also carried out at landfill sites for a fair idea of the different types of waste being generated in each city and the composition of the waste (with particular reference to the contribution of plastics). It also allowed comparison between the waste compositions at collection and disposal sites.

The Jawaharlal Nehru National Urban Renewal Mission (JNNURM) aims to encourage cities to initiate steps to bring about improvement in the existing service levels in a financially sustainable manner. The JNNURM consists of two sub-missions: the Urban Infrastructure and Governance and the Basic Services to the Urban Poor. It believes that in order to make cities work efficiently and equitably, it is essential to create incentives and support urban reforms at state and city levels; develop appropriate enabling and regulatory frameworks; enhance the creditworthiness of municipalities; and integrate the poor with the service delivery system.
thereby providing insight into the retrieval of materials of value by the informal sector.

The landfill site survey also helped in estimating the total quantity of waste generated in each city on the basis of the numbers and capacities of disposal vehicles entering the landfill each day.

Note: Disposal site vehicle survey for estimating the relative contribution of different sectors to total waste (as suggested in guidelines) were not conducted as it was not relevant in the context of the observed sectoral overlap in waste as already elaborated upon in the section on recce visit findings.

Sample size determination

The sample size was determined based on socio-economic and to provide adequate geographical representation.

> Data Analysis and future projections

The sample data collected will be analysed for quantification and characterisation of waste plastics. Future projections will look at estimating generation of plastic waste in year 2011 & 2016 based on growth in population.

1.4 Setting the boundaries

The following section defines to set the boundaries of cities in terms of geographical and administrative coverage and in terms of different sectors and waste generators with respect to waste plastics generation.

1.4.1 AGRA

The city of Agra is situated on the western bank of river Yamuna on National Highway (N.H- 2) at about 200 Kms from Delhi in the state of Uttar Pradesh. Agra is geographically located at 27° 12' N latitude and 78° 12' E longitude. It has a strategic location, being at the confluence of three distinct geo-physical regions namely the plains of Uttar Pradesh, the plateau of Madhya Pradesh and the desert of Rajasthan.

➢ Geographical size

The administrative jurisdiction of the Agra Nagar Nigam includes an area of 141.0 sq. km with a population density of about 9,043 persons per sq. km as per 2001 census. The city is divided into 80 wards for administrative purposes.

➢ Population size and expected growth

The population of Agra city is 12.75 lakhs as per Census 2001 with a decadal growth rate of 30.37 per cent and the population projections for the year 2021 is 22.69 lakhs. The city is divided into 80 wards but the distribution of population is non-uniform across
the city. The ward nos. 26, 43, 50 and 66 have high concentration of population whereas the ward nos. 36, 40 and 47 have low population.

- **Commercial undertakings**

Agra is a commercial city, the major part of its industrial activity being in the form of small-scale and house-hold industries. The important industries are textiles, leather, foundries, diesel engines, generator sets, electrical goods, fans, pipes, C.I, casting, shoes, steel rolling, packaging materials, etc. The major handicrafts include marble figures, leather products, carpet, brassware, jewellery and *dari* craft.

**Trade & Commerce establishment (2004-2005)**

<table>
<thead>
<tr>
<th>Details</th>
<th>2004-2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shops &amp; Commercial Establishments</td>
<td>50,188</td>
</tr>
<tr>
<td>Hotels &amp; Restaurants</td>
<td>146</td>
</tr>
<tr>
<td>Market Stalls</td>
<td>195</td>
</tr>
<tr>
<td>Market vendors</td>
<td>462</td>
</tr>
<tr>
<td>Offices and Institutions</td>
<td>1,144</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>52,135</strong></td>
</tr>
</tbody>
</table>

As per the report of District Industries Centre there are a total of 5,263 small scale industry (SSI) units in Agra. There are also about 30,000 household handicraft units in the city. Agra city has been the traditional seat of Iron Casting products from the Mughal period. Before 1993, there were approximately 250 foundry units in the city but with the declaration of Taj Trapezium Zone in 1997-98 and implementation of strict pollution norms many industries were closed down. Now there are only 166 foundry units working in the city by adopting environment friendly fuel. The shoe manufacturing industry in Agra exists mainly as a cottage industry. There are about 5,000 to 7,000 such units in Agra.

- **Administrative boundaries and responsibilities**

The civic administration in the city of Agra falls under the jurisdiction of Agra Nagar Nigam (Municipal Corporation). This is the principal urban governance institution, in addition to few other organizations and parastatals.

Solid waste management is the responsibility of Public Health Department of Agra Nagar Nigam whereas Engineering Department assists in the procurement of the vehicles, equipment and developing the landfill site, etc. The Chief Health Officer is the key person responsible for waste management in the city. About 90% of the total employee strength of the Public Health Department comprise of sanitary workers.
1.4.2 FARIDABAD

Faridabad is situated on the Delhi-Mathura NH-2 at a distance of 32 km. from Delhi, at 28° 25' 16" N latitude and 77° 18' 28" E longitude. The town is bounded on the north by Delhi, on the east by Agra and the Gurgaon canals and on the west by the Aravali Hills. Faridabad is the biggest urban agglomeration of the Haryana State consisting of the old municipal town of Faridabad, Ballabgarh, and the New Industrial Town (NIT) along with 38 revenue villages.

- **Geographical size**

  The present geographical area of Faridabad is 207.88 sq. km. The population density in Faridabad city is estimated to be about 6,129 persons per sq.km. The city has been divided into 91 sectors for administrative purposes.

- **Population size and expected growth**

  The Development Plan (DP) for Faridabad prepared in 1991 assumed a decadal growth rate of 70 percent for the decades 1991-01 and 2001-11 and estimated a population of 17.5 lakhs by 2011. This was based on past growth rates which were above 100 percent; the same have however declined during the last two decades. Based on similar analysis, the NCR regional plan for 2021 has projected the population of Faridabad as 16 lakhs by 2011 and 25 lakhs by 2021.

- **Commercial undertakings**

  Faridabad, is home to one of the largest industrial estates in Asia, housing a large number of manufacturing industries. The economy of Faridabad is more or less dependent on Industry. As on date there are 16 multinational companies (MNC), 809 ISO-based industries, 205 medium and large-scale industries and 399 small-scale units as per the records of the District Industrial Centre, Faridabad.

