

**BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL
SOUTHERN ZONE BENCH, CHENNAI**

**ORIGINAL APPLICATION NO. 295 OF 2024 (SZ)
[EARLIER ORIGINAL APPLICATION NO. 1186 OF 2024 (PB)]**

IN THE MATTER OF:

Suo Motu matter in respect of news item appearing in The Hindu dated 08.09.2024 titled "Lakes developed under Smart Cities Initiative in Coimbatore turn dumping grounds for plastic waste"

Vs

Coimbatore City Municipal Corporation,
Through its Commissioner,
Coimbatore and Ors.

..... Respondent(s)

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Place: Chennai

Date: 27.01.2025



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B. Sambareddy

COUNSEL FOR R3

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**REPLY FILED ON BEHALF OF RESPONDENT NO. 3,
CENTRAL POLLUTION CONTROL BOARD (CPCB)**

1. That, Hon'ble NGT (PB) vide order dated 26.09.2024 in case of Original Application No. 1186 of 2024 (PB), impleaded Central Pollution Control Board (hereinafter referred as CPCB) as Respondent No. 3 and sought the response in the instant matter. Thereby, the reply is made in this instant Original Application (hereinafter referred to as OA) in succeeding paragraphs.
2. That, CPCB is constituted under Section 3 of the Water (Prevention and Control of Pollution) Act, 1974. It performs the functions under the Water (Prevention and Control of




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Pollution) Act ,1974, the Air (Prevention and Control of Pollution) Act 1981, and the Environment (Protection) Act, 1986.

REPLY

1. That, the matter is related to the lakes in Coimbatore that were developed under Smart Cities initiative. As per the news item, food outlets located on the premises and nearby areas dispose of their waste on the banks of the water bodies. The news item highlights that packaged drinking water bottles, snack wrappers, disposable cutlery, trays, plastic bags and other single-use packaging are being discarded around the lakes. The news item also highlights the need for using biodegradable packaging and placing public information systems at the lakes to educate visitors about the importance of water bodies and harmful effects of pollution. Furthermore, the news item alleges that banning the sale of packaged water bottles at lakesides, installing drinking water kiosks, and introducing a buyback scheme for water bottles can encourage responsible waste disposal.
2. That, it is humbly submitted that, Ministry of Environment, Forest & Climate Change has notified the Plastic Waste Management Rules, 2016 (hereinafter referred to as 'PWM Rules, 2016') vide Notification No. G.S.R. 320(E) dated March 27, 2016. As per Rule 4(2) of PWM Rules, 2016 (as amended in 2021); the manufacture, import, stocking, distribution, sale and use of following single use plastic items, including polystyrene and expanded polystyrene commodities, shall be prohibited with effect from the 1st July, 2022:
 - a. ear buds with plastic sticks, plastic stick for balloons, plastic flags, candy sticks, ice-cream sticks, polystyrene (Thermocol) for decoration.
 - b. plates, cups, glasses, cutlery such as forks, spoons, knives, straw, trays, wrapping or packing films around sweet boxes, invitation cards, and cigarette packets, plastic or PVC banners less than 100 microns, stirrers.




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3. That, it is humbly submitted that, as per Rule 6 (1) of PWM Rules, 2016; the local bodies are entrusted with the responsibility for development and setting up of infrastructure for segregation, collection, storage, transportation, processing and disposal of the plastic waste either on its own or by engaging agencies or producers. As per Rule 7 (a) of the said rules, Gram panchayats either on its own or by engaging an agency are responsible for setting up plastic waste management facilities, operationalizing and co-ordinating for waste management in the rural area under their control and for ensuring segregation, collection, storage, transportation, plastic waste and channelization of recyclable plastic waste fraction to recyclers having valid registration; ensuring that no damage is caused to the environment during this process. As per Rule 8 (a) of the PWM Rules, 2016; the waste generators shall take steps to minimize generation of plastic waste and segregate plastic waste at source in accordance with the Solid Waste Management Rules, 2016 as amended from time to time. As per Rule 8 (b) of the PWM Rules, 2016, waste generators shall not litter the plastic waste and ensure segregated storage of waste at source and handover segregated waste to urban local body or gram panchayat or agencies appointed by them or registered waste pickers', registered recyclers or waste collection agencies.

4. That, it is humbly submitted that, as per Rule 12 (1) of the PWM Rules, 2016 (as amended in 2021); the Central Pollution Control Board, State Pollution Control Boards and Pollution Control Committee in respect of a Union territory shall be the authority for enforcement of the provisions of these rules relating to registration, manufacture of plastic products and multi-layered packaging, processing and disposal of plastic wastes. As per Rule 12 (2) of the PWM Rules, 2016 (as amended in 2021), the concerned Secretary-in-charge of Urban Development of the State or a Union Territory shall be the authority for enforcement of the provisions of these rules relating to waste management by waste generator, restriction or prohibition on use of plastic carry bags, plastic sheets or like, covers made of plastic sheets and multi-layered packaging. As per Rule 12 (3) of the PWM Rules, 2016 (as amended in 2021), the concerned Gram Panchayat shall be the authority for enforcement of the




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provisions of these rules relating to waste management by the waste generator, restriction or prohibition on use of plastic carry bags, plastic sheets or like, covers made of plastic sheets and multi-layered packaging in the rural area of the State or a Union Territory.

5. It is submitted that CPCB prepared a Comprehensive Action Plan to enforce the ban on SUP, which was broadly divided into following three categories:

- **Supply Side Intervention:** With focus on stopping the production of banned SUP
- **Demand Side Intervention:** With focus on stopping the demand of banned SUP
- **Creating of Enabling Environment for Phasing out SUP:** With focus on implementing measures facilitating phasing out SUP

6. The major activities carried for enforcement of SUP ban are enlisted below:

i. **Issue of Directions & Communications:** Following Directions / Communications were issued for implementation of SUP ban:

- **Direction under section 5 of the Environment (Protection) Act, 1986:** Issued to all SPCBs/PCCs on **11.11.2024** to conduct inspection and monitoring of all compostable plastic manufacturing units in their jurisdiction.
- **Direction Under Section 5 of the Environment (Protection) Act, 1986:** Issued to the Principal Secretary, all State Urban Development Departments(UDDs) and SPCB/PCCs on the following dates: 01-02-2022, 30-06-2022, 01-03-2023, 17-05-2023, 20-11-2023, 16-02-2024 and 11.11.2024 These directions were issued for conduction of joint enforcement drive for enforcement of SUP ban for four days a month. The latest direction was issued **on 11.11.2024** for joint inspections during October 2024 to January 2025.
- **Direction Under Section 5 of the Environment (Protection) Act, 1986:** Issued to all SPCBs/PCCs on **04-07-2024** to direct local bodies and district panchayats to




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assess and characterize plastic waste for annual reporting as per Standard Operating Procedure(SOP) and PWM Rules.

- **Direction to Airlines operators regarding SUP:** Issued to 11 airline companies on **17-02-2023** to phase out banned SUP items.
- **Direction under Section 5 of the EPA, 1986:** Issued to 10 e-commerce companies and 21 e-commerce on **25-01-2023** and **13-12-2022** respectively to stop usage of SUP items
- **Directions under Section 5 of the EPA, 1986:** Issued to plastic raw material manufacturers on **13-12-2022** regarding supply restrictions to unregistered producers and manufacturers of banned SUP items.
- Letter issued on 12.10.2022 to Chief Secretaries of all States & UTs to issue necessary instructions to all concerned authorities in their jurisdiction to facilitate implementation of SUP Ban.
- Letter issued on 01.12.2021 to Custom Authorities to stop import of banned SUP items.

ii. **Development of Web Portals**

CPCB developed two web portals for the management of banned Single Use Plastic, which are as under:

- **CPCB Monitoring Module for Compliance of SUP:** This portal facilitates the uploading of information of entities such as Sellers, Users and Commercial Establishments by Local Bodies. An app has also been developed as part of this portal, wherein field officers from Local Bodies can feed in information of inspections carried out by them. Details of entities uploaded by local bodies and those inspected by field officers are accessible to the relevant local




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bodies and also the concerned State Pollution Control Boards (SPCBs) or Pollution Control Committees (PCCs). (<http://plastic.cpcb.gov.in/sup>)

- **SUP Public Grievance Portal:** This portal allows the public to register complaints regarding banned SUP items through an app. The portal has also mapped Local Bodies across India so that complaints submitted are directed to concerned Local Body which can then address the grievances within their jurisdiction. Furthermore, if no action is taken within the specified time limit, the portal allows for escalation of complaints to the relevant SPCB/PCC and UDD as needed. (<https://sup.cpcbcr.com/v2.0/#>)

iii. **Workshops on Alternative to SUP**

- 14 State-wise in-person Workshops for MSMEs on Alternatives to SUP were conducted in association with CIPET, concerned SPCBs/PCCs & MSME.
- 10 Workshop on “Alternatives to Single Use Plastic” for various stakeholders were conducted by CPCB.
- Compendium of presentations of workshops prepared and uploaded on CPCB’s website.
- Compendium of manufacturers/sellers of alternatives to SUP prepared and uploaded on CPCB’s website.

iv. **Awareness Activities on SUP**

- **Webinar on “Phasing out Single use plastic”**

CPCB organised “Awareness programmes to avoid the use of Single Use Plastics” during the week from 4th to 10th October, 2021 allocated by Ministry of Culture under the Azadi Ka Amrit Mahotsav’ programme.




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Webinar was organized by CPCB for “Phasing out of Single Use Plastic”. Presentations regarding current status of SUP across the country and available alternatives of SUP were made during webinar. Members from State Boards, UDDs, Regional Directorate of CPCB and different plastic associations participated in the webinar.

○ **Campaign in Social & Print Media**

- Campaign Material for phasing out SUP has been prepared by CPCB and placed on CPCB’s website.
- Advt. on Campaign to reduce/eliminate use of littered single use plastic been published in leading National & Local Dailies.

○ **Awareness events organized under Mission LiFE**

Central Pollution Control Board, State Pollution Control Boards & Pollution Control Committees have made significant efforts in implementing Mission LiFE by conducting various mass awareness programs on all the seven themes of Mission LiFE including the reduction in Single Use Plastics. A total of 38000 (approx.) mass awareness events with participation from over 35 lakh people has been recorded.

v. **Enforcement Drive for implementation of SUP Ban**

- CPCB has conducted a total of 21912 inspections out of which 15694 joint inspections were carried out along with SPCB/PCCs/UDD officials.
- Further as per details provided by SPCBs/PCCs and details available at SUP Compliance Monitoring Portal, total 857813 number of inspections have been




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conducted, 1963.6 tons of SUP items have been seized and total Rs.19.77 crore fine has been imposed for violation of SUP ban.

7. That, it is humbly submitted that, CPCB had prepared Standard Operating procedure (SOP) for assessment of quantity of plastic waste generated and its characterization, with a focus on enforcement on ban on Single Use Plastic as per the PWM rules, 2016. A copy of the Standard Operating Procedure for Assessment & Characterization of Plastic Waste is attached as **Annexure-1**. In addition, vide File No. CP-20/117/2021-UPC-II-HO-CPCB-HO-Part (7) dated 04.07.2024, CPCB had issued directions to all the State Pollution Control Boards (SPCBs) and Pollution Control Committees (PCCs) under Section 5 of the EPA, 1986 regarding Characterization & Assessment of Plastic Waste by Local bodies, District Panchayats, SPCBs & PCCs as per methodology developed by CPCB. A copy of the directions issued is attached as **Annexure-2**.
8. It is humbly submitted that CPCB has taken various steps as given above to enforce the implementation of ban on Single use plastics. Further, the concerned SPCBs/PCCs are required to take necessary action for enforcement of PWM Rules and compliance of Directions issued by CPCB on the matter in their jurisdiction.
9. It is humbly submitted that Compostable plastic manufacturers are required to obtain certificate from CPCB as per Rule 4(h) of the PWM Rule 2016 (As amended). CPCB has certified over 300 compostable plastic manufacturers with a production capacity of 3,00,000 TPA in accordance with the provision of the said Rules.
10. That, it is humbly submitted that, as per the information provided by TNPCB, Coimbatore City generates plastic waste of 90TPD and out of which 60TPD of plastic waste is being processed (TNPCB Annual Report 2023-24). There are 12 plastic waste recycling facility having capacity to recycle 7284TPA of plastic waste. As per the information, Coimbatore city corporation for the enforcement of SUP ban from January 2019 to December 31, 2024




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has conducted 42,931 nos of raids, seized SUP items of 40,500Tons and imposed & collected fine of Rs. 120,6655 Lakhs. The copy of the report submitted by TNPCB w.r.t plastic waste generation, processing and enforcement of SUP by Coimbatore City Corporation is attached as **Annexure 3**.

11. That the CPCB has formulated Indicative Guidelines for Restoration of Water Bodies in compliance to the directions of Hon'ble NGT order dated 10.05.2019 in OA No. 325 of 2015 titled Lt. Col. Sarvadaman Singh Oberoi Vs. UoI & Ors. CPCB further requested all SPCBs/ PCCs including Tamil Nadu state to formulate its action plan for restoration of water bodies in their respective States/UTs vide letter dated 18.06.2019. Salient features of the indicative guidelines for restoration of water bodies are detailed below:-

- Recognition Phase includes identification and recognition of the problem (inventory of existing and lost water bodies (due to encroachment, pollution, diversion etc.), analysis of cause of the problem and its effect and development of alternative solutions of problem.
- Restoration Phase includes declaring the 'designated best use' in order to formulate strategies and to decide degree of treatment required for restoration of such water body.
- Protection Phase that takes care of the general health of the water body and ensures normal functioning. A long-term, preventive approach directed to preventing the causes of water body degradation is essential
- Improvement phase deals with overall improvement in the water body and its uses including resolution of conflicts among competing users of resources taking into the needs present and future generations and nature.




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Copy of the Indicative Guidelines for Restoration of Water Bodies is annexed herewith as **Annexure-4**.

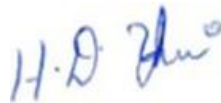
12. For ensuring compliance to the above-mentioned matter, Tamil Nadu Pollution Control Board (TNPCB) submitted the information on Restoration of Water Bodies vide e-mail dated 30.05.2020. Salient features of the information submitted by TNPCB is detailed below:

- Tamil Nadu Pollution Control Board vide e-mail dated 30.05.2020 informed that in Tamil Nadu State, 14,341 water bodies are under the custody of Public Works Department (PWD) in 32 Districts in TN.
- During the last five years 4,718 water bodies have been restored at a total cost of Rs.1308.49 Lakhs under various schemes such as Repair, Renovation and Restoration (RRR), Tamil Nadu Irrigation Agriculture Modernization Project (TNIAMP) Phase I, Kudimaramath, De-silting of water bodies for city water supply, De-silting of reservoirs, De-silting by NGO, traditional water bodies and National Bank For Agriculture & Rural Development (NABARD) aided schemes.
- Restoration work of 1,717 water bodies is under progress at an estimated cost of Rs. 445.3 Crore .

Copy of information submitted by TNPCB is annexed herewith as **Annexure 5**.

13. That, in light of the above submission, it is respectfully submitted that this Answering Respondent No. 3, i.e. CPCB, shall abide by any order(s) or direction(s) passed by this Hon'ble Tribunal in the instant OA.




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Scientist E & Regional Director
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..... Respondent(s)

AFFIDAVIT

I, H. D. Varalaxmi, D/o Shri H.S. Devaiah, Hindu, aged about 55 years and having office at the Regional Directorate - Chennai, Central Pollution Control Board, 40-E, 2nd Floor, BSNL Building, TVK Industrial Estate, CIPET Road, Chennai - 600 032, do hereby solemnly affirm and sincerely state as follows:

1. That the deponent is authorized representative to represent the Respondent CPCB in the present case, and as such, I am well conversant with the facts and circumstances of the present case on the basis of the information derived from the official records, and hence, I




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am competent and authorized to verify, sign and swear this affidavit on behalf of the Respondent CPCB.

2. That the accompanying reply may be read part and parcel of the present affidavit as I am competent to swear this affidavit.
3. That the accompanying reply has been drafted and filed under my instructions and authority the contents thereof of are true and correct on the basis of the record maintained during ordinary course of business of CPCB and available records and documents and the contents of the same are read over and explained to me and are not repeated herein for the sake of brevity.

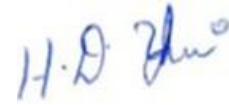


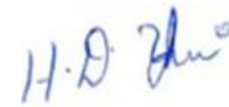
VERIFICATION

Verified at Chennai on this 27th day of January, 2025 that the contents of the above reply are correct and true on the basis of the record of the cases as maintained in the day to day affairs of the CPCB. Nothing has been concealed therefrom or mis-stated.

Verified at Chennai on this the 27th day of January 2025


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**Standard Operating Procedure
for
Assessment & Characterization of Plastic Waste**



June, 2024

Central Pollution Control Board, Delhi

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Annexures:

- **Annexure I:** Amendment to PWM Rules dated August 12, 2021
- **Annexure II:** Amendment to PWM Rules dated February 16, 2022- Extended Producer Responsibility Guidelines
- **Annexure II A:** Amendment to PWM Rules dated March 14, 2024
- **Annexure III:** Report on Study conducted by GIZ
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- **Annexure V:** Determination of Sorting Sample size, number of vehicle loads, Vehicle load size and no. of days for sampling
- **Annexure VI:** Illustrative Example
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1.0 Background & Legal Framework

In the last couple of decades, India has experienced rapid urbanization, industrialization, and economic growth, which has led to a substantial increase in plastic waste generation. The burgeoning population, along with improvements in living standards, has further exacerbated the quantum of plastic waste generation. The widespread use of plastics, especially single-use items and its indiscriminate disposal, poses a serious threat to the environment.

The Plastic Waste Management Rules of 2016, along with subsequent amendments, laid out a statutory framework for effective plastic waste management in the country. As per the provision of PWM Rules, the local bodies are required to assess the quantum of plastic waste generated in their jurisdiction and report the same in the Annual Report to be submitted to the concerned SPCB/PCC, which in turn compiles the same and submits it to CPCB.

Further, vide Amendment to PWM Rules dated August 12, 2021 (**Annexure I**) - import, production, sale, stocking and use of identified single-use plastic items like ear buds with plastic sticks, plastic flags, plates, cups, cutlery, and other similar disposable plastic products, has been banned w.e.f July 01, 2022. Also, vide Amendment to PWM Rules dated February 16, 2022- Extended Producer Responsibility Guidelines (**Annexure II**) with thrust on processing of plastic packaging waste has been notified by MoEFCC. Various measures have been taken across the country to ensure effective implementation of the said Amendments. It is required to periodically assess the impact of these measures on plastic waste management to strengthen implementation of EPR Guidelines and enforcement of SUP ban.

Further, MoEFCC vide Amendment dated March 14, 2024 (**Annexure IIA**) has included the following in the PWM Rules

- Rule 6 (5) The local body shall undertake assessment of plastic waste generated, including plastic waste existing in dump sites, by the 30th June of every year and also estimate the quantity of plastic waste to be generated in following five-year period.

Standard Operating Procedure (SOP) for Assessment & Characterization of Plastic Waste

- Rule 6 (8) The local body shall include in the annual report the following details on plastic waste management, namely:- (i) plastic waste generated, including plastic waste existing in dump sites, in a year; (ii) plastic waste management infrastructure available for collection, segregation, processing; (iii) projection of plastic waste to be generated; (iv) status on framing and implementation on byelaws; (v) actions taken action to prevent stocking, distribution, sale and usage of prohibited Single Use Plastic items.
- Rule 7A.: Responsibility of Panchayat at District level. - (1) The Panchayat at District level shall undertake assessment of plastic waste generated, including plastic waste existing at dump sites, by the 30th June of every year for rural areas of the district and also estimate the quantity of plastic waste to be generated in following five-year period.
- Rule 7A (3) The Panchayat at District Level shall include in the annual report the following details on plastic waste management, namely:- (i) plastic waste generated, including plastic waste existing at dump sites, in a year; (ii) plastic waste management infrastructure available for collection, segregation, processing; (iii) projection of plastic waste to be generated; (iv) status on framing and implementation on byelaws; (v) actions taken action to prevent stocking, distribution, sale and usage of banned Single Use Plastic items.
- Rule 17 (4) Every urban local body and Panchayat at District Level shall prepare and submit online an annual report in Form-V to the Urban Development Department and to Rural Development Department, respectively, and also to the State Pollution Control Board or Pollution Control Committee concerned by the 30th June every year.
- Rule 17 (5) The State Pollution Control Board or Pollution Control Committee concerned shall cause the report submitted by the urban local body and Panchayat at District level to be audited by itself or through a designated agency and copy of the report of such audit and the annual report shall be made available on website of State Pollution Control Board or Pollution Control Committee concerned.

Standard Operating Procedure (SOP) for Assessment & Characterization of Plastic Waste

- Rule 17 (6) The State Pollution Control Board or Pollution Control Committee shall prepare and submit online an annual report in Form VI to the Central Pollution Control Board on the implementation of these rules by the 31st July of every year.
- As per Form V A (Format of Annual Report by Local Bodies) (Section B (1 & 2)), Form V B ((Format of Annual Report by Village Panchayats) (Section B (3 & 4)) the Local Bodies / Village Panchayats are required to carry out the assessment related to plastic waste generation as per the methodology developed by CPCB, the details of which are to be included in the Annual Report which is to be submitted online.
- As per Form VI (Format of Annual Report to be submitted by SPCBs/PCCs) (Section C 8 -13), the SPCBs/PCCs are required to assess the Plastic waste generated in their jurisdiction as per methodology developed by CPCB

This SOP has been prepared incorporating the aforementioned provision of PWM Rules. The SOP outlines the methodology to assess the quantity of plastic waste generation and its characterization specifically w.r.t Single Use Plastic and Categories of Plastic Packaging as per PWM Rules. A study conducted by GIZ on the matter (**Annexure III**) has been referred to for preparing this document. Further, methodology for validation of data reported by the Local Bodies in the Annual Report, by the SPCBs/PCCs has also been included in this document. All concerned stakeholders including the local bodies and the SPCBs/PCCs shall follow the methodology delineated in this SOP for compliance of PWM Rules, 2016 (as amended).

2.0 Characterization & Assessment of Plastic Waste by Local Bodies

2.1 Determination of parameter for waste Characterisation

The plastic waste characterization method is based on the Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste, American Society for Testing and Materials (ASTM) standard test method (D5231- 92) (**Annexure IV**). As per methodology, the following parameters are to be decided prior to initiation of the Waste Characterization:

Standard Operating Procedure (SOP) for Assessment & Characterization of Plastic Waste

- a. **Number of Vehicles to be sampled (n):** It refers to the number of vehicles transporting municipal waste from which the waste sample for characterization is to be collected.
- b. **Sorting sample size (kg) (s) :** It is the quantum of sample extracted for further analysis, from each vehicle load, using cone and quarter method (Refer Annexure IV). It is to be in the range of 91-135 Kg
- c. **Vehicle load Size (kg) (v):** It is the quantum of waste which the aforementioned vehicles can transport in one trip. It is four times the size of the sorting samples i.e 360- 540 kg
- d. **Duration of sampling (No of Days) (k):** It is the number of days during which waste samples for analysis have to be collected.

The steps to be followed for determination of Sorting Sample size, number of vehicle to be sampled, Vehicle load size and no. of days for sampling in a particular Local body's jurisdiction as per ASTM D 5231-92 are detailed at **Annexure V**. Wide variation in quantum of waste generation in the country, depending upon the population, has been observed in the country. Further, sampling and analysis capacity also varies significantly with the type of the local body, being higher for large cities as compared to smaller cities. Further, higher Confidence level and lower precision level in the Assessment is required for the larger cities (refer **Annexure V**). Accordingly, the various parameters (n, v, s & k as per (a-d above) have been computed using ATM D 5231-92 assigning value of Confidence & Precision values proportionate to the population size of city /town/village panchayat and are given in **Table 1**.

*Standard Operating Procedure (SOP) for Assessment & Characterization of Plastic Waste***Table 1: Sorting Sample size, number of vehicle loads, Vehicle load size and no. of days for sampling for Cities, Towns & Villages:**

S. No.	Category	Min Population	Max Population	Confidence level	Precision level	Vehicle Load Size (kg)	Sorting Sample size (Kgs)(s)	Total no. of Samples To be collected (n)	Sampling Days (k)
1.	Village Panchayat	1000 (avg.)	4999	0.9	0.2	360 [#]	90	7	5
2.	Cities & Towns	5000	99999	0.9	0.15	400	100	14	6
3.	Cities & Towns	>10000		0.95	0.1	480	120	45	7

Note #: *In hilly regions where movement of heavy vehicles is difficult, the Vehicle Load size of “360 Kg” applicable for “Village Panchayats” can be considered for Cities and Towns (Category 2&3 of Table 1)*

2.2 Distribution of the sampling locations:

Three stage random sampling method is to be followed to ensure full coverage of the geographical area as well as to include impact of socio-economic variation of the population on the waste generation.

Stage 1: Division of the city area into five zones East, West, North, south and central zone

Stage 2: Classification of the various wards in the zone under the following five major categories based on its socio-economic attributes of the ward as given below

Standard Operating Procedure (SOP) for Assessment & Characterization of Plastic Waste

- High-income residential wards (HI)
- Middle-income residential wards (MI)
- Economically Weaker Section (EWS) residential wards/slums
- Commercial wards (CW)
- Mixed commercial and residential wards (MX)

It is to be noted that the class assignment as per aforementioned details, should be based on the predominant feature of the ward. In addition to above, one disposal point should be identified in each Zone.

The number of vehicle loads to be collected from each zone would be distributed amongst the wards, to ensure adequate representation of the socio-economic attributes of the population in the Assessment. The number of samples from each economic category and zone should be uniformly distributed throughout the assessment duration (k days). Example illustrating the distribution of sampling locations is given at **Annexure VI** (Example 1)

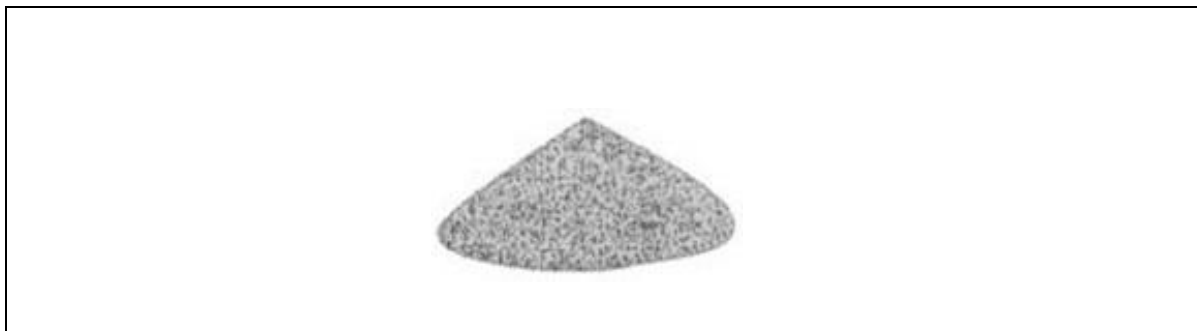
2.3 Sample preparation:

One Sorting sample is to be selected using the Cone & Quarter method from each vehicle load following the given steps:

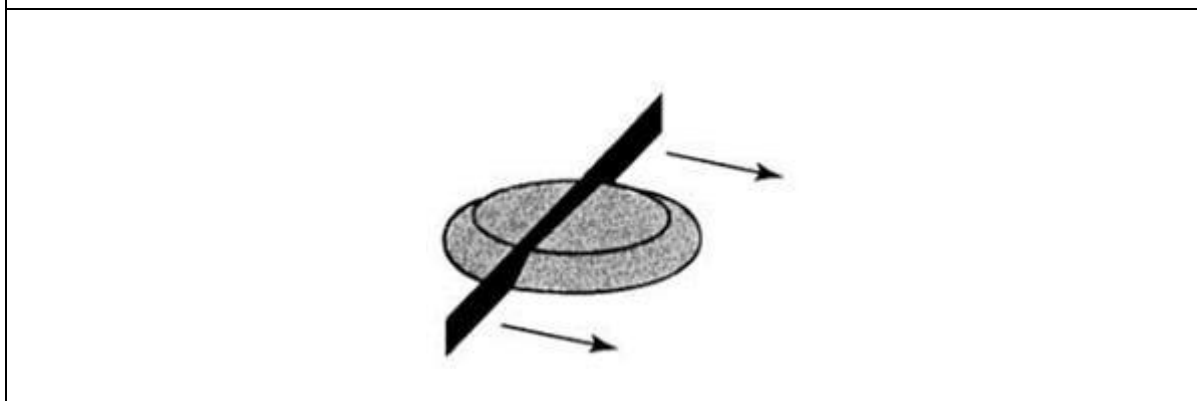
- A location is to be selected for discharge of designated vehicle loads, manual sorting activities, and weighing operations. The location should be flat, level, and away from the normal waste handling and processing areas.
- The entire vehicle load of waste should be discharged in a designated area.
- The waste should be mixed and using the Quartering and coning, the vehicle load size (400-500 kg) shall be reduced to Sorting sample size (100-125 kg) method to reduce the size of the sample to the range of 100-125 kg.
- The entire vehicle load is to be disposed on the ground and divided into four parts. Two samples positioned diagonally opposite to each other are to be selected for the next step, the other two have to be discarded. The process is to be repeated to reduce the size of the sample from 400-500 kg to 100- 125 kg.

Standard Operating Procedure (SOP) for Assessment & Characterization of Plastic Waste

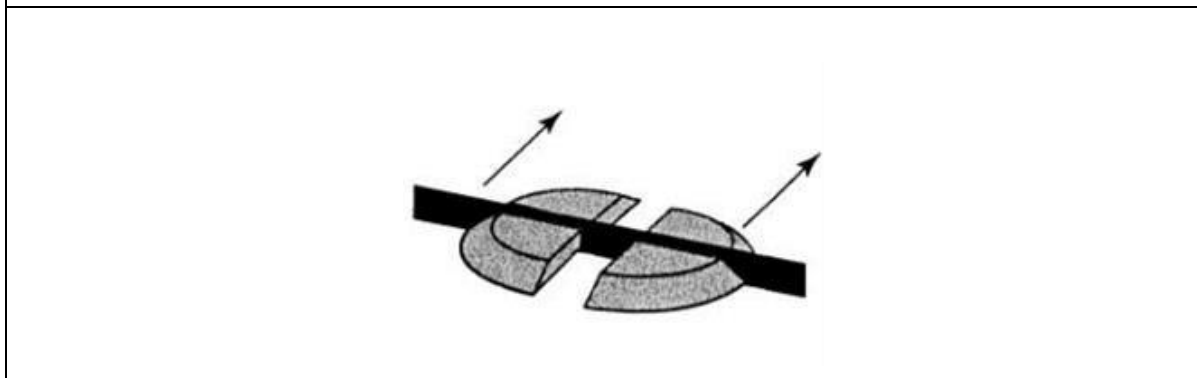
Pictorial representation of the same is given in Figure 1.0. For further details, Section 8 of the ASTM Standard is to be referred to.



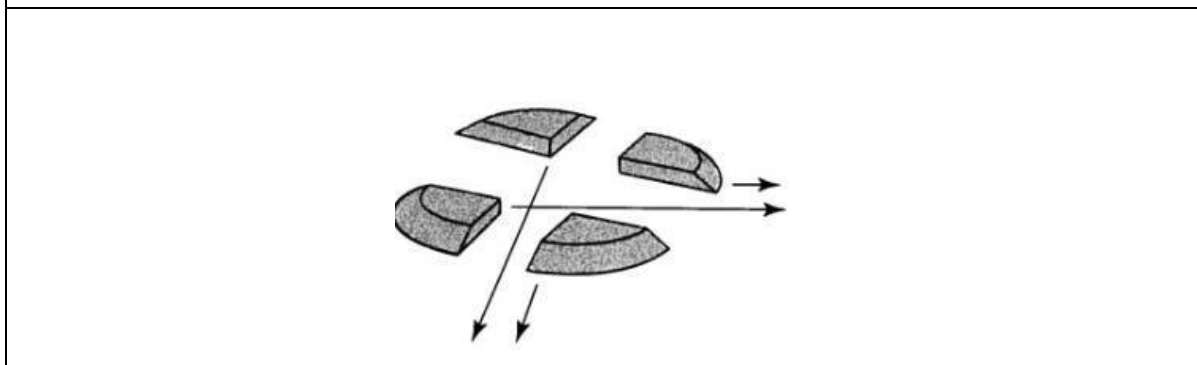
Step 1: Preparation of Cone



Step 2: Flattening & partitioning of the cone into two parts

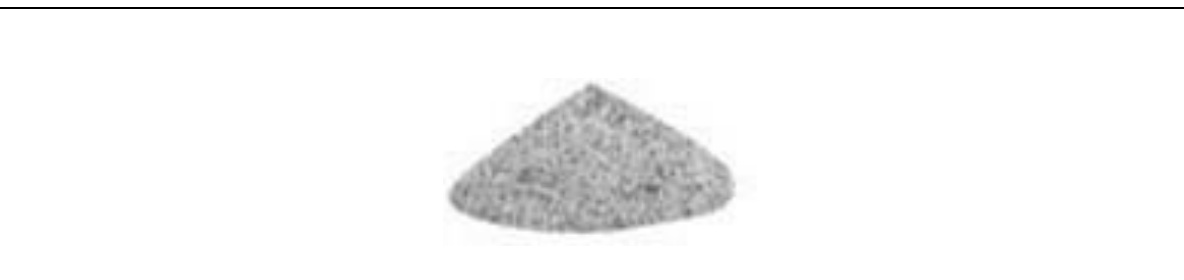


Step 3: Partitioning of the Cone into four parts



Step 4: Select two opposite quarters & discard the remaining two

Step 5: Mix the two selected quarters for further analysis
Figure 1: Cone & Quarter Method for sampling of Waste



2.4 Waste Characterization

The EPR guidelines categorize plastic packaging into four groups: rigid, flexible, multi-layered, and compostable plastics. PET Water bottles, HDPE bottles used for packaging shampoo, detergent etc. are categorized into Rigid plastics (Category I).

Carry bags, plastic packaging etc. are categorized as flexible plastics (Category II). Multilayered plastic packaging (Category III) has at least one layer of plastic and at least one layer of material other than plastic is used for packaging products like chips packets, tea, coffees etc. Compostable plastic packaging (Category IV) under degradation by biological process and have a feel and texture (matt finish) different from the conventional plastics. Various laboratory methods, including the "Quick Verification Test," are available to differentiate between compostable and conventional plastics. SOP for testing compostable plastics developed by CPCB is placed at **Annexure VII**. Further, as per PWM Rules & SOP developed by CPCB, Compostable Plastics are required to be labelled giving details such as the name of its manufacturer.

Pictorial representation of various categories of packaging and SUP items is enclosed at **Annexure VIII**.

Helpers and sorters to be engaged in characterization are to be identified and properly trained for identification of different categories of Single Use Plastic Items and Category of Plastic Management.