- **Administrative boundaries and responsibilities**

  Municipal Corporation of Faridabad (MCF) and Haryana Urban Development Authority (HUDA) are the primary institutions involved in physical development and service delivery aspects in Faridabad. All the core municipal activities, their design and implementation are under the domain of MCF. HUDA primarily exercises the role of a land developer.

  Responsibility of all aspects solid waste management like collection, transportation and final disposal falls under the jurisdiction of MCF.
CHAPTER - II
2 WASTE QUANTIFICATION & CHARACTERISATION

2.1 AGRA

Agra Nagar Nigam estimates the solid waste generation in the city to be around 710MT/day. However, studies done under the JNNURM programme estimate that about 628 MT of solid waste is generated every day in the city, which comes out to be about 492 grams per capita per day (ref: City Development Plan, JNNURM). Significantly, as per a National Environmental Engineering Research Institute (NEERI) Strategy Paper on SWM in India, (1996) the average per capita waste generation in a city with population range between 10-20 lakhs is around 270 grams per capita per day. In this regard, Agra has high per capita waste generation compared to other cities with similar population size. One of the possible reasons could be large tourist population.

2.1.1 Sample Survey

For residential areas, 6 locations were selected keeping in mind the socio-economic status and geographical location. The residential areas selected are:

- Surya Nagar
- Idgah Colony
- Shahdara
- Ghatia Ajam Khan
- Khandari
- Civil Lines – Bagh Farzana

At each location, 4 sites were selected – 2 collection points and 2 open dumps. At each collection point, 3 samples of 20 kg each were taken for analysis and 2 samples of 10 kg at each dump site.

4 key Commercial areas of the city were selected for sample survey namely,

- Sanjay Place
- Transport Nagar
- Bhagwan Talkies
- Subhash Market

Sample selection in commercial areas was same as that employed in residential areas. In Agra, total waste from the city is disposed at a temporary landfill at Kuberpur village, 12 km from the city on Agra – Firozabad highway. At the landfill site, 5 samples of 20 kg each were analysed for plastic content.
Observations

In all the commercial areas, plastic waste from packaging is traded off to kabariwalas or small scrap dealers. In Subhash Market, which is a wholesale market for cloth, a shop produces 5-6 kg of packaging waste per week. This waste is sold to local kabariwalas at Rs 20-25/kg.

2.1.2 Plastic waste characterisation

Plastic waste characterisation and analysis was done using both methods – hand sorting and visual estimation.

Based on the estimations, it was found that the Plastic waste generated in Agra is mostly thin film plastic carry bags and packaging material. The other plastic products like bottles, milk packets (LDPE), buckets, etc do not come into the common collection bins or open dump sites but instead are traded off to small kabariwalas or scrap dealers.

The plastic waste generated is classified locally by Kabariwalas with local names like HM (Poly ethylene), PP (polypropylene), PET (polyethylene terephthalate), LD (low density polyethylene), etc. These classifications are based on the commercial values of plastic waste.

![Residential Waste Plastic Composition](image)

**Fig: 1:** Graph representing plastic waste composition in residential areas
Observations

> Polyethylene (PE) is the major type of plastic waste generated in both residential and commercial areas with 59% and 46% composition respectively, of total waste plastic. The level of Polypropylene (PP) is about 23% and 36% in residential and commercial areas, respectively. Increased levels of PP in commercial areas is attributed to its use in packaging material and also produce disposable cups (these are used by road side tea and snack stalls in huge numbers) which are extensively used in these areas..

> The other types of plastic are similar in both the areas owing to overlap at collection points and dump sites.

- **Plastic waste quantification**

To identify and ascertain the quantity of waste plastic generated in Agra, samples were collected from 6 residential and 4 commercial areas. 100 samples were collected from these 10 locations for an adequate representation of these waste streams.

Mix waste samples were collected from common collection points and open dumps at both residential and commercial areas for analysis. Hand sorting methods were employed for segregating waste plastics from mix waste and data was analysed to assess the quantity of waste plastic generated.

The details of samples collected, their locations, quantity of waste are given as Annexure 1.
Number of samples: 100

Total weight of samples: 1600 kg

Total weight of Plastic: 111.055 kg

Therefore, percentage plastic content = \( \frac{\text{Total weight of Plastic}}{\text{Total weight of samples}} \times 100 \)

\[
= \frac{111.055}{1600} \times 100 = 6.94 \%
\]

*Note: the percentage plastic content has been calculated on the basis of primary survey conducted at residential and commercial sites. Plastic waste generated by industrial sector has not been taken into account as it is generally routed to recyclers directly and therefore, does not reach collection and landfill sites.*

### 2.1.3 Waste projections

The future projections for solid waste generation have been calculated keeping in mind the growth in population. The other influencing factors like change in waste generation patterns have not been considered.

*Population 2001 (Census) – 12.75 lakhs

Projected population 2011 – 17.53 lakhs (ref: City Development Plan)*
Therefore, estimated population for 2009 = 16.57 lakhs

(Note: Assuming linear growth in population figures, 2001 (actual) & 2011 - Estimated population has been calculated)

Waste generated – 710 MT/day

Per capita generation = total waste generated / Population

= 710000
1657000
= 428 gm/capita/day

➢ Projected generation of Plastic in 2011:

Projected population 2011 – 17.53 lakhs (ref: City Development Plan, JNNURM)

Per capita generation = 428 gm/capita/day

Total Waste generated = Projected population x Per capita generation

= 17.53 x 100000 x 0.428 kg
= 750284 kg
= 750MT/day

Assuming no rise in per capita waste generation patterns, the projected plastic was calculated with 6.94%

Plastic waste generation = 6.94 x 750
100
= 52.05 MT/day of plastic

➢ Projected generation of Plastic in 2021:

Projected population 2016 –22.69 lakhs

Per capita generation = 428 gm/capita/day

Total Waste generated = Projected population x Per capita generation

= 22.69 x 100000 x 0.428 kg
= 971132 kg
= 971.13 MT/day
Assuming no rise in per capita waste generation patterns, the projected plastic was calculated with 6.94% 

\[ \text{Plastic waste generation} = 6.94 \times \frac{931.13}{100} \]

\[ = 64.62 \text{ MT/day of plastic} \]

*Note: The city of Agra comes under the Taj Trapezium Zone, therefore, development of large scale industries is not expected. However, there is an expected increase in IT and other software based industries. These industries do not produce large amount of plastic waste.*

### 2.2 FARIDABAD

In Faridabad, total solid waste generated is 480 MT per day with per capita generation about 377 grams per capita per day *(ref: City Development Plan, JNNURM)*.