Quantity of waste categorized shall be determined as given below:

Standard Operating Procedure (SOP) for Assessment & Characterization of Plastic Waste

The findings of the sorted sample in Kg/ Metric Ton-(MT) shall be reported as per format given in Table 2 & 2A (Plastic Packaging Category) (Generation & Disposal Point) and Table 3 & 3A (SUP Category) (Generation & Disposal Point) respectively.

**Table 2A: Plastic Waste characterization (Plastic Packaging category wise):
Generation points**

Vehicle Load No. (1)	Sorting Sample Size (Kg) (2)	Total PW(Kg) (3)	Category 1 PW(kg) (4)	Category 2 PW(kg)(5)	Category 3 PW (kg) (6)	Category 4 PW (kg) (7)
1						
2						
..						

n						
Total	\sum Row 1..n	\sum Row 1..n	\sum Row 1..n	\sum Row 1..n	\sum Row 1..n	\sum Row 1..n
Average (kg/kg)		$\frac{\sum \text{Column 3/ Column 2}}{\sum \text{Column 2}}$	$\frac{\sum \text{Column 4/ Column 2}}{\sum \text{Column 2}}$	$\frac{\sum \text{Column 5/ Column 2}}{\sum \text{Column 2}}$	$\frac{\sum \text{Column 6/ Column 2}}{\sum \text{Column 2}}$	$\frac{\sum \text{Column 7/ Column 2}}{\sum \text{Column 2}}$

**Table 2B: Plastic Waste characterization (Plastic Packaging category wise):
Disposal points**

Vehicle Load No. (1)	Sorting Sample Size (Kg) (2)	Total PW(Kg) (3)	Category 1 PW(kg) (4)	Category 2 PW(kg)(5)	Category 3 PW (kg) (6)	Category 4 PW (kg) (7)
1						
2						

Standard Operating Procedure (SOP) for Assessment & Characterization of Plastic Waste

Vehicle Load No. (1)	Sorting Sample Size (Kg) (2)	Total PW(Kg) (3)	Category 1 PW(kg) (4)	Category 2 PW(kg)(5)	Category 3 PW(kg) (6)	Category 4 PW(kg) (7)
..						

n						
Total						
Average (kg/kg)		$\frac{\sum \text{Column 3}}{\sum \text{Column 2}}$	$\frac{\sum \text{Column 4}}{\sum \text{Column 2}}$	$\frac{\sum \text{Column 5}}{\sum \text{Column 2}}$	$\frac{\sum \text{Column 6}}{\sum \text{Column 2}}$	$\frac{\sum \text{Column 7}}{\sum \text{Column 2}}$

Table 3A: Plastic waste characterization (Single Use Plastic) – Generation point

			Vehicle Load No. 1(kg)	Vehicle Load No. 2(kg)	...	...	...	Vehicle Load No. N(kg)	Total \sum	Average (kg /kg)
1	a	Sorting Sample Size (kg)								
	b	Plastic Waste (kg)								$\frac{\sum \text{ (Row 1b/ } \sum \text{ Row 1a}$
		SUPs								
2	Plastic Sticks	a	Earbuds(kg)							$\frac{\sum \text{ (Row 2a/ } \sum \text{ Row 1a}$

Standard Operating Procedure (SOP) for Assessment & Characterization of Plastic Waste

			Vehic le Loa d No. 1(kg)	Vehic le Loa d No. 2(kg)	...	...	...	Ve hic le Loa d No N(k g)	To tal Σ	Average (kg /kg)
	b	Balloons(kg)								$\frac{\Sigma (\text{Row } 2b)}{\Sigma \text{Row } 1a}$
	c	Candy(kg)								$\frac{\Sigma (\text{Row } 2c)}{\Sigma \text{Row } 1a}$
	d	Ice-cream(kg)								$\frac{\Sigma (\text{Row } 2d)}{\Sigma \text{Row } 1a}$
	e	Straws(kg)								$\frac{\Sigma (\text{Row } 2e)}{\Sigma \text{Row } 1a}$
3	Cutlery i tems	a	Plates(kg)							$\frac{\Sigma (\text{Row } 3a)}{\Sigma \text{Row } 1a}$
		b	Cups(kg)							$\frac{\Sigma (\text{Row } 3b)}{\Sigma \text{Row } 1a}$
		c	Glass(kg)							$\frac{\Sigma (\text{Row } 3c)}{\Sigma \text{Row } 1a}$
		d	Forks(kg)							$\frac{\Sigma (\text{Row } 3d)}{\Sigma \text{Row } 1a}$
		e	Spoons(kg)							$\frac{\Sigma (\text{Row } 3e)}{\Sigma \text{Row } 1a}$
		f	Knives(kg)							$\frac{\Sigma (\text{Row } 3f)}{\Sigma \text{Row } 1a}$
		g	Trays(kg)							$\frac{\Sigma (\text{Row } 3g)}{\Sigma \text{Row } 1a}$

Standard Operating Procedure (SOP) for Assessment & Characterization of Plastic Waste

				Vehic le Loa d No. 1(kg)	Vehic le Loa d No 2(kg)	...	...	...	Ve hic le Lo ad No N(k g)	To tal Σ	Average (kg /kg)
4	Packagi ng / Wra pping Fi lms	a	Sweet box(kg)								Σ (Row 4a/ Σ Row 1a
		b	Invitation (kg) cards								Σ (Row 4b/ Σ Row 1a
		c	Cigarette (kg) Packets								
5	Carry ba gs	a	<120 microns(kg)								Σ (Row 5a/ Σ Row 1a
6	Plastic s heets	b	<50 microns(k g)								Σ (Row 6a/ Σ Row 1a
7	Other it ems	a	Plastic flags(kg)								Σ (Row 7a/ Σ Row 1a
		b	PVC banner s < 100 μ m, polystyrene f or decoratio n(kg)								Σ (Row 7b/ Σ Row 1a
		c	Polystyrene fo r decoration(k g)								

Standard Operating Procedure (SOP) for Assessment & Characterization of Plastic Waste

Table 3B: Plastic waste characterization (Single Use Plastic) – Disposal point

				Vehicle Load No. 1(kg)	Vehicle Load No. 2(kg)	...	...	...	Vehicle Load No. N(kg)	Total \sum	Average (kg/kg)
1		a	Sorting Sample Size (kg)								
		b	Plastic Waste (kg)								$\frac{\sum (\text{Row 1 b})}{\sum \text{Row 1 a}}$
			SUPs								
2	Plastic Sticks	a	Earbuds(kg)								$\frac{\sum (\text{Row 2 a})}{\sum \text{Row 1 a}}$
		b	Balloons(kg)								$\frac{\sum (\text{Row 2 b})}{\sum \text{Row 1 a}}$
		c	Candy(kg)								$\frac{\sum (\text{Row 2 c})}{\sum \text{Row 1 a}}$
		d	Ice-cream(kg)								$\frac{\sum (\text{Row 2 d})}{\sum \text{Row 1 a}}$
		e	Straws(kg)								$\frac{\sum (\text{Row 2 e})}{\sum \text{Row 1 a}}$
3	Cutlery items	a	Plates(kg)							$\frac{\sum (\text{Row 3 a})}{\sum \text{Row 1 a}}$	

Standard Operating Procedure (SOP) for Assessment & Characterization of Plastic Waste

				Vehicle Load No. 1(kg)	Vehicle Load No. 2(kg)	...	...	...	Vehicle Load No. N(kg)	Total Σ	Average (kg/kg)
		b	Cups(kg)								Σ (Row 3 b/ Σ Row 1 a
		c	Glass(kg)								Σ (Row 3 c/ Σ Row 1 a
		d	Forks(kg)								Σ (Row 3 d/ Σ Row 1 a
		e	Spoons(kg)								Σ (Row 3 e/ Σ Row 1 a
		f	Knives(kg)								Σ (Row 3 f/ Σ Row 1 a
		g	Trays(kg)								Σ (Row 3 g/ Σ Row 1 a
4	Packaging / Wrapping Films	a	Sweet box(kg)								Σ (Row 4 a/ Σ Row 1 a
		b	Invitation (kg) cards								Σ (Row 4 b/ Σ Row 1 a
		c	Cigarette (kg) Packets								Σ (Row 4 c / Σ Row 1 a

Standard Operating Procedure (SOP) for Assessment & Characterization of Plastic Waste

				Vehicle Load No. 1(kg)	Vehicle Load No 2(kg)	...	...	...	Vehicle Load No N(kg)	Total Σ	Average (kg/kg)
5	Carry bags	a	<120 microns(kg)								$\Sigma (\text{Row } 5 \text{ a}) / \Sigma \text{Row } 1 \text{ a}$
6	Plastic sheets	b	<50 microns(kg)								$\Sigma (\text{Row } 6 \text{ a}) / \Sigma \text{Row } 1 \text{ a}$

2.5 Assessment of Plastic Waste by Local Bodies

2.5.1. Quantity of Plastic Waste Generation

- Average quantity of plastic waste generated (kg of plastic waste/ kg of mixed waste)

$$Q1 = (\Sigma \text{Column } 3) / (\Sigma \text{ Column } 2) \text{ - refer Table 2A}$$

OR

$$Q1 = (\Sigma \text{Row } 1b) / (\Sigma \text{ Row } 1a) \text{ - refer Table 3A}$$

- Quantity of Mixed Waste generated (TPA) = Q
- Quantity of Plastic Waste Generated (TPA) (QT) = Q1*Q

2.5.2 Quantity of Plastic Packaging Waste Generation

- Average quantity of plastic packaging waste generated (kg of plastic packaging waste / kg of mixed waste)

$$(Q2) = (\Sigma (\text{Column } 4) + \Sigma (\text{Column } 5) + \Sigma (\text{Column } 6) + \Sigma (\text{Column } 7)) / (\Sigma (\text{Column } 2) \text{ --- refer Table 2A}$$

- Quantity of Mixed Waste generated (TPA) = Q
- Quantity of Plastic Packaging Waste Generated (Q_{pack}) (TPA) = Q2*Q

Standard Operating Procedure (SOP) for Assessment & Characterization of Plastic Waste**2.5.3 Quantity of SUP Waste Generation**

- Average quantity of SUP waste generated (SUP in kg / kg of mixed waste)

$$(Q_3) = (\sum (\text{Row } 2a \dots 7c)) / (\sum (\text{Row } 1a)) \text{ --- refer Table 3A}$$

- Quantity of Mixed Waste generated (TPA) = Q
- Quantity of SUP Waste Generated (TPA) (Q_{SUP}) = $Q_3 * Q$

2.5.4 Quantity of Other (Non-packaging waste)

$$Q_{other} = Q_T - Q_{pack}$$

2.5.5 Quantity of Plastic Waste Disposed

- Average quantity of plastic waste generated (kg of plastic waste/ kg of mixed waste)
- $Q_{1d} = (\sum \text{Column } 3) / (\sum \text{Column } 2)$ - refer Table 2B

OR

$$Q_{1d} = (\sum \text{Row } 1b) / (\sum \text{Row } 1a) \text{ --- refer Table 3B}$$

- Quantity of Mixed Waste Disposed (TPA) = Q_D
- Quantity of Plastic Waste Disposed (TPA) (Q_{TD}) = $Q_{1d} * Q_D$

2.5.6 Quantity of Plastic Packaging Waste Disposed

- Average quantity of plastic packaging waste Disposed (kg of plastic packaging waste / kg of mixed waste)

$$(Q_{2d}) = (\sum (\text{Column } 4) + \sum (\text{Column } 5) + \sum (\text{Column } 6) + \sum (\text{Column } 7)) / (\sum (\text{Column } 2)) \text{ ----(refer Table 2B)}$$

- Quantity of Mixed Waste Disposed (TPA) = Q_D
- Quantity of Plastic Packaging Waste Disposed ($Q_{pack D}$) (TPA) = $Q_{2d} * Q_D$

2.5.7 Quantity of SUP Waste at Disposal

- Average quantity of SUP waste at Disposal (SUP in kg / kg of mixed waste)

$$(Q_{3d}) = (\sum (\text{Row } 2a \dots 7c)) / (\sum (\text{Row } 1a)) \text{ --- (refer Table 3B)}$$

- Quantity of Mixed Waste Disposed (TPA) = Q_D

Standard Operating Procedure (SOP) for Assessment & Characterization of Plastic Waste

- Quantity of SUP Waste Disposed (TPA) $(Q_{SUP})_D = Q_{3d} * Q_D$

2.5.8 Quantity of Other (Non-packaging waste) Disposed

$$Q_{other\ D} = Q_{TD} - Q_{pack\ D}$$

2.5.9 Quantity of Plastic waste Utilised/Processed

$$Q_{utilised/processed} = Q_T - Q_{TD} \text{ (refer point 2.5.1 and point 2.5.5)}$$

Example illustrating the above calculations is at **Annexure VI**

3.0 Validation, Assessment and Characterization of PW Data by SPCB/PCC

Urban Local Bodies (ULBs) shall follow the methodology detailed in Section 2.0 for Assessment & Characterization of Plastic Waste Generation in their jurisdiction. They shall inform the schedule of Assessment to the SPCBs/PCCs well in advance. SPCBs/PCCs shall join the Assessment to be carried out by the Local Bodies, as required by them to validate the methodology adopted for the Assessment as well as the data reported by the Local Bodies.

3.1 Validation of PW data reported by Local Bodies

The SPCBs/PCCs shall validate the PW data as per the format given in Table 5

Table 4: Validation of PW Data

Sl. No.	Item	Remarks
1	Total No. of Local Bodies in State/ UT	
2	Number of Local Bodies which have confirmed adoption of CPCB Assessment & Characterization Methodology	
3	No. of Local bodies in which SPCB/PCC joined the Assessment for confirmation of Point (2) above	
4	No. of Local Bodies in which SPCB/PCC joined the Assessment , confirming Point (2) above	
5	Number of Local Bodies in which of Quantity Plastic waste reported was verified by SPCB/PCC.	

Standard Operating Procedure (SOP) for Assessment & Characterization of Plastic Waste

Sl. No.	Item	Remarks
6	Number of Local Bodies found in compliance as per Point (5) above	
7	Number of non-complying Local Bodies as per Point (5) above, in which reported data was reconciled by SPCB/PCC	

3.2 Assessment and Characterization of PW Data

The SPCBs/PCCs shall carryout Assessment and Characterization of PW Data in their respective State/UT as per format given in **Table 5**

Sl. No.	Local Body	Total Plastic Waste generated	Qty of SUP (TPA)	Qty of Plastic Packaging PW generated (TPA)	Qty of Other PW generated (TPA)	Quantity of plastic waste disposed (QDstat (TPA))	Quantity of plastic waste disposed (QDpackstat (TPA))	Quantity of SUP waste disposed (QD SUPstat (TPA))	Quantity of plastic waste processed (Qprocess (TPA))
					state (TPA)				
					A)				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

4.0 Implementation of SOP for characterization and Assessment of PW Generation

- a. The SPCBs/PCCs shall impart training to the concerned stakeholders under their jurisdiction for the assessment & characterization of PW as per this SOP.
- b. The local bodies shall carry out assessment as per this SOP either directly or through an agency engaged by them. The State Level Authorities can also collectively engage agencies at the state level who can carry out the Assessment at Local body / Village Panchayat level.
- c. The SPCBs/PCCs shall monitor the implementation of this SOP by the concerned stakeholders in their jurisdiction.
- d. The local bodies/ VPs/SPCBs/PCCs shall submit the information related to assessment & characterization in accordance with provisions 17(4) & 17(6) of PWM Rules, 2016 (as amended).
- e. The online portal for assessment & characterization of plastic waste as per the methodology stipulated in this SOP shall be developed by CPCB. The online portal shall have provision for assessment & characterization by the Local body / Village panchayat level as well as the State level.

ANNEXURE I

MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE**NOTIFICATION**

New Delhi, the 12th August, 2021

G.S.R. 571(E).—Whereas the draft rules to amend the Plastics Waste Management Rules, 2016, were published in the Gazette of India, Extraordinary, dated the 11th March, 2021 vide notification number GSR 169 (E), inviting objections and suggestions from all persons likely to be affected thereby within a period of sixty days from the date copies of the Gazette containing the said draft rules were made available to the public;

And whereas, copies of the Gazette containing the said draft rules were made available to the public on the 11th March, 2021;

And whereas, objections and suggestions received within the aforesaid period have been duly considered by the Central Government;

Now, therefore, in exercise of the powers conferred by sections 6, 8 and 25 of Environment (Protection) Act 1986, (29 of 1986), the Central Government hereby makes the following rules to amend the Plastic Waste Management Rules, 2016, namely :-

1. (1) These rules may be called Plastic Waste Management (Amendment) Rules, 2021.
- (2) They shall come into force on the date of their publication in the Official Gazette.
2. In the Plastic Waste Management Rules, 2016 (hereinafter referred to as the said rules), in rule 2, in sub-rule (1), after the word “Importers”, the words, “brand-owner, plastic waste processor (recycler, co-processor, etc.)” shall be inserted.
3. In the said rules, in rule 3,
 - (i) after clause (n), the following clause shall be inserted, namely :-

„(na) “Non-woven plastic bag” means Non-woven plastic bag made up of plastic sheet or web structured fabric of entangled plastic fibers or filaments (and by perforating films) bonded together by mechanical or thermal or chemical means, and the “non-woven fabric” means a flat or tufted porous sheet that is made directly from plastic fibres, molten plastic or plastic films;“
 - (ii) after clause (q), the following clause shall be inserted, namely: -

„(qa) “Plastic waste processing” means any process by which plastic waste is handled for the purpose of reuse, recycling, co-processing or transformation into new products;“
 - (iii) after clause (v), the following clauses shall be inserted, namely: -

„(va) “Single-use plastic commodity” mean a plastic item intended to be used once for the same purpose before being disposed of or recycled;“

„(vb) “Thermoset plastic” means a plastic which becomes irreversibly rigid when heated and hence cannot be remoulded into desired shape;“

„(vc) “Thermoplastic” means a plastic which softens on heating and can be moulded into desired shape;“.
4. In the said rules, in rule 4, -
 - (a) in sub-rule (1),—
 - (i) for the words “importer stocking”, the words “import, stocking” shall be substituted;
 - (ii) in clause (c), for the words “fifty microns in thickness”, the words, figures, letters and brackets “seventy five microns in thickness with effect from the 30th September, 2021 and one hundred and twenty (120) microns in thickness with effect from the 31st December, 2022” shall be substituted;
 - (iii) in clause (h), after the words, “carry bags”, the words “and commodities” shall be inserted;

11. In rule 13, in sub-rule (1), after the words “Union Territory concerned”, the words “or the Central Pollution Control Board” shall be inserted.