- **Quantification of Solid Waste**

As per secondary sources – reports of research studies conducted and data available on internet and other sources, daily generation of solid waste in the city is 480 MT. As source segregation is not practised, the data is for complete municipal waste generated and includes wastes originating from residential, commercial and industrial sectors.

Of the total waste generated, only about 450 MT is reported to be collected and transported to landfills. The wastes are being dumped in the open without any treatment. Salvage of materials with recycling potential and value by rag-pickers takes place primarily at the collection points, but also to some extent at the landfill sites.

#### 2.2.1 Sample Survey

For residential areas, 2 locations were selected keeping in mind the socio-economic status and geographical location. The residential areas selected are:

At each location, 4 sites were selected – 2 collection points and 2 open dumps. At each collection point, 2 samples of 20 kg each were taken for analysis and 2 samples of 10 kg at each dump site.

- Sector 19, Old Faridabad
- Green field Colony, Surajkund road

2 key Commercial areas of the city were selected for sample survey namely,

- NH-2, Near Neelam Bata chowk
- Old Faridabad market
Sample selection in commercial areas was same as that employed in residential areas.

In Faridabad, total waste from the city is disposed at 5 different landfill sites across the city. All these landfills are temporary in nature with open dumping of waste being practiced. Under the JNNURM programme, solid waste management is an important component. As part of the programme, a scientifically designed sanitary landfill is coming up at Bhakari village, on Gurgaon- Faridabad road. The new landfill will be serving both the cities of Gurgaon and Faridabad.

For the baseline survey, samples selection was done at 2 landfill sites namely, Kheri road, Old Faridabad & landfill at Gurgaon- Faridabad road.

At the landfill site, 5 samples of 20 kg each were analysed for plastic content.

- **Observations**
  - In Faridabad, the shops and commercial dealers producing large amount of plastic waste sell them directly to local kabariwalas. These are sold at a rate of Rs 20-25 per kg depending on the quality of plastic. LDPE is most viable commercially.

2.2.2 Plastic waste characterisation

In Faridabad, the plastic waste generation is much more than Agra. The major reason for this could be better socio-economic status and large commercial complexes, contribution to the solid waste of city.

The plastic waste composition in Faridabad is similar to that of Agra. However, the content of Polyethylene (PE) and polypropylene (PP) is higher in Faridabad. The Plastic waste generated in is mostly tin film plastic carry bags and packaging material. The other moulded plastic like bottles, milk packets (LDPE), buckets, etc do not come into the common collection bins or open dump sites but instead are traded off to small kabariwalas or scrap dealers. Some of the plastic waste like PET bottles and PVC plastics which come to collection point are eventually picked up by ragpickers and sold to small scrap dealers.

The sample collection at all the sites was mostly done early in the morning. The PET, PVC and other commercially valuable plastic waste would have been picked up by ragpickers during the day.
Residential Plastic waste composition

Commercial Plastic waste composition

Fig: 1: Graph representing plastic waste composition in residential areas

Fig: 2: Graph representing plastic waste composition in commercial areas

Key observations:

> In both the areas, Polyethylene (PE) is the major type of plastic waste generated.
The levels of Polypropylene (PP) and LDPE, normally used as packaging material is much more in Faridabad compared to other cities.

- **Plastic waste quantification**

To identify and ascertain the quantity of waste plastic generated in Agra, samples were collected from 2 residential and 2 commercial areas. 32 samples were collected from these 4 locations for an adequate representation of these waste streams.

Mix waste samples were collected from common collection points and open dumps at both residential and commercial areas for analysis. Hand sorting methods were employed for segregating waste plastics from mix waste and data was analysed to assess the quantity of waste plastic generated.

The details of samples collected, their locations, quantity of waste are given as **Annexure 2**.

Number of samples: 32

Total weight of samples: 480 kg

Total weight of Plastic: 72 kg

Therefore, percentage plastic content = \( \frac{\text{Total weight of Plastic}}{\text{Total weight of samples}} \times 100 \)

\[ = \frac{72.00 \times 100}{480} \]

\[ = 15 \% \]

*Note: the percentage plastic content has been calculated on the basis of primary survey conducted at residential and commercial sites. Plastic waste generated by industrial sector has not been taken into account as it is generally routed to recyclers directly and therefore, does not reach collection and landfill sites.*

**2.2.3 Waste projections**

The future projections for solid waste generation have been estimated keeping in mind the growth in population only. The other influencing factors like change in waste consumption patterns have not been considered.

Population 2001 (Census) – 10,55,938 lakhs

Projected population 2011 – 15,37,208 lakhs (ref: City Development Plan, JNNURM)

Therefore, estimated population for 2009 = 14,40,954 lakhs
(Note: Assuming linear growth in population figures, 2001 (actual) & 2011 - Estimated population has been calculated)

Waste generated – 480 MT/day

Per capita generation = total waste generated
Population

= \frac{480000}{1055938}
= 454 \text{ gm/capita/day}

➢ Projected generation of Plastic in 2011:

Projected population 2011 – 15.37 lakhs

Per capita generation = 454 gm/capita/day

Total Waste generated = Projected population x Per capita generation

= 15.37 \times 100000 \times 0.454 \text{ kg}
= 697798 \text{ kg}
= 697.79 \text{ MT/day}

Assuming no rise in per capita waste generation patterns, the projected plastic was calculated with 15% generation.

Plastic waste generation = 15 \times \frac{697}{100}
= 104.55 \text{ MT/day of plastic waste}
Projected generation of Plastic in 2021:

Projected population 2021 – 21.34 lakhs
Per capita generation = 454 gm/capita/day
Total Waste generated = Projected population x Per capita generation

= 21.34 × 100000 × 0.454 kg
= 968836 kg
= 968.83 MT/day

Assuming no rise in per capita waste generation patterns, the projected plastic was calculated with 15% generation.