[F. No. 17-2-2001 (Pt)-Part I -HSMD]

NARESH PAL GANGAWAR, Jt. Secy.

Note : The principal rules were published in the Gazette of India, Extraordinary, Part II, Section 3, Sub-section (i), *vide* number GSR 320 (E), dated the 18th March, 2016 and subsequently amended *vide* notification number GSR 285 (E), dated the 27th March, 2018.

ANNEXURE II

Multilayered plastic packaging (at least one layer of plastic and at least one layer of material other than plastic);

(iv) **Category IV**

Plastic sheet or like used for packaging as well as carry bags made of compostable plastics.

(5.2) The Extended Producer Responsibility Guidelines covers the following with respect to plastic packaging namely: -

- (i) Reuse;
- (ii) Recycling;
- (iii) Use of recycled plastic content;
- (iv) End of life disposal.

6. Registration:

(6.1) (a) The following entities shall register on the centralized portal developed by Central Pollution Control Board namely: -

- (i) Producer (P);
- (ii) Importer (I);
- (iii) Brand owner (BO);
- (iv) Plastic Waste Processor engaged in (a) recycling, (b) waste to energy, (c) waste to oil, and (iv) industrial composting,

(b) Registration of Producers, Importers & Brand-Owners (operating in one or two states) and Plastic Waste processors shall be done by State Pollution Control Board or Pollution Control Committee through the centralized Extended Producer Responsibility portal developed by Central Pollution Control Board.

(c) After these guidelines have come into effect, with respect to, entities starting their business in a particular year and placing their products in market in that year, they shall have Extended Producer Responsibility target obligations from the next year.

(6.2) The entities covered under clause 6.1 shall not carry any business without registration obtained through on-line centralized portal developed by Central Pollution Control Board.

(6.3) The entities covered under clause (6.1) shall not deal with any entity not registered through on-line centralized portal developed by Central Pollution Control Board.

(6.4) In case, it is found or determined that any entity registered on the on-line portal has provided false information or has willfully concealed information or there is any irregularity or deviation from the conditions stipulated while obtaining registration under Extended Producer Responsibility guidelines, then the registration of such an entity would be revoked for a one -year period after giving an opportunity to be heard. The entities whose registration has been revoked shall not be able to register afresh for the period of revocation.

(6.5) In case any entity falls in more than one sub-category mentioned in the clause (6.1) then the entity shall register under each of those sub-categories separately. Further, in cases, where the entity has units in different states, in a particular sub-category mentioned in clause 6.1, then these units shall also be registered separately. However, only one registration under a sub category in a state would be needed, even if, more than one unit are located in a state. The registration shall be as per Standard Operating Procedure laid down by Central Pollution Control Board for the purpose, as per these Guidelines.

(6.6) While registering, the entities shall have to provide PAN Number, GST Number, CIN Number of the company and Aadhar Number and PAN Number of authorized person or representative and any other necessary information as required.

7. Targets for Extended Producer Responsibility and obligations of Producers, Importers & Brand-Owners:

(7.1) The Extended Producer Responsibility targets for the Producers, Importers & Brand-Owners shall be determined category-wise.

(7.2) Producer (P):

(a) Extended Producer Responsibility target (Refer example 1 to 3 in Annexure):

Year 2022-23	
Plastic packaging introduced in the market category-wise (Category II Flexible plastic packaging)	100 MT
Extended Producer Responsibility Target @ 70 %	70 MT
Minimum level of recycling of plastic packaging waste collected under Extended Producer Responsibility - no threshold has been prescribed	Quantity of plastic packaging waste collected under Extended Producer Responsibility and recycled as per actuals Quantity of plastic packaging waste collected under Extended Producer Responsibility and used for energy recovery, co-processing, road construction, waste to oil etc. as per actuals

Example 2:

Year 2024-25	
Plastic packaging introduced in the market category-wise (Category II Flexible plastic packaging)	100 MT
Extended Producer Responsibility Target @ 100 %	100 MT
Minimum level of recycling of plastic packaging waste collected under Extended Producer Responsibility @ 30%	Minimum 30 MT of plastic packaging waste collected under Extended Producer Responsibility needs to be recycled. Remaining plastic packaging waste collected(Maximum 70 MT) may be used for energy recovery, co-processing, road construction, waste to oil etc.

Example 3:

Year 2028-29	
Plastic packaging introduced in the market category-wise (Category II Flexible plastic packaging)	100 MT
Extended Producer Responsibility Target @ 100 %	100 MT
Minimum level of recycling of plastic packaging waste collected under Extended Producer Responsibility @ 60 %	Minimum 60 MT of plastic packaging waste collected under Extended Producer Responsibility needs to be recycled. Remaining plastic packaging waste collected(Maximum 40 MT) may be used for energy recovery, co-processing, road construction, waste to oil etc.

Reuse**[Refer Clause 7.4 (b)]****Example 4:**

Year 2025 – 26 (Minimum obligation for reuse comes into effect)	
Plastic packaging introduced in the market category-wise (Category I Rigid Plastic Packaging)	100 MT
Reuse of Category I rigid plastic packaging with volume or weight equal or more than 0.9 litres or	15 MT

kilogrammes bUnion Territory less than 4.9 litres or kilogrammes	(Reuse @ 15 %; minimum obligation for reuse 10 %)
Fresh plastic packaging introduced (A)	85 MT
Extended Producer Responsibility target for compliance @ 100% of (A)	85 MT
Minimum level of recycling of Category I plastic packaging waste collected under Extended Producer Responsibility @ 60%	Minimum 51 MT of plastic packaging waste collected under Extended Producer Responsibility needs to be recycled. A maximum of 34 MT plastic packaging waste collected may be used for energy recovery, co-processing, road construction, waste to oil etc.

Example 5:

For Year 2022 - 23	
Plastic packaging introduced in the market category-wise (Category I Rigid Plastic Packaging)	100 MT
Reuse of Category I rigid plastic packaging with volume or weight equal or more than 0.9 litres or kilogrammes bUnion Territory less than 4.9 litres or kilogrammes	10 MT
Fresh plastic packaging introduced (A)	90 MT
Extended Producer Responsibility Target @ 35 % of (A)	31.5 MT

Use of recycled plastic content**[Refer Clause 7.2 (d), 7.3 (d)]****Example 6:**

Year 2025-26	
Plastic packaging introduced in the market category-wise (Category II Flexible plastic packaging)	100 MT
Extended Producer Responsibility Target as per clause 5.1 @ 100 %	100 MT
Minimum content of recycled plastic in packaging @ 10%	10 MT of plastic content in the packaging should be recycled plastic 90 MT of virgin plastic content in packaging

[F. No. 17/2/2001 – Part I - HSMD]

NARESH PAL GANGWAR, Addl. Secy.

Note : The principal rules were published in the Gazette of India, Extraordinary, Part II Section 3, Sub-Section (i) vide number G.S.R 320 (E) dated the 18th March, 2016 and subsequently amended *vide notification numbers G.S.R 285 (E) dated the 27th March, 2018, G.S.R. 571 (E) dated the 12th August, 2021 and G.S.R. 647 (E) dated the 17th September, 2021.*

ANNEXURE II A

[See rules 13 (2)]

APPLICATION FOR REGISTRATION FOR PRODUCERS or Brand Owners

From:

.....

..... (Name and full address of the occupier)

To

The Member Secretary,

..... Pollution Control Board or Pollution Control Committee

.....

.....

Sir,

I /We hereby apply for registration under rule 9 of the Plastic Waste Management Rules, 2016

1. Producers

(A) other than micro and small enterprises (as per criteria of Ministry of Micro, Small and Medium Enterprises, Government of India)

PART – A		
GENERAL		
1.(a)	Name and location of the unit	
(b)	Address of the unit	
(c)	Registration required for manufacturing of: i. Carry bags; (a) petro- based, (b) Compostable ii. Multilayered plastics	
(d)	Manufacturing capacity	
(e)	In case of renewal, previous registration number and date of registration	
2.	Is the unit registered with the District Industries Centre of the State Government or Union territory? If yes, attach a copy.	
3.(a)	Total capital invested on the project	
(b)	Year of commencement of production	
4.(a)	List and quantum of products and by-products	
(b)	List and quantum of raw materials used	
5.	Furnish a flow diagram of manufacturing process showing input and output in terms of products and waste generated including for captive power generation and water.	
6.	Status of compliance with these rules- Thickness – fifty micron (Yes/No)	
PART – B		
PERTAINING TO LIQUID EFFLUENT AND GASEOUS EMISSIONS		
7.	a. Does the unit have a valid consent under the Water (Prevention and control of Pollution) Act, 1974 (6 of	

	1974)? If yes, attach a copy	
	b. Does the unit have a valid consent under the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981)? If yes, attach a copy	
PART – C PERTAINING TO WASTE		
8.	Solid Wastes or rejects: a. Total quantum of waste generated b. Mode of storage within the plant c. Provision made for disposal of wastes	
9.	Attach or Provide list of person supplying plastic to be used as raw material to manufacture carry bags or plastic sheet of like or multilayered packaging	
10.	Attach or provide list of personnel or brand Owners to whom the products will be supplied	
11.	Action plan as per Regulation notified for Extended Producer Responsibility	
Name and Signature Designation Date : Place :		

(B) Producers; Micro and Small Enterprises (as per criteria of Ministry of Micro, Small and Medium Enterprises, Government of India)

PART-A General		
1.	Micro or Small Producer	
2.	Details: (a) Name and location (b) Registered Address (c) Postal Address (d) GST No. (e) PAN No. (f) CIN No (Applicable for companies) (g) Udyam Registration No.	
3.	Authorized Person Details: (a) Name (b) Designation (c) Mobile No. (d) Aadhaar No. (Aadhaar authentication on voluntary basis) (e) PAN No. (f) Email ID	

4.	Plastic packaging manufactured: Category - I/Category - II/ Category - III/ Category - IV/Category - V)	
5.	Year of commencement of business	
6.	Unit Location: S.No. Place of Manufacturing unit Manufacturing capacity (plastic-packaging category wise)	
7.	Total Capital invested in project	
Part B: Details on plastic packaging		
8.	Manufacturing details 1. Raw material procured 2. Plastic packaging produced category-wise 3. Total Plastic packaging sold category-wise (MT) a. Plastic packaging sold to Brand owner b. Plastic packaging sold to Producer (Large and Medium) c. Plastic packaging sold to Producer (Small and micro) c. Plastic packaging sold to seller 4. Pre-consumer plastic packaging waste (MT)	Year 1 Year 2 Quantity (MT)
9.	Status of Compliance with Rule 4 of Plastic Waste Management Rules, 2016 as amended	Yes/No
10.	Cover Letter (with attachment)	
11.	Self-Declaration by Micro and Small Producers	
12.	Authorized Signatory	
13.	Self-Declaration: Name: Digital Signature Date: Place:	

Note:

(i) The registration shall be based upon self-declaration and done through centralized online portal on plastic packaging.

(ii) In case of proprietorship firm not registered under any Act or rules of the Central Government or the State Government, the proprietor may use his or her Permanent Account Number (PAN) issued by Income Tax Department for registration of the enterprise.

2. Brand Owners:

PART – A		
GENERAL		
1.	Name, address and Contact number	
2	In case of renewal, previous registration number and date of registration	
3	Is the unit registered with the District Industries Centre of the State Government or Union territory? If yes, attach a copy.	
4.(a)	Total capital invested on the project	
(b)	Year of commencement of production	
5. (a)	List and quantum of products and by-products	
(b)	List and quantum of raw materials used	
PART – B		
PERTAINING TO LIQUID EFFLUENT AND GASEOUS EMISSIONS		
5	Does the unit have a valid consent under the Water (Prevention and control of Pollution) Act, 1974 (6 of 1974)? If yes, attach a copy	
6	Does the unit have a valid consent under the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981)? If yes, attach a copy	
PART – C		
PERTAINING TO WASTE		
7.	Solid Wastes or rejects: (a) Total quantum of waste generated (b) Mode of storage within the plant (c) Provision made for disposal of wastes	
8.	Attach or Provide list of person supplying plastic material	
9	Action plan on collecting back the plastic wastes	
Name and Signature		
Designation		
Date :		
Place :		

3. Importers:

Item 3, 4, 5 of Part A, Part B, and item 7 and 8 of Part C, to be filled as per applicability.

PART – A		
GENERAL		
1.	Name, Address and Contact number	

2	In case of renewal, previous registration number and date of registration	
3	Is the unit registered with the District Industries Centre of the State Government or Union Territory? If yes, attach a copy.	
4.(a)	Total capital invested on the project	
(b)	Year of commencement of production	
5. (a)	List and quantum of products and by-products	
(b)	List and quantum of raw materials used	
6 (a)	Quantity of plastic sheet or like used for packaging of imported or to be imported products	
(b)	Quantity of imported or to be imported plastic sheet or like used for packaging for further supply or self-use	
(c)	Quantity of imported or to be imported multilayered packaging for further supply or self-use	
PART – B		
PERTAINING TO LIQUID EFFLUENT AND GASEOUS EMISSIONS		
5	Does the unit have a valid consent under the Water (Prevention and control of Pollution) Act, 1974 (6 of 1974)? If yes, attach a copy	
6	Does the unit have a valid consent under the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981)? If yes, attach a copy	
PART – C		
PERTAINING TO WASTE		
7.	Solid Wastes or rejects: (a) Total quantum of waste generated (b) Mode of storage within the plant (c) Provision made for disposal of wastes	
8. (a)	Attach or Provide list of person supplying imported (i) plastic sheet or like used for packaging, (ii) multilayered packaging	
(b)	Quantity of imported (i) plastic sheet or like used for packaging, (ii) multilayered packaging used for self use	
9	Action plan as per Regulation notified for Extended Producer Responsibility	
Name and Signature		
Designation		
Date :		

Place :

14. For Form V in the said rules, the following Form shall be substituted, namely:-

FORM V

[See rules 17 (4)]

(A) FORMAT FOR ANNUAL REPORT ON PLASTIC WASTE MANAGEMENT TO BE SUBMITTED BY THE URBAN LOCAL BODY

Period of Reporting: (Year)

A	General Information	
1	Name of the City or Town and State:	
2	Name & Address of Local body	
3	Contact E-mail:	
4	Contact Phone No.	
5	Population	
6	Area in sq. Kilometers	
7	Whether separate Plastic Waste Management Cell is operational (Y/N)	
8	Staff deployed in Plastic Waste Management Cell	
9	Total numbers of the wards in the area under jurisdiction	
10	Total numbers of households in the area under jurisdiction ward –wise	
11	Number of households covered by door-to-door collection – ward-wise	
12	Total number of commercial establishments and Institutions in the area under jurisdiction and those covered by door to door collection	
a	Commercial establishments	
b	Institutions	
13	(i) Details of human resource including waste pickers in informal sector (concessionaire or own resource) deployed for (a) Collection (b) Street sweeping (c) Transportation (d) Segregation (e) Processing (f) disposal (ii) Details of waste pickers engaged in plastic waste management (ward wise) No. of waste pickers	
B	Plastic Waste Management	
1	Quantity of Plastic Waste generated (Tonnes) as per CPCB methodology	
2	Compositional characterization of plastic waste as per CPCB methodology	
	<ul style="list-style-type: none"> • Plastic packaging (Cat I/Cat II/Cat III/Cat IV/Cat V) • Others type of plastic waste (i) recyclable and (ii) non-recyclable 	
3	Door to Door collection of segregated waste (coverage in % or number of households) – ward-wise	

4	Total no. and capacity of MRF	
	(a) No. and capacity of Mechanical MRF Facilities No. Capacity (MT) Waste segregated (MT)	
	b) No. and capacity of Manual MRF Facilities No. Capacity (MT) Waste segregated (MT)	
5	Number of plastic recycling facilities with details of category- wise Name and address with EPR registration number Capacity (MT) Total Plastic Waste recycled (MT) Plastic packaging waste recycled category –wise (MT) Other plastic waste recycled (MT) EPR certificates generated category-wise (MT)	
6	Number and capacity of industrial composting unit for compostable plastics Name and address with EPR registration number Capacity (MT) Waste composted (MT) Compostable plastics processed (MT)	
7	Number and capacity of Operational Waste to energy Plants Name and address with EPR registration number Capacity (MT) Plastic Waste processed (MT) Energy produced	
8	Number and capacity of operational wastes to Oil units Name and address with EPR registration number Capacity (MT) Waste processed (MT) Oil generated	
9	Quantity and capacity of Plastic waste used in road construction along with KM Plastic Waste used (MT) Road Length (Km)	
10	Disposal of thermoset plastic as per guidelines Thermoset plastic Waste sent to secured landfill (MT) Thermoset plastic Waste co-processed (MT)	
11	Cement plants for plastic waste for coprocessing	
a	Name and address with EPR registration number Total unsegregated waste received (MT) Percentage of plastic waste in unsegregated waste Plastic waste co-processed (MT)	
b	Name and address with EPR registration number Total segregated plastic waste received (MT) Plastic waste co-processed category-wise (MT)	
12	Quantity of inert material disposed (MT) from recyclers and other waste processor in sanitary landfill	
13	Scientific Landfill site (number and capacity) No. Capacity (MT) Waste received (MT)	
14	Legacy waste site (number and amount of legacy waste) Waste present (MT) Waste processed to RDF (MT) Plastic waste in RDF (%) Waste remaining (MT)	
15.	EPR Registration No. of ULB in case registered	
16	EPR Guidelines leveraged for PWM (Y/N) Details to be attached	
C.	Enforcement of Plastic Waste Management Rules	
1	Please confirm if Bye- laws have been framed (Yes/No)	
2	No. of violations & action taken on non-compliance of provisions of PWM Rules, 2016, except for banned Single Use Plastics and plastic carry bags (Rule 12)	