Plastic waste generation = 15 × 968.83
= 145.32 MT/day of plastic waste

Note: Faridabad is currently at a developing stage and is expected to have good economic growth in the coming years. This could have an impact on waste generation patterns especially of plastics. Due to non availability of such projected data, it could not be incorporated into the projected data.

2.3 Conclusions and Recommendations

- The Guidelines for Assessment of Waste Plastics developed by UNEP-IETC were applied and it was found keeping in mind the waste management scenario in India.

  - For example: The waste management is very different in Indian cities and towns due to lack of segregation of waste at any point of generation, collection or disposal. The collection system is also not planned and designed to separate waste from different waste streams like residential, commercial and industrial sources. At the collection points, the waste from these is mixed. As a result, the methodology of waste quantification and characterisation becomes non-applicable.

  - Keeping in mind, the guidelines methodology need to be modified for assessment of plastic in mixed waste.

- It is estimated that in Agra city, composition of plastic waste is about 6.94% of total waste generated. However, previous studies have estimated it to be about 8.72%. This can be due to seasonal variations and also contribution of industrial waste. The
plastic generation is tremendously increasing in the city. The major types of plastic
generated are Polyethylene, Poly propylene and Low Density Polyethylene (LDPE).

> In Faridabad, plastic waste composition is 15% of the total waste. Studies done by
research organisations estimate it to be around 13%. It is estimated that plastic
waste generation will increase substantially with development of new industrial
areas and zones.

> Although the amount of plastic waste generation in both the cities is of substantial
quantity, the waste plastic which reaches the landfill is soiled due to mixing with wet
organic waste.

However, this type of low quality plastic waste is being successfully utilised for other
applications as indicated below. (This list is just an indication of possible productive
waste utilisation opportunities)

- **Road making**
  Use of waste plastic in road construction is gaining popularity. Bangalore is
  one such city where such initiative has been piloted and has been successful.
  The CPCB has also undertaken a project in collaboration with Thiagarajar
  College of Engineering Madurai to evaluate the performance of polymer
  coated built roads laid during 2002-2006 in different cities.

  The study has found that the plastic tar roads are more durable and do not
developed any potholes, rutting, raveling or edge flaw, even though these
roads are more than four years of age.

- **Composite making**
  Sriram Institute of Industrial Research has developed technologies for plastic
  furniture made from waste material with good durability and aesthetics.

- **Cement kilns**
  One of the most effective methods of recycling of plastics waste for recovery
  of energy is the use of plastics waste as an alternative to possible fuel in
  Cement Kilns.

  As Cement Kilns operate at a very high temperature in the range of 1500°C
  or more, there is no risk of generation of any toxic emission due to the
  burning of plastics waste.

  Central Pollution Control Board has realized this opportunity of using cement
  kilns as an alternative incinerator and has allowed some cement plants for
  conducting operational trials under controlled conditions and supervision.
3 ASSESSMENT OF PLASTIC WASTE MANAGEMENT SYSTEM / PRACTICES

3.1 Introduction

General patterns of waste generation in urban India indicate increasing trends in terms of quantum of generation and percentage of plastics. This is arguably an outcome of the urbanisation phenomena that is leading to an increase in the spread and population of cities. Waste management systems and infrastructure in most Indian cities are ill-equipped for dealing with this expanding stream of waste and this is leading to serious public health concerns.

This chapter presents an overview of waste management systems and practices with particular reference to waste plastics in each of the two cities. The chapter broadly covers the policy aspects in terms of rules and regulations in effect for waste management, the institutional systems in place and the role of other stakeholders in recycling of waste plastics.

3.2 Policies

No specific regulations have been framed for addressing the management of plastic waste, and it is thus governed by the general guidelines and rules for management of municipal solid wastes. The management of municipal solid waste in India is mostly governed by Municipal Solid Waste (Management and Handling) Rules, 2000.

3.2.1 Municipal Solid Waste (Management and Handling) Rules, 2000

Extracts from the Municipal Solid Waste (Management and Handling) Rules, 2000 that are particularly relevant to the purposes of the current project have been included below. These rules, notified by the Government of India, Ministry of Environment and Forests, apply to every municipal authority responsible for collection, segregation, storage, transportation, processing and disposal of municipal solid wastes. The complete notification is included as annexure for reference purpose.

- Roles & Responsibilities

  - Municipal Authority

    1. Every municipal authority shall, within the territorial area of the municipality, be responsible for the implementation of the provisions of these rules, and for any infrastructure development for collection, storage, segregation, transportation, processing and disposal of municipal solid wastes.
2. The municipal authority or an operator of a facility shall make an application for grant of authorization for setting up waste processing and disposal facility including landfills from the State Board or the Committee.

3. The municipal authority shall comply with these rules as per the implementation schedule laid down in Schedule I.

- **State Governments and the Union territory Administrations**

  1. The Secretary-in-charge of the Department of Urban Development of the concerned State or the Union territory, as the case may be, shall have the overall responsibility for the enforcement of the provisions of the rules in the metropolitan cities.

  2. The District Magistrate or the Deputy Commissioner of the concerned district shall have the overall responsibility for the enforcement of the provisions of the rules within the territorial limits of their jurisdiction.

- **Responsibility of Central Pollution Control Board and State Board or Committees**

  1. The State Board or the Committee, after the receipt of application from the municipal authority for grant of authorization for setting up waste processing and disposal facility including landfills, shall examine the proposal taking into consideration the views of other agencies.

  2. The State Board or the Committee shall issue the authorization to the municipal authority or an operator of a facility within forty-five days stipulating compliance criteria and standards as specified including such other conditions, as may be necessary.

  3. The Central Pollution Control Board shall co-ordinate with the State Boards and the Committees with particular reference to implementation and review of standards and guidelines and compilation of monitoring data.

- **Management of municipal solid wastes**

  1. Any municipal solid waste generated in a city or a town, shall be managed and handled in accordance with the compliance criteria and the procedure laid down in Schedule-II.

  2. The waste processing and disposal facilities to be set up by the municipal authority on their own or through an operator of a facility shall meet the specifications and standards as specified in Schedules III and IV.
The Rules are included under four Schedules corresponding to different aspects of waste management. The four schedules are:

- **Schedule I**: Implementation Schedule
- **Schedule II**: Management of municipal solid waste
- **Schedule III**: Specifications for landfill sites
- **Schedule IV**: Standards for Composting, Treated Leachates and Incineration

### Schedule I - Implementation Schedule

<table>
<thead>
<tr>
<th>Compliance Criteria</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting up of waste processing and disposal facilities</td>
<td>By 31.12.2003 or earlier</td>
</tr>
<tr>
<td>Monitoring the performance of waste processing and disposal facilities</td>
<td>Once in six months</td>
</tr>
<tr>
<td>Improvement of existing landfill sites as per provisions of these rules</td>
<td>By 31.12.2001 or earlier</td>
</tr>
<tr>
<td>Identification of landfill sites for future use and making sites ready for operation</td>
<td>By 31.12.2002 or earlier</td>
</tr>
</tbody>
</table>

### Schedule II - Management of Municipal Solid Wastes

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Compliance criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collection of municipal solid wastes</td>
<td>1. Littering of municipal solid waste shall be prohibited in cities, towns and in urban areas notified by the State Governments. To prohibit littering and facilitate compliance, the following steps shall be taken by the municipal authority:-</td>
</tr>
<tr>
<td></td>
<td>i. Organising house-to-house collection of municipal solid wastes through any of the methods, like community bin collection (central bin), house-to-house collection, collection on regular pre-informed timings and schedules;</td>
</tr>
<tr>
<td></td>
<td>ii. Devising collection of waste from slums and squatter areas or localities including hotels, restaurants, office complexes and</td>
</tr>
</tbody>
</table>
commercial areas;

iii. Bio-medical wastes and industrial wastes shall not be mixed with municipal solid wastes and such wastes shall follow the rules separately specified for the purpose;

iv. Collected waste from residential and other areas shall be transferred to community bin by hand-driven containerised carts or other small vehicles;

v. Horticultural and construction or demolition wastes or debris shall be separately collected and disposed off following proper norms;

2. The municipal authority shall notify waste collection schedule and the likely method to be adopted for public benefit in a city or town.

3. It shall be the responsibility of generator of wastes to avoid littering and ensure delivery of wastes in accordance with the collection and segregation system to be notified by the municipal authority.

<table>
<thead>
<tr>
<th>Segregation of municipal solid wastes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. In order to encourage the citizens, municipal authority shall organise awareness programmes for segregation of wastes and shall promote recycling or reuse of segregated materials.</td>
</tr>
<tr>
<td>2. The municipal authority shall undertake phased programme to ensure community participation in waste segregation. For this purpose, regular meetings at quarterly intervals shall be arranged by the municipal authorities with representatives of local resident welfare associations and non-governmental organizations.</td>
</tr>
</tbody>
</table>
| Storage of municipal solid wastes | 1. Municipal authorities shall establish and maintain storage facilities in such a manner as they do not create unhygienic and unsanitary conditions around it. Following criteria shall be taken into account while establishing & maintaining storage facilities :-  
   i. Storage facilities shall be created and established by taking into account quantities of waste generation in a given area and the population densities. A storage facility shall be so placed that it is accessible to users;  
   ii. Storage facilities to be set up by municipal authorities or any other agency shall be so designed that wastes stored are not exposed to open atmosphere and shall be aesthetically acceptable and user-friendly;  
   iii. Storage facilities or ‘bins’ shall have ‘easy to operate’ design for handling, transfer and transportation of waste. Bins for storage of bio-degradable wastes shall be painted green, those for storage of recyclable wastes shall be printed white and those for storage of other wastes shall be printed black;  
   iv. Manual handling of waste shall be prohibited. If unavoidable due to constraints, manual handling shall be carried out under proper precaution with due care for safety of workers. |
| Transportation of municipal solid wastes | 1. Vehicles used for transportation of wastes shall be covered. Waste should not be visible to public, nor exposed to open environment preventing their scattering. The following criteria shall be met:-  
   i. The storage facilities set up by municipal authorities shall be daily attended for clearing of wastes. The bins or containers wherever placed shall be cleaned before they start overflowing;  
   ii. Transportation vehicles shall be so designed that multiple handling of wastes, prior to final disposal, is avoided. |
| Processing of municipal solid wastes | Municipal authorities shall adopt suitable technology or combination of such technologies to make use of wastes so as to minimize burden on landfill. Following criteria shall be adopted:-  
   i. Mixed waste containing recoverable resources shall follow the route of recycling. Incineration with or without energy recovery including pelletisation can also be used for |
processing wastes in specific cases. Municipal authority or the operator of a facility wishing to use other state-of-the-art technologies shall approach the Central Pollution Control Board to get the standards laid down before applying for grant of authorisation.

| Disposal of municipal solid wastes | Land filling shall be restricted to non-biodegradable, inert waste and other waste that are not suitable either for recycling or for biological processing. Land filling shall also be carried out for residues of waste processing facilities as well as pre-processing rejects from waste processing facilities. Land filling of mixed waste shall be avoided unless the same is found unsuitable for waste processing. Under unavoidable circumstances or till installation of alternate facilities, land-filling shall be done following proper norms. |

**Schedule III - Specifications for Landfill Sites**

- **Site Selection**
  - In areas falling under the jurisdiction of ‘Development Authorities’ it shall be the responsibility of such Development Authorities to identify the landfill sites and hand over the sites to the concerned municipal authority for development, operation and maintenance. Elsewhere, this responsibility shall lie with the concerned municipal authority.
  - The landfill sites shall be selected to make use of nearby wastes processing facility. Otherwise, wastes processing facility shall be planned as an integral part of the landfill site.
  - Biomedical wastes shall be disposed off in accordance with the Bio-medical Wastes (Management and Handling) Rules, 1998 and hazardous wastes shall be managed in accordance with the Hazardous Wastes (Management and Handling) Rules, 1989, as amended from time to time.
  - The landfill site shall be large enough to last for 20-25 years.