(i)	Total no of Violations (eg. Burning/ Littering of plastic waste)			
(ii)	Actions Taken (Fines/penalties Imposed Rs.)			
3 Implementation of ban imposed under Rule 4 including on identified single use plastic items, plastic carry bags having thickness less than 120 microns (ward-wise) (quarterly reporting)				
(i)	Registration number CPCB SUP compliance App			
(ii)	Total number of commercial establishments/Institutions and Hotspots in the area under jurisdiction			
(a)	-Commercial establishments : Malls, Cinema Halls, Airports, Railway Stations, Metro Stations, others			
(b)	- Institutions- Schools, Colleges, Office Complex etc			
(c)	-Hotspots – Tourist spots, sabzi Mandi, Wholesale market, Fish Market, Flower market, Religious Places etc.			
(iii)	Total No of Inspections carried out			
(iv)	Total Fine imposed (Rs.)			
(v)	Quantity of Banned SUP seized(Tons)			
(vi)	Details of mode of disposal of seized SUP			
	Qty of SUP Seized (T)	Mode of Disposal (Recycling/ WtE/ WtO/ Co-processing/Road making)	Name & Address of the Plastic Waste Processor	
(vii)	Details of Entities producing Alternatives			
	S.No	Name of Entity	SUP Alternative produced	Production Capacity (TPA)
				Address
(ix)	Details of Entities producing compostable plastics and biodegradable plastics			
(xi)	Shops for Eco alternatives for banned Single Use Plastic items			
D.	Data on ingress of littered plastic waste in water bodies			
1	Ingress points for plastic waste in Drain and Water Body Number of ingress points Measures taken to stop ingress of plastic waste			
2.	Surface water bodies including river stretches Number of surfaces water bodies Quantity of plastic waste collected			
3.	Number of drains cleaned from Plastic waste Total length of drains Total length of drains cleaned from plastic waste Plastic waste collected (MT) Silt collected			

(B) FORMAT FOR ANNUAL REPORT ON PLASTIC WASTE MANAGEMENT TO BE SUBMITTED BY THE PANCHAYAT AT THE DISTRICT LEVEL

Period of Reporting: (Year)

A	General	
1	Name of the District and State:	
2	Name & Address of Panchayati Raj Institution At The District Level	
3	Contact E-mail:	
4	Contact Phone No.	
5	Number of Gram Panchayats covered	
6	Number of villages covered	
7	Total Population	
8	Total Area	
9	Total number of households	
B	Plastic Waste Management	
1.	Summary of the mechanisms put in place for management of plastic waste in the area under jurisdiction along with the details of agencies involved (Please attach the details)	
2.	Please attach details of infrastructure put in place for management of plastic waste generated in the area under jurisdiction	
3.	Total no. of Plastic Waste Management Units set up with capacity	
4.	Quantity of Plastic Waste generated (Tonnes) as per CPCB methodology	
5	Plastic Waste Characterization as per CPCB methodology (Plastic packaging waste: Cat I/Cat II/ Cat III/Cat IV/Cat V and Others ((i) recyclable and (ii) non-recyclable)	
6.	Quantity of Plastic Waste collected (Tonnes)	
7.	Plastic Waste Segregated (Tonnes)	
8.	Plastic waste channelized for processing and recycling (details quantum of plastic waste, type of processing) (a) Plastic waste to recyclers (b) Plastic waste to co-processing in cement kilns (c) Plastic waste to waste to energy/waste to oil plants (d) Plastic waste for road construction	
9	(i) Details of human resource including waste pickers in informal sector (concessionaire or own resource) deployed for (a) Collection (b) Street sweeping (c) Transportation (d) Segregation (e) Processing (f) disposal (ii) Details of waste pickers engaged in plastic waste management (ward wise) No. of waste pickers	
10	EPR Guidelines leveraged for PWM (Y/N)	
	Details to be attached	
C	Enforcement of Plastic Waste Management Rules	
1	Please confirm if Bye- laws have been framed (Yes/No)	
2	No. of violations & action taken on non-compliance of provisions of PWM Rules, 2016, except for banned Single Use Plastics and plastic carry bags (Rule 12)	

I	Total no of Violations (eg. Burning/ Littering of plastic waste)	
ii	Actions Taken (Fines/penalties Imposed Rs.)	
3	Implementation of ban imposed under Rule 4 including on identified single use plastic items, plastic carry bags having thickness less than 120 microns (ward-wise) (quarterly reporting)	
I	Total number of Institutions & Hotspots in the area under jurisdiction	
(a)	- Institutions- Schools, Colleges, etc	
(b)	Hotspots – Subzi Mandi, Wholesale market, Fish Market, Flower market, Religious Places etc.	
II	Total No of Inspections carried out	
III	Total Fine imposed (Rs.)	
IV	Quantity of Banned SUP seized(Tons)	
D.	Data on ingress of littered plastic waste in water bodies	
1	Ingress points for plastic waste in Drain and Water Body Number of ingress points Measures taken to stop ingress of plastic waste	
2.	Surface water bodies including river stretches Number of surfaces water bodies cleaned Quantity of plastic waste collected	
3.	Number of drains cleaned from Plastic waste Total length of drains Total length of drains cleaned from plastic waste Plastic waste collected (MT) Silt collected	

15. for Form VI in the said rules, the following shall be substituted, namely:-

FORM VI

[See rule 17(6)]

FORMAT FOR ANNUAL REPORT ON PLASTIC WASTE MANAGEMENT TO BE SUBMITTED BY SPCB/PCC

Period of Reporting:

A	General	
1	Name of the State/UT:	
2	Name & Address of SPCB/PCC:	
3	Contact E-mail:	
4	Contact Phone No.	
5	Details of Plastic Waste Management (State Level)	
	• Collection (MT)	
	• Segregation (MT)	
	• Processing including recycling (MT)	
	• Disposal (MT)	
B	Mechanism of Plastic Waste Management	
1	Summary of the mechanisms put in place for management of plastic waste in your State/UT along with the details of agencies involved (Please attach the details)	
2	Please attach details of infrastructure put in place for management of	

	plastic waste generated in your State/UT								
3	Total no. of MRF Facilities								
(a)	No. of Mechanical MRF Facilities with capacity								
(b)	No. of Manual MRF Facilities with capacity								
C	Plastic Waste Generation, Collection, Segregation & Characterization								
1	Total Numbers of the Urban Local Bodies (ULBs) in the area under jurisdiction								
2	No. of ULBs who have submitted Annual Report								
3	Total Numbers of the Gram Panchayat (GPs) in the area under jurisdiction								
4a	Total number of Panchayati Raj institution at District Level								
4b	No. of Panchayati Raj institution at District Level who have submitted annual report								
5	Please confirm that all GPs/ULBs have provided complete information in stipulated time as per format prescribed by CPCB (Yes/No)								
6.	Please provide no. of ULBs/GPs which have not submitted complete information within the stipulated time frame								
7.	Please provide total amount of EC levied on PRI at District Level / ULBs who have not submitted annual report as per prescribed timelines under the rules								
8.	Quantity of Plastic Waste generated (Tonnes) as per CPCB methodology (Cat I/Cat II/ Cat III/Cat IV/Cat V/ Others)								
9.	Quantity of Plastic Waste collected (Tonnes)								
10.	Plastic Waste Segregated (Tonnes)								
11.	Please confirm that all Local Bodies/ GPs have carried out Assessment of Plastic Waste Generation & Characterization as per methodology specified by CPCB (Yes/No)								
12.	Please upload Plastic Waste Characterization Report as per methodology specified by CPCB								
13.	Please confirm that data validation and reconciliation for ULB and PRI at District Level has been done as per methodology specified by CPCB (Yes /No)								
D	Extended Producer Responsibility Implementation								
1.	Total Number of ULBs registered on EPR (To be auto fetched from EPR portal)								
2.	Details of Plastic Waste Processors (To be auto fetched from EPR Portal)								
	Name	Type (Recycler/Coprocessors/Waste to Energy/Waste to Oil/Road Making)	Registration No	Processing Capacity (TPA)					
				PW (Cat-I)	PW (Cat-II)	PW (Cat-III)	PW (Cat-IV)	PW-(Cat-V)	Other
3.	Plastic Waste Processed through PWPs (TPA)								
	Type (Recycler/Coprocessors/Waste to Energy/Waste to Oil/Road Making)		PW (Cat-I)	PW (Cat- II)	PW (Cat- III)	PW (Cat- IV)	PW (Cat- V)	Others	
4.	Audit & Levying of Environmental Compensation (EC) (To be auto fetched from the EPR Portal)								
(a)	No. of Entities (PIBOs/PWPs) audited								
(b)	No. of Entities (PIBOs/PWPs) found in violation								
(c)	EC levied on violating Entities (PIBOs/PWPs)								
E.	Implementation of ban imposed under Rule 4 including on identified single use plastic items, plastic carry bags having thickness less than 120 microns								
1	Total number of commercial establishments/ Institutions &								

	Hotspots in the area under jurisdiction				
(a)	-Commercial establishments :Malls, Cinema Halls, Airports, Railway Stations, Metro Stations				
(b)	- Institutions: Schools, Colleges, Office Complex etc				
c	-Hotspots :Tourist spots, sabzi Mandi, Wholesale market, Fish Market, Flower market, Religious Places etc.				
2	Total No of Inspections (Data Auto fetched from SUP Compliance Monitoring Portal)				
3	Total No of Commercial Establishment and hotspots closed for SUP Ban Violation				
4	Total No. of Industries inspected(Data Auto fetched from SUP Compliance Monitoring Portal)				
5	Total no. of industries closed for manufacturing banned SUP items				
6	Total Fine imposed (Rs.) (Data Auto-fetched from SUP Compliance Monitoring Portal)				
7	Quantity of Banned SUP seized(Tons) (Data Auto-fetched from SUP Compliance Monitoring Portal)				
8	Total No of Commercial establishment and hotspot made SUP free				
9	Details of mode of disposal of seized SUP				
	Qty of SUP Seized (T)		Mode of Disposal (Recycling/ WtE/WtO/ Co-processing/ roadmaking)	Name & Address of the Plastic Waste Processor	
10.	Details of Entities producing Alternatives including compostable plastics				
	Sl.No.	Name of Entity	SUP Alternative	Processing Capacity (TPA)	Address
11.	No of Complaints received on SUP grievance App (Data Autofetched from SUP Grievance redressal app)				
12.	No of Complaints resolved (Data Autofetched from SUP Grievance redressal app)				
F	Enforcement of Plastic Waste Management Rules				
1.	Details of Registered Plastic Raw Material Manufacturing Units				
	Total No:		Capacity:	Product Manufactured	
2.	Details of Registered PWP (Non- packaging) Processing Facilities				
	Total No:		Capacity:	Product Manufactured	
3.	Details of Unregistered Manufacturing or Recycling Units (in residential or unapproved areas).				
	Total No:		Capacity:	Product Manufactured	
4.	No. of ULBs which have framed bye-laws				
5.	No. of violations & action taken on non-compliance of provisions of PWM				

	Rules, 2016, as amended, 2018 (Rule 12)	
6.	Total no. of violations (Burning/ Littering/non-registration and other non-compliance)	
7.	Action Taken (Fine Imposed / Closures issued)	

16. After Form VI in the said rules, the following Form shall be inserted, namely:-

FORM VII

[See rule 17(2)]

Format for Quarterly report of Plastic Raw Material

Manufacturer/Importer of plastic raw material

Year : Quarter : Q1/Q2/Q3/Q4

S. No.	Name of Buyer	Address of Buyer	Email ID	Phone No.	Buyer Category	GST no. of Buyer	Category of plastic packaging	Qty of plastic raw material supplied (T)	Type of plastic raw material supplied

Note:

- (i) Quarterly report shall be submitted as per pro forma in electronic format prescribed by CPCB.
- (ii) Individual invoices for transactions are not required for the purposes of quarterly report.

Buyer Category

1. Large and Medium Producers (as per criteria of Ministry of Micro, Small and Medium Enterprises, Government of India)
2. Micro and Small Producers (as per criteria of Ministry of Micro, Small and Medium Enterprises, Government of India)
3. Brand Owners
4. Seller
5. Others (Non-plastic packaging applications)

Type of plastic raw material supplied

1. PET
2. HDPE
3. PVC
4. LDPE
5. PP
6. PS
7. Others
8. Biodegradable plastic in specified environment
9. Compostable plastic

[F. No- 17/6/2023 HSM]

NARESH PAL GANGWAR, Addl. Secy.

Note- The principal rules were published in the Gazette of India, vide number G.S.R. 320(E), dated the 18th March, 2016 and subsequently amended vide notification number G.S.R. 285(E), dated the 27th March, 2018, vide notification number G.S.R. 571(E), dated the 12th August, 2021, vide notification number G.S.R. 647(E), dated the 17th August, 2021, vide notification number G.S.R. 133(E) , dated the 16th February 2022, vide notification number G.S.R. 522(E) dated the 6th July 2022, vide notification number G.S.R. 318(E) , dated the 27th April 2023 and last amended vide notification number G.S.R. 807(E) dated the 30th October 2023.

ANNEXURE III

SINGLE-USE PLASTICS

**NATIONAL LEVEL COMPLIANCE
ASSESSMENT METHODOLOGY OF SINGLE-
USE PLASTIC BAN**

As a federally owned enterprise, GIZ supports the German Government in achieving its objectives in the field of international cooperation for sustainable development.

Published by

Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Registered offices

Bonn and Eschborn

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On behalf of the

German Federal Ministry for the
Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV)

New Delhi, November 2022

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List of Abbreviations

ASTM	American Society for Testing and Materials
CIPET	Central Institute of Petrochemicals Engineering and Technology
CPCB	Central Pollution Control Board
CSIR	Council of Scientific and Industrial Research
HDPE	High-density polyethylene
LDPE	Low-density polyethylene
MoEF&CC	Ministry of Environment, Forest and Climate Change
MLPs	Multi- Layer Plastics
MRF	Material Recovery Facility
NEERI	National Environmental Engineering Research Institute
NGT	National Green Tribunal
PCCs	Pollution Control Committees
PET	Polyethylene Terephthalate
PP	Polypropylene
PPE	Personal Protective Equipment
PS	Poly-Styrene
PVC	Poly-Vinyl Chloride
SDMC	South Delhi Municipal Corporation
SPCBs	State Pollution Control Boards
SUPs	Single-Use Plastics
ULBs	Urban Local Bodies
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UTs	Union Territories

Executive Summary

The mismanagement of plastic waste, especially that of Single-use Plastics products (SUPs), has emerged as a major environmental challenge for the country. Globally, countries are enforcing rules and legislations at the policy level for sustainable management of plastic waste and SUPs. The Government of India is also placing significant emphasis on curbing the adverse impacts of littered plastic waste on both terrestrial and aquatic ecosystems, and has banned manufacture, import, stocking, distribution, sale and use of identified SUP items, having low utility and high littering potential, all across the country from 1 July 2022.

A national level task force is in place and a comprehensive action plan is developed by the Ministry of Environment, Forest and Climate Change (MoEF&CC) for effective implementation of the SUP ban. The Ministry of Environment, Forest and Climate Change (MoEF&CC), Central Pollution Control Board (CPCB), State Pollution Control Boards (SPCBs), Pollution Control Committees (PCCs), Urban Local Bodies (ULBs) and other state government agencies are collecting working together for effective implementation of the ban in India. The Government departments at state, district levels are ensuring action plans in place through by-laws, awareness generation, municipal solid waste surveys on banned SUP items to implement the ban in India. However, there is no standard methodology to estimate the quantum of SUP being used and sold to assess the compliance status of the ban. In this backdrop, this study introduces a standardized methodology that can be employed to evaluate the compliance status of the ban on Single-Use Plastics (SUPs) in India. This methodology can be adopted by relevant stakeholders, including regulatory bodies and local authorities.

The suggested methodology was pilot tested for its robustness in 20 cities during the months of March to September 2022 and presents a baseline of SUPs in the selected cities, enabling a comparison of the compliance status of the ban on SUPs in the future.

Key Observations

- With increased dependence on use-and-throw plastics, the proportion of plastics in municipal solid waste has almost doubled in India, from 6.9% in 2015 to 12.2% in the present study (2022).
- Banned SUPs accounted for about 20% of the total plastic waste. In other words, on an average, banned SUPs account for about 2.4% of the total municipal waste (by weight). The proportion of banned SUPs in cities ranged from 5% to about 45% of the total plastic waste.
- The use and availability of banned SUPs were still prevalent in the market, during the surveys (March - September 2022). On an average, 57% of the samples surveyed in 137 markets across 20 cities includes the banned SUP items (use/sale).
- Alternatives for all banned SUPs are available in the market.
- The cost of the alternatives to the SUPs are on higher side. Depending upon the product category, it varies from 3 to 5 times the cost of SUP items.
- Most of the alternatives to the banned SUP are again of single-use nature. Multi-use alternatives should be promoted and made available, which will ultimately help in reducing plastic pollution.
- It is challenging to directly implement the ban in most of the cities, therefore a grace period was in place in few cities.
- The proposed methodology in this study is robust and has the capability to effectively capture the on-ground situation in different cities. It is designed to be simple, less time-consuming, and resource-efficient, allowing for its implementation by Urban Local Bodies (ULBs).

Way Forward

- Similar SUP inventory studies should be undertaken across the country to assess the status of the ban and gaps in implementation.
- The study should be repeated at an interval of every 6 months to assess the progress, regular inventorisation at MRFs to track the SUP in all cities. Training to all MRF operator on inventorisation.
- Research studies focused on providing multi-use alternatives to SUPs should be developed in association with industries.
- Continuous effort is required to bring down the cost of the alternatives.
- Improvement in infrastructure to support collection and treatment of the SUPs as well as alternatives, and the recycling potential of alternative to SUP items should be enhanced.

1. Introduction

1.1. About the Project

Under the Indo-German Bilateral Cooperation, the Federal Ministry of Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV), the Federal Republic of Germany, is supporting the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India to implement a Technical Cooperation (TC) project on “Circular Economy Solutions (CES) Preventing Marine Litter in Ecosystems”. The project is implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH in collaboration with MoEFCC. The project focus ranges from tracking and monitoring of marine litter and to demonstrate technological solutions in river, marine and coastal ecosystems to close material cycles of marine litter using resource efficient and circular economy approaches in the selected states of India.

The Government of India is also placing significant emphasis on curbing the adverse impacts of littered plastic waste on both terrestrial and aquatic ecosystems. In this direction, MoEFCC has banned identified Single-Use Plastics products (SUPs) from 1 July 2022. Under the CES project, GIZ India is supporting the Central Pollution Control Board (CPCB) for developing a compliance assurance methodology to assess the compliance with the notified ban. GIZ India has collaborated with Sustainability Innovations and Advisories (SIA) Pvt. Ltd. to develop and test the National Level Compliance Assessment Methodology of Single-Use Plastic Ban in 20 cities of India.

1.2. Background

In July 2022, The Plastic Waste Management (PWM) Rules, 2016, as amended, provide the statutory framework and prescribed authorities for enforcing the rules, including the ban on identified single-use plastic items. The Plastic Waste Management Amendment Rules, 2021, which came into effect on 1st July, 2022, have prohibited the following single-use plastic items having low utility and high littering potential:

- Ear buds with plastic sticks, plastic sticks for balloons, plastic flags, candy sticks, ice-cream sticks, and polystyrene [Thermocol] for decoration;
- Plates, cups, glasses, cutlery such as forks, spoons, knives, straw, trays, wrapping or packing films around sweet boxes, invitation cards, cigarette packets, plastic or PVC banners less than 100 microns, and stirrers.

The following banned items are shown below.



Plastic carry bags (<75 μ or <75 microns)



Plastic flags



PVC banners (<100 μ)



Plastic films on cigarette packets



Plastic films on invitation cards



Plastic films on sweet boxes



Plastic balloon sticks



Plastic spoons



Plastic cups



Plastic candy sticks



Plastic straws



Ice cream sticks



Plastic glasses



Plastic forks



Earbuds with plastic sticks



Plastic plates



Plastic trays



Thermocol-based decorative items



Stirrers



Plastic knives

Post the official notification of the ban, a National Task Force was constituted by the Ministry for taking coordinated efforts to eliminate identified single-use plastic items and effective implementation of Plastic Waste Management Rules, 2016. As per provision 9.2 of Schedule-II notified through amendments to PWM Rules dated February 16, 2022, CPCB has to finalise the compensation and penal action regime in case of violation. CPCB was also given the responsibility to establish a National Control Room to monitor effective implementation of SUP Ban, and develop a comprehensive action plan to ensure that the ban is implemented successfully throughout the country. The action plan encompasses measures to reduce the SUPs from the supply, demand and the usage side. This includes measures to restrict the supply of raw materials, demand-side measures to reduce plastic demand, enabling measures to promote alternatives to SUP, digital interventions for efficient monitoring and creating awareness and guidance to SPCB/PCCs for effective implementation of directions.

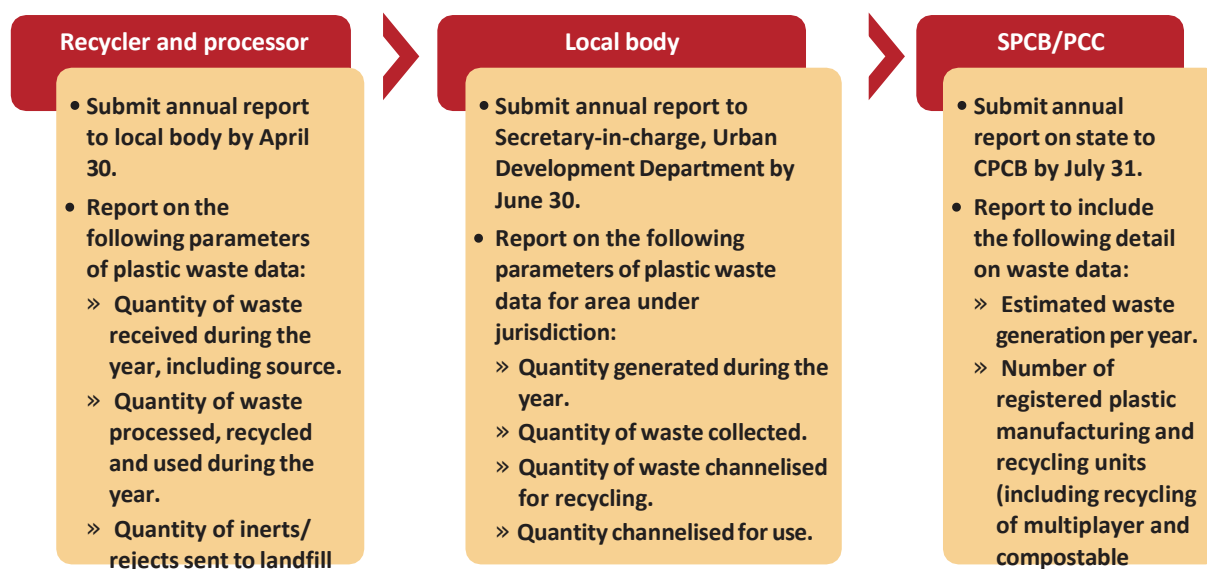
The directions issued by CPCB specifies the role of different stakeholders, as well as the need for coordinated activities, timely action and awareness programmes among different stakeholders. Further, the SPCBs/PCCs have been directed to execute the same at the state district levels in coordination with local authorities. The action points for the SPCBs/PCCs also includes identifying major stockiest/retailers/sellers and survey of municipal solid waste for presence of banned SUP items. This necessitates a standard compliance assessment methodology which will help in quantifying the presence of banned SUP in municipal solid waste and analyse the quantum and types of banned SUPs sold in the markets. The specified role of SPCBs/PCCs and local authorities among others are as provided in Annexure 1.

Presently, there is also no established methodology to estimate the quantum of SUPs in the municipal waste or the quantum of SUPs being sold and used, The only framework for plastic waste is a reporting framework developed by CPCB to publish its annual report on the state of plastic waste management in the country. The report contains only data on the quantity of plastic waste produced by different states and UTs with no specific data on SUPs.¹

The data published by CPCB is based on the data submitted every year by SPCBs and PCCs. The data collection and reporting format is specified in Rule 17 of the Plastic Waste Management Rules, 2016. As per Rule 17, an annual report is to be submitted by waste processors and ULBs on waste generation, treatment and disposal to SPCBs/PCCs, and the collated report is further submitted to CPCB by SPCBs/PCCs. The mechanism for this is outlined in the diagram below (see Figure 1).² The biggest challenge with the data collection mechanism, as specified under Rule 17, is that there is no standard methodology to quantify and characterise total plastic wastes. Due to a lack of suitable methodologies, there is currently a gap in both the assessment of compliance with SUP (Single-Use Plastic) bans and the quantification and characterisation of plastic waste.

In this context, the present report “National Level Compliance Assessment Methodology of Single-Use Plastic Ban” aims to support CPCB and other regulatory agencies in developing a robust methodology for estimating plastic waste and to assess compliance with the notified ban on SUPs.

Figure 1: Data collection and reporting on plastic waste



¹ Central Pollution Control Board (CPCB). 2021. Annual Report 2019-20, Implementation of Plastic Waste Management Rules, 2016. Retrieved 2 December 2022, from https://cpcb.nic.in/uploads/plasticwaste/Annual_Report_2019-20_PWM.pdf

² Ministry of Environment, Forest and Climate Change, 2016. Plastic Waste Management Rules, 2016. Retrieved 2 December 2022, from <https://cpcb.nic.in/displaypdf.php?id=cGxhc3RpY3dhc3RlL1BXTV9HYXpldHRILnBkZg==>

1.3. Objectives and Scope

The key objective of this study is to:

1. Assess the compliance of SUPs ban –
 - a. Through characterisation of SUPs in MSW samples, and
 - b. By conducting market survey of SUPs/alternatives to ascertain their availability within the developed methodological framework,
2. Test the methodology in 20 selected cities and develop the baseline for SUPs in the selected cities.

Based upon the objective of the study and desired outcome, the study framework is as depicted below in Figure 2.

Figure 2: Study Framework



As the methodology for National Level Compliance Assessment Methodology of Single-Use Plastic Ban also includes quantification and characterisation of waste (see Section 2.2), the scope of the methodology, under the study includes:

1. Estimation of plastic waste in the city under composition and quantification.
2. Compliance assessment with the notified SUP ban.

To ensure that the methodology is easily implemented by cities of different sizes (and in turn the capacity of the ULBs), the following guiding principles were used to develop the methodology.

- It should be a rapid method to assess the on-ground situation and be less intensive in terms of resource requirements.
- It should be easy to replicate at a fixed time interval (once or twice a year) to check on-ground level effectiveness of the ban.
- It should assist in ensuring compliance, identify gaps and help in strengthening strategy for effective implementation.

1.4 Studies Carried Out Previously

For finalising the suitable framework for the assessment of SUP ban, we looked into some of the previous studies carried out. The reference was made to some of the existing studies on waste inventorisation, as no specific study on SUP quantification was available. Therefore, to arrive at the methodology for SUPs, it is necessary to review the assessment methodologies for the plastic waste.

The available studies, includes the following;

1. Assessment and Characterisation of Plastic Waste Generation in 60 Major Cities, 2015.
2. Assessment of the Status of Municipal Solid Waste Management in Metro Cities, State Capitals, Class I Cities, and Class II Towns in India: An insight, 2008.
3. Baseline Assessment Report, Rishikesh and Haridwar, 2020.

All three studies have used one of the following two methodologies:

- Guidelines for solid waste management assessment (baseline survey) in secondary cities and small towns in Asia and the Pacific, United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), 2010.
- Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste, American Society for Testing and Materials (ASTM) standard test method (D5231- 92).

The Baseline assessment study in Rishikesh and Haridwar was carried out on the methodology derived from UNESCAP, and was customised to suit the Indian context, which is largely to quantify the waste generation from different contributing sectors.

The NEERI study has used the ASTM method which involve sampling of waste from vehicles employed for collection and transportation of waste. The assessment and characterisation of plastic waste generation in 60 major cities, done by CIPET, has referred the ASTM Method (D5231-92) as guiding principle for assessment and quantification of plastics waste at Dump sites.

The UNESCAP method is based on the household survey and is used for detailed municipal waste quantification and characterisation for the development of waste management infrastructure. These studies are resource intensive and should be done once in 5-10 years to assess the status of waste management and infrastructure in cities. The ASTM method is for municipal waste characterisation and is a rapid method to assess the composition of waste. This is less resource intensive and can be done annually to assess the changing composition of municipal waste.

Based on the above, it is advisable to use ASTM Method (D5231-92) as the guiding principle for developing the methodology for analysing SUP in the waste stream.

2. Methodology

The primary objective of this study is to develop a methodology for assessing the compliance with the SUP ban notification. In India, so far, there is no documented study to assess the quantity of SUPs being sold/used in cities. A global framework or methodology also does not exist that is used worldwide or internationally. As SUPs are a sub-set of the plastic waste, any methodology that attempts to quantify and characterise SUPs, must necessarily also quantify and characterise the total plastic waste.

2.1 Literature Review

This literature review focuses on the selection of an appropriate methodology for compliance assessment of Single Use Plastics (SUPs) in India and verify its suitability for this study. It acknowledges the limited number of studies conducted at the city-level to quantify and characterize plastic waste. Three key studies on plastic waste inventorisation have been identified, along with their respective methodologies (as discussed in section 1.4). The ASTM method emerges as a suitable choice, in the context of waste characterisation and quantification for SUPs.

Suitability of the ASTM Method (D5231-92) for Compliance Assessment of SUPs:

1. **Simplicity and Resource Efficiency:** The ASTM method offers a simplified and less resource-intensive approach to waste characterization. This makes it practical for conducting regular assessments to track the changing composition of municipal waste, including SUPs.
2. **Standardization and International Recognition:** The ASTM method (D5231-92) is an internationally recognized standard for waste characterization. Its use ensures consistency and comparability of results across different studies and regions.
3. **Focus on Plastic Waste:** The ASTM method provides specific guidelines for the characterization and quantification of different waste materials, including plastics. It allows for the identification and separation of SUPs from other waste streams, enabling a targeted analysis of their quantity and composition.
4. **Supplementary Approach:** To obtain a comprehensive picture of SUP ban compliance, it is advisable to supplement waste inventorisation studies with an assessment of the supply-side, including the sale and use of SUPs. This approach would provide a more accurate understanding of the overall SUP landscape and inform effective compliance measures.

The ASTM method is widely recognized and accepted for its comprehensive guidelines and established procedures. It ensures standardization, comparability, and reliability of results across studies and locations.

However, relying only on waste inventorisation to assess the compliance is fraught with uncertainties. The Indian waste sectors is based to a significant extend on informal activities, which poses a notable challenge for arriving at a reliable data based on inventory studies. For a compliance assessment study on SUP, it would be prudent to also assess the supply-side to get an accurate picture on the sale and use of SUPs.

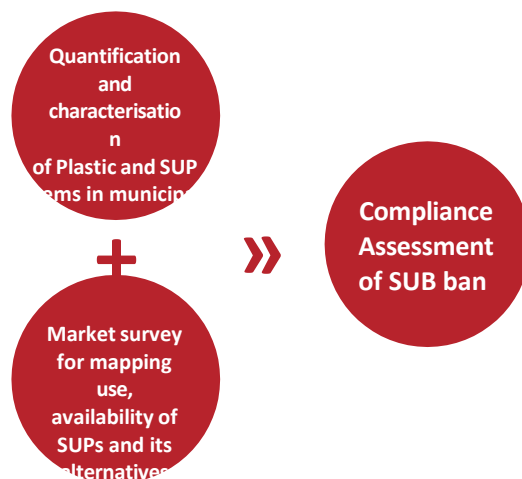
2.2 Methodology for Compliance Assessment

The objective of the methodology is to assess and quantify the availability of the SUP products in the market and its use in the city. A two-pronged methodology is being proposed to ensure a robust compliance assessment:

1. Compliance assessment through quantification and characterisation of Plastic and SUP items in municipal waste.
2. Compliance assessment through a market survey for mapping use, availability of SUPs and its alternatives.

The methodology targets both the supply as well as the demand side, to get a comprehensive picture of the compliance status. The objective of the market survey is to assess the availability of banned SUPs and its alternatives in the market. On the other hand, the waste inventory study has been designed to determine the prevailing use and disposal practices.

Figure 3 (a): Two-pronged methodology for assessment of compliance of SUP ban



The indicators used for assessing compliance with the ban are:

1. Percentage of banned SUPs in the municipal waste.
2. Proportion of surveyed entities selling SUP products in major markets of the city.