- **Facilities at the Site**
  - Landfill site shall be fenced or hedged and provided with proper gate to monitor incoming vehicles or other modes of transportation.
  - Approach and other internal roads for free movement of vehicles and other machinery shall exist at the landfill site.
The landfill site shall have wastes inspection facility to monitor wastes brought in for landfill, office facility for record keeping and shelter for keeping equipment and machinery including pollution monitoring equipments.

Provisions like weigh bridge to measure quantity of waste brought at landfill site, fire protection equipments and other facilities as may be required shall be provided.

Status of Implementation

In both Agra and Faridabad, the relevant authorities i.e. the Agra Nagar Nigam (ANN) and Municipal Corporation of Faridabad (MCF) have not complied with the rules in the stipulated time frame. As per the municipal corporations, this is due to various factors such as the absence of community involvement, lack of technical know-how, inadequate financial resources and a certain degree of apathy of municipal authorities.

However, both ANN and MCF have undertaken projects for city level integrated solid waste management under the JNNURM scheme. The projects have been designed in order to enable the cities to conform to the Municipal Solid Waste (Management and Handing) Rules, 2000.

The unique challenges for plastic waste management and disposal were recognised and in 1996, a Plastic Waste Management Task Force was formulated to provide technical guidance in this regard. Based on the recommendations and suggestions of this task force, the Recycled Plastic Manufacture & Usage Rules, 1999 were formulated.


3.2.2 Recycled Plastic Manufacture and Usage (Amendment) Rules, 2003

This is the first Central Government Rule formulated specifically for plastics and was officially notified by the Ministry of Environment and Forests. The prime objectives were to control the packaging of food products in recycled plastics, as well as to control the problem of increasing plastic waste across the country. The State Pollution Control Boards are responsible for enforcement in the states and the Pollution Control Committees in the union territories.

Some of the salient features of the Rules are given below.

- The Rule prohibits the usage of carry bags and containers made of recycled plastic bags for storing, carrying and dispensing or packaging of foodstuffs. Mandates the use of only virgin bags of 20 microns of natural colour without any dyes and pigments for packaging foodstuffs

- The Rule specifies minimum thickness of the carry bags for virgin to be 20 microns and recycled to 25 microns and calls for the producer of the plastic
product to mark the product as stated in the Guidelines for Recycling of plastics. It also allows the use of recycled polybags of a minimum thickness of 25 microns for non-food applications provided the dyes and pigments used conform to the specification in the Food Adulteration Act.

> The Rules call for recycling of plastics to be carried out according to the Guidelines for Recycling of Plastics.

> The scheme states that plastic packaging used for packaging food, pharmaceuticals, cosmetics and drinking water shall comply with the relevant Indian standards and packaging of non-food, non-pharmaceutical and non-drinking applications shall be from recycled plastics, which shall, apart from fillers and reinforcing agents, be a minimum of 30% by weight of compatible plastic wastes.

> In the case of PET there is no comprehensive legislation in India but there have been discussions in the National Plastic Waste Management Task Force on the possibility of introducing a take-back scheme for PET waste in India.

### Ecomark Scheme of India

The Government of India launched the Ecomark Scheme of India, a scheme on labeling of environment friendly schemes in 1991 for easy identification of environment friendly products and to increase consumer awareness. The Ecomark label is awarded to consumer goods, which meet the specified environmental criteria, and the quality requirements of Indian Standards. Under the Ecomark scheme, the requirements for plastic products are that material for packaging should be recyclable or biodegradable.

However, this Scheme has not been very successful in implementation.

### 3.3 Solid Waste Management in Both Cities

#### 3.3.1 AGRA

> Institutional Structure/ Mechanism

The solid waste management in Agra city is primarily the responsibility of Municipal Corporation- Agra Nagar Nigam. Agra Nagar Nigam looks at all aspects of waste management – collection, storage and disposal of waste.

Health Department of ANN takes up the responsibility of management with Chief Health Officer heading the department whereas Engineering Department assists in the procurement of the vehicles, equipment and developing the landfill site, etc. The Health Department has total employee strength of 2299 out of which 2090 (90.9%) are the sanitary workers.

The urban local bodies in the state of Uttar Pradesh are governed by two important legislation viz. UP Municipal Corporations Adhiniyam, 1959 and UP Municipalities Act.
1916. These two acts specify the governance framework, spatial jurisdiction and the functional domain of the urban local bodies.

The corporation has a democratically elected leadership from the constituencies within the geographic jurisdiction of the corporation boundaries.

Flowchart: Organisational structure of Agra Nagar Nigam. The Senior Health Officer is responsible for waste management and sanitation in the administrative areas of ANN.
Solid waste management

A typical waste management system in Agra is similar to any other medium city in India and has following major steps:

- Collection and Storage of waste
  - Primary collection
  - Temporary storage
- Transportation
- Treatment and Disposal

**Collection and Storage of Waste**

Generally, primary collection is the most essential component of SWM service and is highly inefficient. Municipal authorities, do not provide the service of door-to-door collection of waste, even when it has been provisioned by MSW rules.

The waste generators be it residences or commercial establishments do not store the waste at source nor do they segregate the waste as recyclable and non-recyclable waste. Most of the waste is thrown on streets in small dumps.

There is a need to create awareness amongst generators for responsible handling of waste and ensure efficient collection.

In Agra, door-to-door collection was started in about 2000 households of Surya Nagar and Ram Nagar. However, it was observed that the collection system is not working these days.

The Agra Nagar Nigam has identified waste collection points across the city where the waste from residential and commercial areas are deposited. The waste dumped on the streets and roadsides is collected through street sweeping. The street sweeping operations are inefficient in the city. While one worker sweeps the road, cleans the small drains, a second worker picks up the sweeping, which are kept in heaps by the first one. Safai Karamcharis or street sweepers authorised by Municipal corporations, collect this waste in handcarts and deposit it in few designated collection points.

These sweepers work for only 4-5 hrs a day the work is not carried out on Sundays and other holidays.
In Agra private agencies have been contracted for collection, transportation and safe disposal of biomedical waste. Almost 75-80 per cent of the hospitals segregate the waste while the waste from rest of the hospitals gets mixed with the Nagar Nigam waste. ANN is setting up a common facility for treatment of bio-medical waste from hospitals and medical institutions in the city.

During the course of field survey, it was observed in areas Civil lines, Bagh Farzana area which has many private hospitals and clinics, biomedical waste like syringes, cotton, bottles, etc is dumped at common municipal collection points contaminating the other waste. This waste is picked by ragpickers and sold off to scrap dealers.

- **Collection Points:**

Municipal authorities have designated several locations in cities and towns for the temporary storage of waste collected by street sweepers and for the deposition of the domestic or trade waste by the citizens. Those sites are intended to facilitate the bulk transport of waste from such depots.

The collection centres are either masonry structures, waste bins or open disposal points. In Agra, there are about 561 waste storage depots in the city and out of which 225 are the open storage points causing nuisance and unsanitary conditions. The distribution of temporary waste storage point is non-uniform in the city.

- **Transportation of Wastes:**

Transportation of waste is a crucial step in waste management. In both the cities, waste is collected from various collection points and open waste storage depots and is mostly loaded to the transport vehicle manually.

  > Manual handling of wastes poses threat to the health of Sanitary Workers, as the waste can be highly contaminated.

  > However, at some large collection points, JCBs are used for loading the transport vehicle.
Another issue of concern is irregular transportation of waste to disposal sites. The waste is not transported from all the storage points on a daily basis, especially construction debris. This leads to unhygienic conditions. This is more necessary during the monsoons.

The problem faced by municipal corporations, is of inadequate transport infrastructure and sanitary workers to support the manual system.

- Treatment and Disposal:

There is no processing of waste being done at the city level. The entire waste, which is collected, is taken for dumping to the disposal site.

At present there is no sanitary landfill site in Agra. The disposal is carried out following the method of crude dumping where the waste is neither spread nor covered. In some areas the garbage waste is recklessly burnt in open dump yards placed on the main highway road. The present dumping site is at Shahdara near Jarnah nallah on Agra-Firozabad road.

The site has also been exhausted and now the vehicles are dumping the waste at Kuberpur village on Agra-Firozabad road has been identified for sanitary landfill.

3.3.2 FARIDABAD

Institutional Structure/ Mechanism

In Faridabad, the Municipal Corporation of Faridabad (MCF) is the primary urban local body for all core municipal services including solid waste management. However, there are other agencies like Haryana Urban Development Authority (HUDA), Haryana State Industrial Development Corporation (HSIDC) and Haryana Housing Board which provide services in addition to MCF.

HUDA, for example, supports planned urban development by acquiring both movable and immovable land for residential, industrial, recreational and commercial purposes. The developed areas are transferred to MCF for maintenance purposes only after five years of development. This duplicacy of roles also leads to inefficient management of services.

The Municipal Commissioner is the key figure in local self-government and is the administrative head of MCF; the Commissioner is assisted by senior officials in discharging his functions.
MCF is governed by the Haryana Municipal Corporation Act, 1994 (HMCA). As per this Act, MCF is obligated to provide basic infrastructure like water supply, drainage, sewerage and roads, and services such as conservancy, fire fighting, streetlights, education and primary health.

- **Collection and Storage of Waste**

Faridabad, Municipal Corporation has also outsourced door-to-door collection in sectors 21A, 21B, 21C, 22 & 23 by NGOs Naya Savera and Pathey. After collecting the waste, these NGOs transfer it to the nearest collection point.

In Faridabad, this activity has been contracted to an independent agency. This agency carries the waste to Gurgaon\(^2\) where a centralised incinerator is being operated.

- **Collection Points:**

  In Faridabad, 342 collection points have been identified and supplied with community bins, open bins, dumper, etc. in addition, 180 dustbins have also been installed at specific points for primary collection.

- **Transportation of Wastes**

In Faridabad, Sulabh International has been contracted for transfer of waste from collection points to disposal site. The agency is currently looking at only few sectors like 15, 16, 17, 21, 22, etc.

In Faridabad, 5 temporary disposal sites have been identified wherein waste is simply dumped on the land.

- **Treatment and Disposal**

These sites are:

  > Kheri road, Basalwa Dairy Site, Old Faridabad

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\(^2\) Gurgaon is the sixth largest city in the Indian state of Haryana. Gurgaon is the industrial and financial center of Haryana. An important town in ancient Hindu mythology, Gurgaon is one of Delhi’s four major satellite cities and is part of the National Capital Region of India.  
Both Agra and Faridabad have got support under the JNNURM project for installation for energy generation from municipal waste.

In Agra, Hanjer Biotech Energies Pvt Limited has been contracted to develop a sanitary landfill at Bhakari village and also conversion of municipal waste to refuse derived fuel (RDF) on Build, operate and transfer basis.

In Faridabad, a similar facility is being installed at Faridabad- Gurgaon road which will address the waste issues of both Faridabad and Gurgaon cities.

### 3.4 Plastic waste management

Pertaining to the objectives of the study, plastic waste management system was studied in greater detail. There is no separate institutional mechanism for management of plastic waste. However, due to commercial value of waste plastic, there is large scale involvement of informal sector in management.

#### 3.4.1 Plastic waste generation

Urbanization and increased incomes have lead to rampant use of resources and therefore, more generation of waste. Enhanced plastic waste generation is one such waste stream which has increased manifold because of these factors.

The major sources of plastic waste are:

- Municipal sources like households, commercial establishments, hotels, etc
- Industry sector like packaging films, pipes, food, etc

#### 3.4.2 Plastic waste collection and disposal

Plastic waste like regular municipal waste is disposed off at roadsides. The biodegradable waste along with the uncollected non-biodegradable waste is deposited by consumers and is taken care of by the municipal corporations.

Since, plastic waste has a commercial value; it is picked up by informal sector from street dumps and also at municipal collection points. The unutilized waste along with municipal waste is disposed off at landfill site.
3.4.3 Plastic waste recovery and recycling

An important feature of waste recovery and recycling in India is the involvement of the informal sector. This sector is mainly engaged in the recovery and re-sale of most of the recyclables and is highly labour intensive. The informal sector constitutes a chain of actors who are involved in the trade of plastic waste and recycling.