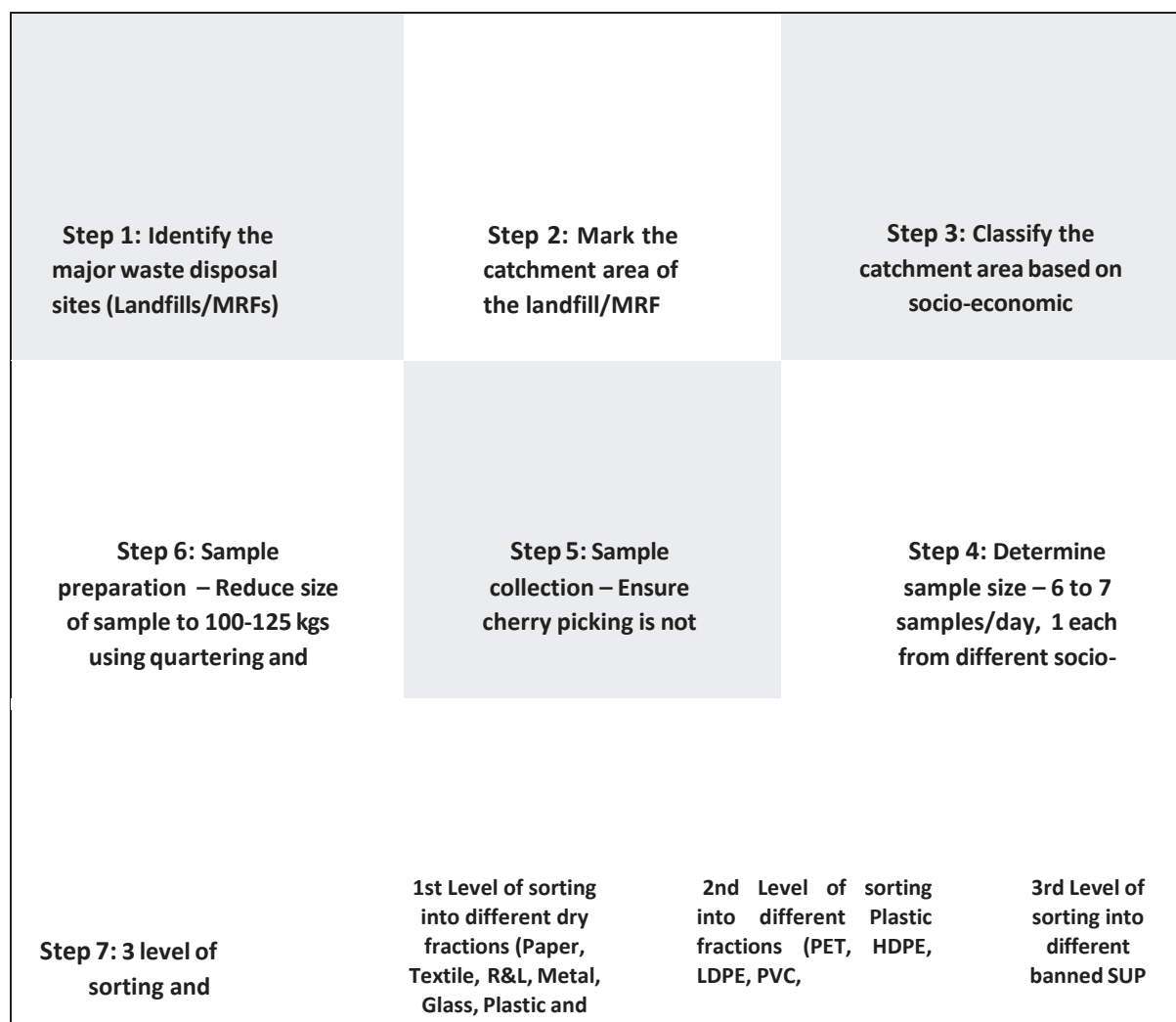


2.2.1 Plastic and SUP Quantification and Characterisation in Municipal Waste

The Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste, American Society for Testing and Materials (ASTM) standard test method (D5231- 92) is taken as the basis for developing the methodology for conducting inventorisation of Single-Use Plastics (SUPs).

The detailed procedure for conducting the SUP inventorisation study is as follows:

Figure 3: Methodology for quantification and characterisation of SUP in municipal waste



Step 1: Identify the major waste disposal sites

The major waste disposal sites in a city, which could either be landfills collecting unsegregated waste or Material Resource Facilities (MRF) with a good rate of source segregation, should be identified.

All major landfills/MRFs needs to be identified, this will help in deciding the number of samples. Landfills are selected in cities with direct waste collection at landfills, and MRFs are selected in cities with operational MRFs. The waste from the catchment area, catered by the facility is mapped and categorised, accordingly. In cities where no landfill is present (as in Thiruvananthapuram), the MRF or the resource recovery centre will be identified, and in cities where both landfill and MRFs are present (as in Surat), the first entry point is selected where the waste is collected without any recovery or cherry picking.

Step 2: Mark the catchment area

Divide the city based on the area catered by the landfill/MRF. All wards catered by the landfill/MRF should be mapped and classified under the following 5 major categories based on its socio-economic characteristics/ land use:

- High-income residential wards
- Middle-income residential wards
- Economically Weaker Section (EWS) residential wards/slums
- Commercial wards
- Mixed commercial and residential wards

See Table 1 on guidance on classification of wards.

Table 1: Classification of different wards

Wards	Example of housing type/land use
EWS/Low-income group/ Slums	Single room residents, areas with low rentals/slum areas. Lowest property tax or tax exempted or unauthorized settlement.
Middle income	Apartments, single detached houses without garden. Median tax rate.
High income	Single detached houses with parking and garden, Luxury condominiums, and high-rise buildings. Highest tax rate.
Mixed commercial and residential	Areas where both commercial and residential complexes are present in an equal ratio or areas where waste from both commercial establishments as well as residential houses are collected in equal ratio.

The socio-economic characteristics of the city should be analysed to understand the population characteristics and determine the proportion of the population residing in each economic strata/ land use. The number of samples to be sorted from each category should be fixed based on the population proportions observed in the city, to eliminate any biases in the selection of samples and ensure representativeness.

Step 3: Determine sample size

The sample size should be determined based on ASTM (D5231- 92). The methodology for determining the sample size is given in Box 1. In the Indian context, for determining the composition of plastic waste, 30-35 samples should be collected over a period of five days (6-7 samples per day) from the catchment areas of each landfill/MRF facility. If a city has only one landfill site, then 30-35 samples should be collected. If the city has two landfills, then 60-70 samples are to be collected. One sample is equal to one vehicle load of waste.

BOX 1: METHODOLOGY FOR DETERMINING SAMPLING SIZE

Vehicles for sampling shall be selected at random during each day of the sampling period, so as to be representative of the waste stream. With respect to the random selection of vehicles, any method is acceptable that does not introduce a bias into the selection. For a weekly sampling period of k days, the number of vehicles sampled each day shall be approximately n/k, where n is the total number of samples (1 sample is equivalent to 1 vehicle load from 1 ward) to be selected for the determination of waste composition.

$$n=(t*s/(e*x))^2$$

Where,

t = student t statistic corresponding to the desired level of confidence
 s = estimated standard deviation
 e = desired level of precision
 x = estimated mean.

The required number of samples will vary among the components for a given set of conditions, a compromise will be required in terms of selecting a sample size, that is, the number of samples that will be sorted. The component that is chosen to govern the precision of the composition measurement is termed the “governing component” for the purposes of this method, which is plastic in our case.

Box 1 continued

The mean value and standard deviation for plastic waste is estimated based on field test data from our previous ground study on MSW in Rishikesh and Haridwar (also cross checked with some other national studies) reported for MSW sampled for a week, the values of standard deviation is 0.03 and mean value is 0.09 for plastic.

The desired level of precision is taken at 10% for calculating the sample size.

The sample size has been calculated for confidence level 90%, and is as provided below;

> 90% confidence level and 10% precision

$s = 0.03$ (as explained above from different ground studies)

$e = 0.10$ (10% desired level of precision)

$x = 0.09$ (as explained above from different ground studies)

Using formula for n at $(n = \infty)$, with value of t from table at $(n = \infty)$;

$n = ((1.645 * 0.03) / (0.1 * 0.09))^2 = 30$, referring to t table again for t value at $n = 30$

$n = ((1.699 * 0.03) / (0.1 * 0.09))^2 = 32$

The value 32 is within 10 % of 30 (for $n = z$), 32 sample should be selected for analysis within the desired spread of 5 to 7 days.

That is, $32/5 = 6$ samples/day if analysis is done for 5 days, and $32/7 = 5$ samples/day if analysis is done for 7 days.

At least one sample should be collected from each socio-economic strata/land use, i.e., one sample each from High income, Middle-income, and Low-income residential wards, Commercial wards, and Mixed residential and commercial wards. However, based on the proportion of population, the number of samples from certain socio-economic strata/land use can be increased. For example, if the catchment area is predominantly mixed residential, then the number of samples can be increased to two from the mixed residential wards. Similarly, if the catchment area is predominantly commercial, and mixed commercial and residential, then two samples each from commercial, and mixed commercial and residential wards can be collected. The number of samples from each economic stratum should remain constant on all days throughout the Inventory study.

The basic idea of collecting waste from different socio-economic strata/land use is to make sure that the waste sample is representative of the city/town waste profile, and there is no bias while selecting the sample size. In case of cities/towns where such predefined bifurcation is not available, the bifurcation of wards is based upon the predominant nature. For example, wards with more than 50% high income residences is classified as High income wards, and so on.

APPENDIX 1: CALCULATION OF SAMPLES FOR SORTING

a. Number of samples for sorting

The number of sorting samples (that is, vehicle loads) (n) required to achieve a desired level of measurement precision is a function of the component(s) under consideration and the confidence level. The governing equation for n is as follows:

$$n = (t * s / (e * x))^2 \dots \dots \dots (\text{Eq 1})$$

Where,

t = student t statistic corresponding to the desired level of

confidence s = estimated standard deviation

e = desired level of

precision x = estimated

mean

b. One sorting sample is chosen per vehicle load.

Appendix 1 continued

c. Suggested values of s and of \bar{x} for waste components are listed in Table A.

Table A: Values of mean (\bar{x}) and standard deviation (s) for determining waste composition

Component	Standard Deviation (s)	Mean (\bar{x})
Paper	0.05	0.10
Textile	0.01	0.03
Glass	0.02	0.03
Rubber & Leather	0.01	0.02
Metal	0.007	0.01
Plastic	0.03	0.09

The tabulated mean values and standard deviations are estimates based on field test data reported for MSW sampled during weekly sampling periods at different locations.

d. Values of t are given in Table B for 90 and 95 % levels of confidence, respectively.

Table B: Values of t Statistics (t) as a Function of Number of Samples and Confidence Interval

Number of Samples, n	90 %	95 %	Number of Samples, n	90 %	95 %
2	6.314	12.706	25	1.711	2.064
3	2.920	4.303	26	1.708	2.060
4	2.353	3.182	27	1.706	2.056
5	2.132	2.776	28	1.703	2.052
6	2.015	2.571	29	1.701	2.048
7	1.943	2.447	30	1.699	2.045
8	1.895	2.365	31	1.697	2.042
9	1.860	2.306	36	1.690	2.030
10	1.833	2.262	41	1.684	2.021
11	1.812	2.228	46	1.679	2.014
12	1.796	2.201	51	1.676	2.009
13	1.782	2.179	61	1.671	2.000
14	1.771	2.160	71	1.667	1.994
15	1.761	2.145	81	1.664	1.990
16	1.753	2.131	91	1.662	1.987
17	1.746	2.120	101	1.660	1.984
18	1.740	2.110	121	1.658	1.980
19	1.734	2.101	141	1.656	1.977
20	1.729	2.093	161	1.654	1.975
21	1.725	2.086	189	1.653	1.973
22	1.721	2.080			

e. Estimate the number of samples (n) for the selected conditions (that is, precision and level of confidence) and components using (Eq 1). For the purposes of estimation, select from Table B the t value for $n = \infty$ for the selected level of confidence. Since the required number of samples will vary among the components for a given set of conditions, a compromise will be required in terms of selecting a sample size, that is,

Appendix 1 continued

the number of samples that will be sorted. The component that is chosen to govern the precision of the composition measurement (and therefore the number of samples required for sorting) is termed the “governing component” for the purposes of this method.

f. After determining the governing component and its corresponding number of samples (n), return to Table B and select the student t statistic (t) corresponding to n . Recalculate the number of samples, that is, n .

g. Compare n at $t=1.645$ with the new estimate of n , which was calculated for the governing component. If the values differ by more than 10 %, repeat the calculations given in (e) and (f).

h. If the values are within 10 %, select the larger value as the number of samples to be sorted. Refer to Box 1 for a sample calculation of n .

Step 4: Sample collection

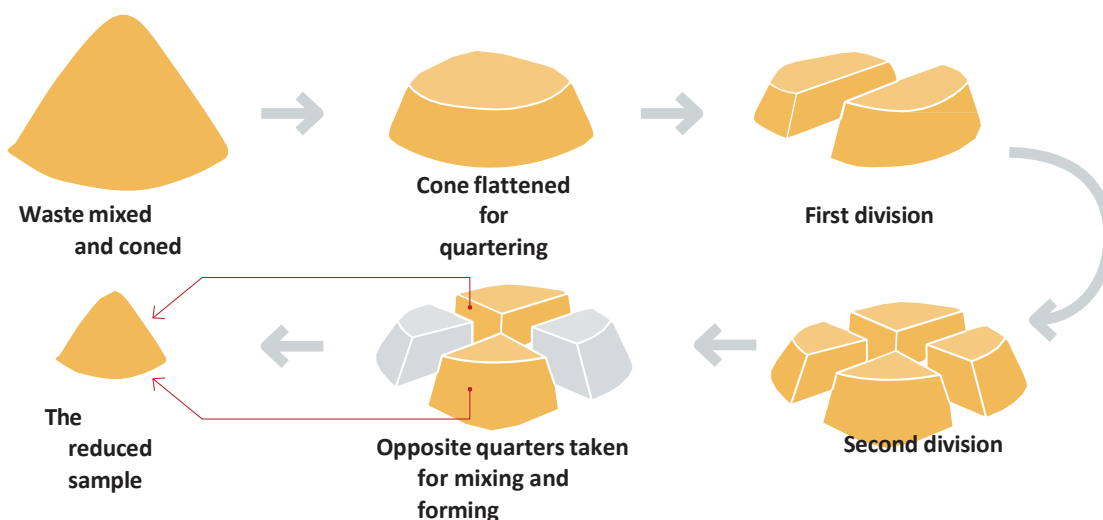
Identify the vehicles collecting waste from each socio-economic strata/land use. Every day, select vehicles randomly from each socio-economic strata/land use. Make sure that the waste collectors are not removing valuable plastics/ dry wastes beforehand.

Step 5: Sample preparation

The entire truckload of waste (approximately 400-500 kg) should be discharged in a designated area. Use the Quartering and coning method to reduce the size of the sample to the range of 100-125 kg.

Method: Unload an entire truckload of waste on the ground or on a sheet, divide the waste into four parts. Select two samples positioned diagonally opposite to each other for the next step, and discard the other two as shown in the figure. Repeat this process once again, to reduce the size of the sample from 400-500 kg to 100-125 kg.

Figure 4: Quartering and coning process



Step 6: Sorting and quantifying

A temporary platform with High-density polyethylene (HDPE) liner should be made for waste quantification at the sorting station (either at the landfill site or at the MRF). Two helpers and five sorters should be engaged in carrying out the quantification exercise. The helpers and sorters should be provided with appropriate personal protection equipment (PPE) for their safety. Before the sorting, the helpers and sorters should be trained on different types of plastics and various kinds of SUPs banned.

The resource requirement human and logistics for sorting and quantifying is as provided in Box 2.

BOX 2: RESOURCE REQUIREMENT (EQUIPMENT/APPARATUS AND HUMAN RESOURCE)

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- i). Select a location for the discharge of waste load, manual sorting activity, and weighing operations that is flat, level, and away from the normal waste handling and processing area.
- ii). HDPE liner to make a platform for sorting and quantification which will help in eliminating possibility of leachate contaminating the soil and the surroundings.
- iii). Containers for storing and weighing each waste component, labelled accordingly for storing different fractions (like paper, textile, glass, metals, etc.) or subsequently sacks can be used except for the storing and quantifying wet waste. The weight of containers and sacks should be noted at the beginning and the same should be subtracted from the measurements while noting the data.
- iv). Electronic weighing scale, 2 weighing scale (1 scale of 250 kg capacity and accuracy of ± 10 g, and second smaller with accuracy of ± 1 g or less). All weighing scale shall be calibrated according to the manufacturer's instructions. Take appropriate corrective action if the readings are different from those of the calibration weights.
- v). Shovels, Rakes, Brooms (push and hand), First Aid kit, and other PPEs (such as safety boots, gloves, apron/ jacket, etc.)
- vi). For the sorting and quantification exercise, at least two helpers and five sorters will be required along with one coordinator to monitor and oversee the whole process.
- vii). The helpers and sorters should be trained to identify the different types of plastics and SUPs, pictorial banner is used to train them on this. (*refer Annexure 3*)

Sorting and quantification level 1: Dry waste fraction

Firstly, the total waste, sampled from coning and quartering method, should be weighed. It should then be separated into dry and wet waste and weighed separately. The dry waste should be further sorted into seven primary sorting categories:

- Paper
- Rubber and Leather
- Metal
- Glass
- Plastics, and
- Others (including medical waste, Sanitary waste, Hazardous substances, etc).

The weight fraction of each seven components should be measured.

Sorting and quantification level 2: Plastic waste fraction

The total plastic waste, sorted and weighed from above, should further be sorted into seven secondary categories, as per the IS 14534:1998 guidelines. Each sub-category category was weighed and registered in the datasheet.

Table 2: Categories of plastic

Category Type	Short Name	Scientific Name	Uses	Quantification (Kg/Kg of municipal waste)
1	PET	Polyethylene terephthalate	Water bottles, soft drink bottles, Juice bottles/ Rigid cosmetic jars/microwavable containers	
2	HDPE	High-density polyethylene	Shampoo bottles/Toys/Chemical containers/Pipe system/Recycling bins/Flower pots	
3	PVC	Polyvinyl chloride	Water pipes/Insulation wiring and cables/Bio-medical drips and tubings	
4	LDPE	Low-density polyethylene	Carry bags (grocery, dry cleaning, bread and bin liners)/Plastic wraps/Milk pouches/Squeezable bottles	
5	PP	Polypropylene	Bottle lids/Straws/Lunch boxes/Take away food containers/Ice cream containers/Syrup bottles	
6	PS	Polystyrene	Form packaging/Tea cups, plates and disposable cutlery/Containers/Yogurt containers	
7	Others	-	Multilayer packaging of chips, biscuits, etc.	

Notes: 1. Compostable plastic should be collected as a separate category or in Others category, but while quantifying MLPs it should be separated.

2. While quantifying banned SUP items, products made from compostable plastic should not be included.

BOX 2(A): IDENTIFY DIFFERENT PLASTIC CATEGORY

To identify different plastics, markings are made on the products. For example refer picture below,



The number mentioned in the triangle on bottles show the recycling codes of the specific products. The one

Sorting and quantification level 3: Banned SUPs

All the 19 banned SUP along with carry bags above 75 micron, obtained from waste samples should be separated from the plastic wastes and weighed as shown in Table 3 below.