- **Informal sector**

The informal sector is parallel to the formal municipal waste management system, and is largely an economic driven activity. The key players in informal management are:

- **Ragpickers**

The ragpickers carry out scavenging with bare hands that make them susceptible to a wide range of infections, cuts and wounds. Secondary research estimates that the ragpickers feed into the recycling chain between 12 and 15% of the total waste generated. These ragpickers are generally children from very low socio-economic backgrounds.

The average earning of the ragpickers varies from Rs 30 - Rs 200 per day depending on the quantity and quality of plastic collected. Clear, transparent and soft plastics are sold for better price. Their earnings are also dependent on seasonal variations.

Since they endanger themselves physically by entering disposal sites and collection bins without any protection equipments like gloves, masks, boots, etc. they are exposed to injury by iron and glass pieces.

- **Kabariwala/ Scrap Dealers**

Some good quality plastics like (kitchen ware, buckets, etc) are sold to the kabariwalas directly by households and small shops, as they fetch better price. Since this material has not been mixed with the disposable waste, the quality of plastics is much higher than that gathered by the ragpickers.

These kabariwalas collect the waste and sell it to scrap dealers. Scrap dealers generally collect one type of scrap (for instance plastics only). This trade is still an informal activity because the traded materials are unregistered. The dealer sorts the waste, bundles it, and sells it to the bulk buyers.
• **Bulk Buyers & Granulators**

They are the traders and collect material until it is sufficient to be sent to the recycling plant. Since the investment is very low, and the quantities of waste are very high, some of the bulk buyers are also the granulators. They feed the granules into the recycling sector.

• **Recyclers**

The plastic acquires a fairly high value before it is fed into the recycling chain. Interactions with scrap dealers in Agra revealed that even without any reprocessing, the value of the plastic waste within the trade increases by more than triple.

### 3.5 Conclusions and Recommendations

> There are no independent management mechanisms or systems for management of plastic waste. They come under the larger purview of solid waste management with Municipal Corporation’s being the key organization responsible for it. Management of solid waste including waste plastic waste is in a dismal state in both the cities of Agra and Faridabad. Due to lack of proper collection systems, the waste generated in the city is littered at public places leading to unhygienic conditions. Lack of segregation of waste at source or at collection points is creating problems for management of waste.

To support any recycling initiative, storage of plastic waste will be a problem due to its high volume but less density. However, if there are systems in place for segregation and storage of plastic waste at a central collection point, there are technologies available for compacting the waste for easy and economical storage and transportation without compromising the quality of plastic. *(Ref: Poly – Melt range of plastic densification equipment from Next-tec Ltd)*

> JNNURM is an important government programme supporting infrastructure development in both the cities. The important aspect being technology support for safe disposal of solid waste. In both the cities, refuse derived fuel projects are supported for energy generation from solid waste.

> The major legislations governing solid plastic waste management are:

- Municipal Solid Waste (Management and Handling) Rules, 2000
- Recycled Plastic Manufacture and Usage (Amendment) Rules, 2003

The MSW rules lays down strict norms and timelines for municipal corporations for management of municipal solid waste. However, in both
the cities of Agra and Faridabad, the municipal corporations are way behind the decided timelines. Lack of awareness and capacities to fulfill the tasks have come up as major shortcomings. Hence, capacity building and awareness generation of municipal officials on issues of waste management needs is essential.

> Informal sector is an important player in management of solid waste especially recyclable wastes like plastic, paper and glass, etc., providing livelihoods to thousands in a city. There is a need to integrate this sector with the formal waste collection systems to ensure efficient waste management.
ANNEXURES
### Table 1: Plastic waste characterisation - Agra

<table>
<thead>
<tr>
<th>S. No</th>
<th>Site</th>
<th>Type of collection point</th>
<th>Sample Size (kg)</th>
<th>Plastic waste (gm)</th>
<th>HM (wt)</th>
<th>PP (wt)</th>
<th>LD (wt)</th>
<th>PVC (wt)</th>
<th>PET (wt)</th>
<th>Others (wt)</th>
<th>Others (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ghatia (Ajam Khan)</td>
<td>Collection bin</td>
<td>20 1500</td>
<td>2813</td>
<td>925</td>
<td>360</td>
<td>0</td>
<td>0</td>
<td>600</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Collection bin</td>
<td>20 1400</td>
<td>2120</td>
<td>705</td>
<td>488</td>
<td>400</td>
<td>164</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Open dump</td>
<td>10 850</td>
<td>980</td>
<td>214</td>
<td>85</td>
<td>0</td>
<td>48</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Open dump</td>
<td>10 600</td>
<td>496</td>
<td>380</td>
<td>50</td>
<td>0</td>
<td>52</td>
<td>200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Surya Nagar</td>
<td>Collection bin</td>
<td>20 1450</td>
<td>2776</td>
<td>1081</td>
<td>28</td>
<td>192</td>
<td>104</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Collection bin</td>
<td>20 1300</td>
<td>2435</td>
<td>1660</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Open dump</td>
<td>10 550</td>
<td>511</td>
<td>187</td>
<td>326</td>
<td>0</td>
<td>21</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Open dump</td>
<td>10 480</td>
<td>640</td>
<td>153</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Khandari (M &amp; I)</td>
<td>Collection bin</td>
<td>20 1250</td>
<td>2635</td>
<td>1692</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Collection bin</td>
<td>20 1600</td>
<td>2500</td>
<td>1462</td>
<td>0</td>
<td>390</td>
<td>93</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Location</td>
<td>Collection Times</td>
<td>Details</td>
<td>Volume (Litres)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Civil Lines, Bagh Farzana (HI)</td>
<td>20 1600</td>
<td>Open dump</td>
<td>860</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>20 1700</td>
<td>Open dump</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Collection bin</td>
<td>20 1850</td>
<td>Collection bin</td>
<td>1484</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>20 1050</td>
<td>Collection bin</td>
<td>2189</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Collection bin</td>
<td>20 1300</td>
<td>Collection bin</td>
<td>2890</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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**Notes:**
- Collection bins are used for waste collection.
- Open dumps are used for waste disposal.
- The volume of waste collected is measured in litres.
- The numbers indicate the volume of waste collected at different locations.
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**LANDFILL SITE**

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