Table 3: Different categories of SUPs

Sr. No.	SUP items (banned)		Quantification (kg/kg of plastic waste)	Percentage
1	Plastic sticks	Ear buds		
2		Balloon		
3		Candy		
4		Ice-cream		
5		Straw		
6	Carry bags	< 75 μ		
7	Plastic sheets	< 50 μ		
8	Cutlery items	Plates		
9		Cups		
10		Glasses		
11		Spoons		
12		Forks		
13		Stirrers		
14		Knives		
15		Trays		
16	Plastic wrapping and packaging films	Sweet Box		
17		Invitation cards		
18		Cigarette packets		
19	Others	Plastic flags		
20		PVC banners <100 μ m		
21		Polystyrene for decorations		
	Total			

BOX3: SAMPLING IN CITIES WITH SEGREGATED WASTE COLLECTION

In cities where waste collection is being done separately i.e. dry and wet fraction is being collected separately, the following sampling procedure should be used:

- If mixed dry waste is being collected, then in that case select the vehicle of dry waste from each economic stratum. Reduce it to 100-125 kg by quartering and coning method.
- If all the dry waste is collected separately. That is, glass, cloth, rubber and leather, domestic hazardous, sanitary, plastic, E-waste etc. are collected separately, then in that case take 30-50 kg of plastic waste from each economic strata for quantification and characterisation.

(Note: If the agency is collecting dry waste from different localities each day, collect waste each day depending upon the economic strata of the locality. Ensure that each day waste from all different categories is collected for quantification and characterisation)

2.2.2 Market Survey for Use, Availability and Alternatives of Banned SUPs

The major objective of the Market survey is to understand the availability of banned SUP items and its alternatives within the municipal boundaries.

To capture the entire municipal area with diversity in location as well as the economic activity associated with the usage of SUP, it is important to have an indicative sample from different market areas within the municipal boundary. The stratified random sampling method provides flexibility to divide population into smaller groups with respect to the characteristic under the study, which helps in providing a representative sample and makes it less resource intensive and time consuming. A two-stage stratified random sampling here would help in dividing the market area within the municipal area into smaller groups and help in capturing the diversity in terms of location, so that the results are not bias by a survey at a particular market location in the city.

As a next step, the commercial areas in each zone is further divided into more specific categories such as restaurants, offices, shops and stores, and cinemas etc. A reference here is taken from UNESCAP suggested sampling method for commercial establishments, which suggests to select approximately 10 to 20 samples for each category. A predefined number for each category was finalised to have a comparable analysis from different locations and cities.

A check for total number of sample to be surveyed was also done based upon the statistical method to provide precision. The sample size was estimated based on a 90% confidence level and 10% error. This reflects a reasonable balance between resources and statistical integrity. This essentially means that the results will be accurate to within 10% percentages points, 90% of the time.

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Formula for calculating Sample Size

$$\text{Sample size} = \frac{\frac{z^2 \times p \times (1-p)}{e^2}}{1 + \left(\frac{z^2 \times p \times (1-p)}{e^2 N}\right)}$$

Where:

N = population size

e = Margin of error (percentage in decimal form)

z = z-score

z-score is calculated based on the confidence level. For 90% confidence level, z-score is 1.645

Through this formula the number of commercial establishments to be surveyed comes out to be 69 (sixty-nine). To meet the theoretical requirement, the actual sample size is kept on higher side to ensure that maximum category of economic activity involved in usage of banned SUP is included.

Therefore, it was decided to survey 125-150 commercial establishments in smaller cities and 250-300 commercial establishments in big cities.

(a). Sampling

A two-stage stratified random sampling method is used to capture the diversity in location and type of commercial establishment (economic activity) in the city.

Figure 5: Methodology for market survey



Step 1: Divide the city area into four zones, and identify the predominant commercial areas in each zone. In small cities (cities with up to 5 lakhs population), take one market area in each zone. For big cities (cities with population above 5 lakhs), take two market areas in each zone.

Step 2: In each commercial area, nine major types of commercial establishments where the maximum amount of SUP is likely to be sold should be identified. These establishments are: medical stores, restaurants and roadside eateries, paan shops, Ice-cream parlors/carts, vegetable, fish, chicken, and meat shops, printing shops, sweet shops, general stores and stationaries, toy shops, and decorative item stores.

Step 3: In each market area, 30-35 commercial establishments under these nine different segments should be selected randomly for conducting the survey. In smaller cities, about 120-150 commercial establishments are to be surveyed. In big cities, the number of establishments to be surveyed should be 250-300.

Table 4: Sample size

Sl. No.	Types of shops	Sample size
1	Medical stores	3
2	Restaurants and roadside eateries	7
3	Paan shops	2
4	Ice-cream vendors	3
5	Vegetable, fish, chicken and meat shops	5
6	Printing stores	2
7	Sweet shops	3
8	General stores and stationeries shops	5
9	Toy sellers and decorative item stores	5

Step 4: A structured questionnaire (as given in Annexure 2) should be used for quantifying the availability, sale, and use of each banned SUP product and its alternatives in these commercial establishments.

Step 5: Results

The results should be compiled as shown in Table 5 below.

Table 5: Availability of SUPs and its alternatives in the market

Sr. No.	SUP items (banned)		Number of samples surveyed	Number of samples selling SUPs	Number of samples selling alternatives	Number of samples selling both	Percentage of samples selling SUPs
1	Plastic sticks	Ear buds					
2		Balloon					
3		Candy					
4		Ice-cream					
5		Straw					
6	Carry bags	< 75 μ					
7	Plastic sheets	< 50 μ					
8	Cutlery items	Plates					
9		Cups					
10		Glasses					
11		Spoons					
12		Forks					
13		Knives					
14		Trays					
15	Plastic wrapping and packaging films	Sweet Box					
16		Invitation cards					
17		Cigarette packets					
18	Others	Plastic flags					
19		PVC banners <100 μ m					
20		Polystyrene for decorations					
	Total for the city						

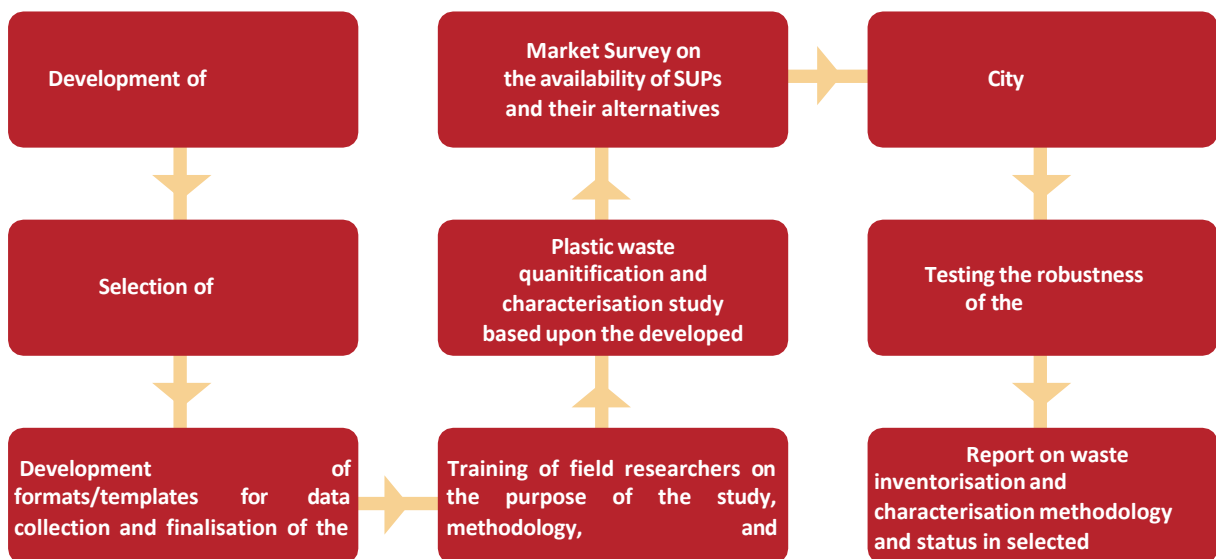
Note: Carry bags above 75 μ is allowed till 31 December, 2022 post this date carry bags thickness will be revised to 100 μ .

3. Study of 20 cities

3.1 Approach

A **comprehensive** study was conducted to test the methodology, and to find out its robustness and applicability on the ground. The approach used in the cities is shown in Figure 6.

Figure 6: Approach



The process followed for the study was as follows:

- Selection of cities
- Development of questionnaire and information collection forms
- Identification of city partners (organisations who are already working in the field of waste management in the cities) in each city to undertake the survey.
- Development of training toolkit: An online training and mock survey was done for each city partner to train them on data form, market survey and waste inventory.
- The sampling size, location and procedure was finalised in coordination with city partners.
- The SIA team travelled to cities for hand holding the city partners in waste inventory, and market surveys.
- Random data check (approximately 1/4th of the sample size) done by SIA team to authenticate the survey results.

3.1.1 Selection of Cities

The study was done in 20 cities across 11 states, with diversity in location, population, waste generation quantity and current waste management practices. The selected cities are given in Table 6 and shown in MAP 1 below.

The selection of the 20 cities was done at three levels:

1. Stratification of the cities to ensure best representation of the country, and to best capture the diversity (hill, plain, tourist, capitals, etc.).
2. Stratification in terms of population, waste management practice, Swachh Sarvekshan ranking, and quantum of waste generation.
3. Lastly, cities with better waste data collection were selected to cross-check the inventory results and thus establish the robustness of the methodology.

Map 1: Cities selected for the survey



Table 6: Selected cities

North	South	East	West	Central	North East
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<p>1. Delhi</p> <ul style="list-style-type: none"> • South Delhi Municipal Corporation <p>2. Uttar Pradesh</p> <ul style="list-style-type: none"> • Agra • Lucknow 	<p>1. Karnataka</p> <ul style="list-style-type: none"> • Mysuru • Bengaluru <p>2. Kerala</p> <ul style="list-style-type: none"> • Alappuzha • Thiruvananthapuram <p>3. Andhra Pradesh</p> <ul style="list-style-type: none"> • Tirupati • Vijayawada <p>4. Telangana</p> <ul style="list-style-type: none"> • Warangal <p>5. Tamil Nadu</p> <ul style="list-style-type: none"> • Coimbatore • Mamallapuram <p>6. Puducherry</p> <ul style="list-style-type: none"> • Karaikal 	<p>1. Jharkhand</p> <ul style="list-style-type: none"> • Dhanbad 	<p>1. Gujarat</p> <ul style="list-style-type: none"> • Surat • Vadodara 	<p>1. Madhya Pradesh</p> <ul style="list-style-type: none"> • Bhopal • Indore 	<p>1. Assam</p> <ul style="list-style-type: none"> • Guwahati • Jorhat
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(a). Diversity in location

The selected cities are from across the country. The cities are selected such that at least one state from each zone is represented. The maximum representation is from the Southern states due to several factors including availability of past inventory data, cooperation from ULBs and wider diversity in the classification of cities.

The cities represent the geographical diversity cities from coastal areas, plains, and hills. The cities also represent diversity in terms of religious, tourist, commercial and historical places.

(b). Diversity in population

The sample includes small cities such as Mamallapuram and large corporations with populations above five million like Bengaluru. The largest number of cities in the sample are in the population range of 1-5 million.

Table 6 (a): Diversity of cities based upon population range

City based on population				
0-100,000	100,000-500,000	500,000-1,000,000	1,000,000-5,000,000	5,000,000 above
Mamallapuram	Alappuzha	Thiruvananthapuram	Vijayawada	SDMC
Jorhat	Tirupati	Mysuru	Agra	Bengaluru
Karaikal		Guwahati	Bhopal	
			Indore	
			Lucknow	
			Dhanbad	
			Surat	
			Coimbatore	
			Warangal	
			Vadodara	

(c). Diversity in waste management practices

The list includes cities with both centralised and decentralised waste management systems. Some cities like Alappuzha perform well with excellent source segregation and home composting mechanisms, whereas other cities like Dhanbad and Jorhat do not practice source segregation. The list includes cities without landfill, and also cities which use information technology to effectively manage its waste such as Bengaluru. The list includes cities where the waste management is done by the municipality itself, and also cities where private companies and NGOs have been given the responsibility.

(d). Diversity in terms of Swachh Sarvekshan rankings

Cities from both above 10 lakh population and 1 to 10 lakh population are selected. Indore with rank number 1 and Guwahati with rank 310 shows a diversity of selection. There are also few municipal towns, namely Mamallapuram, which are not part of the Swachh Sarvekshan ranking.

Table 6 (b): Diversity of cities in terms of Swachh Sarvekshan ranking

Swachh Sarvekshan Ranking for cities with population more than 10L		Swachh Sarvekshan Ranking for cities with 1L-10L population			
1-10	11-50	1-100	101-200	201-300	301-400
Indore	Lucknow				Guwahati
Surat	Agra	Mysuru		Alappuzha	
Vijayawada	Dhanbad				Thiruvananthapuram
Bhopal	Bengaluru				
Vadodara	SDMC				
	Coimbatore				

(e). Diversity in quantum of waste generation

In terms of waste generation, cities represent a huge variation, Mamallapuram generates only about 6 tonnes/day, Bengaluru generates more than 6,000 tonnes/day.

Table 6 (c): Diversity of cities based upon quantum of waste generation

Cities based on waste generation (Metric tonnes per day)			
0-500	501-1,000	1,001-1,500	1,501 and above
Mamallapuram	Guwahati	Indore	SDMC
Jorhat	Bhopal	Lucknow	Bengaluru
Karaikal	Agra	Coimbatore	Surat
Alappuzha	Vijayawada		
Tirupati	Vadodara		
Mysuru	Dhanbad		
Warangal			
Thiruvananthapuram			

3.1.2 Development of Information Collection Form

A detailed information collection form was developed to collect all the basic information of current waste management scenarios in the city. The form included information on waste generation, collection, transportation and available infrastructure to manage the same. The information collection form was discussed and validated through discussions with the experts working in the waste management sector at national level. The information collection forms were put online, and for the market survey an online survey software was used.

3.1.3 Training Toolkit

A training toolkit was developed to facilitate and train the partners, their volunteers and sorters in different cities. This included a pictorial representation of the sorting facility, material requirements, a guide to identify different types of banned SUPs, and different plastic categories (*refer Annexure 3*).

An online training session was organised for every partner to familiarise them with the data collection form, daily entry sheet, and market survey form. This training included mock sessions and training videos.

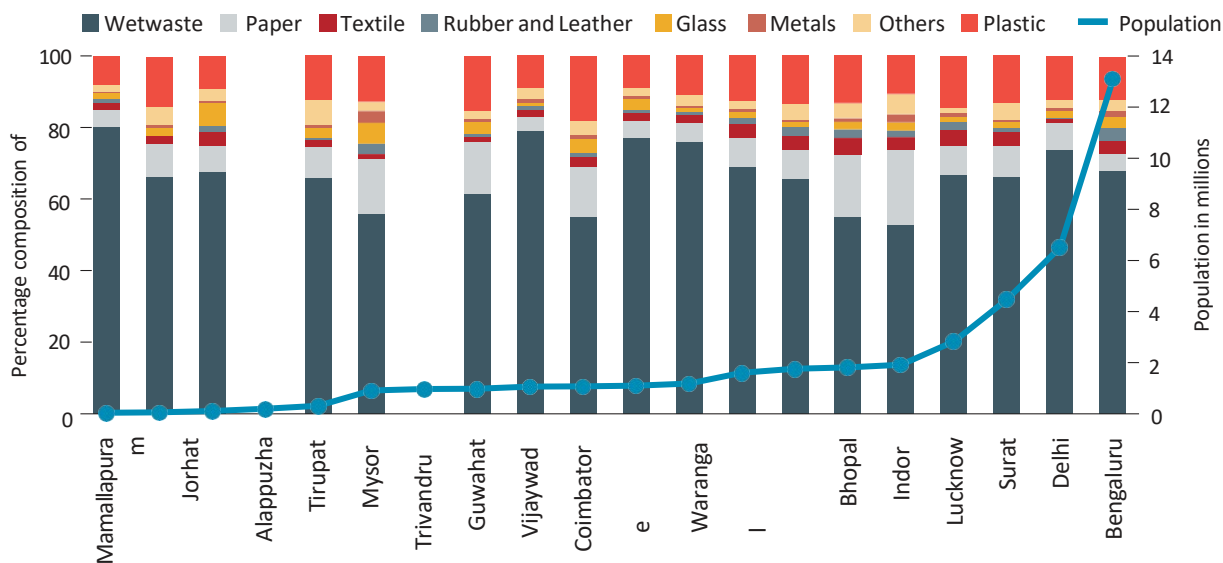
3.1.4 Project Implementation

The implementation of the project in all 20 pilot cities across 11 states, took place from March to September, 2022. The city wise detail of inventory and market survey is as provided in the table 6 (d) below. The results and findings of the study are presented in the subsequent sections. The city wise details of inventory is presented in Annexure 5: Cities Case Files.

Table 6 (d): Diversity of cities in terms of Swachh Sarvekshan ranking

Sr No	City Name	Inventory Dates	Market survey month
1	Jorhat	7 to 11 April, 2022	April and May
2	Guwahati	7 to 10 May, 2022	April and May
3	Agra	13 to 17 May, 2022	April and May
4	Delhi	26 to 29 May, 2022	March and May
5	Dhanbad	26 to 30 June, 2022	April and May
6	Mamalapuram	1 to 5 July, 2022	June and July
7	Karaikal	4 to 8 July, 2022	June and July

Figure 7: Municipal waste composition in selected cities

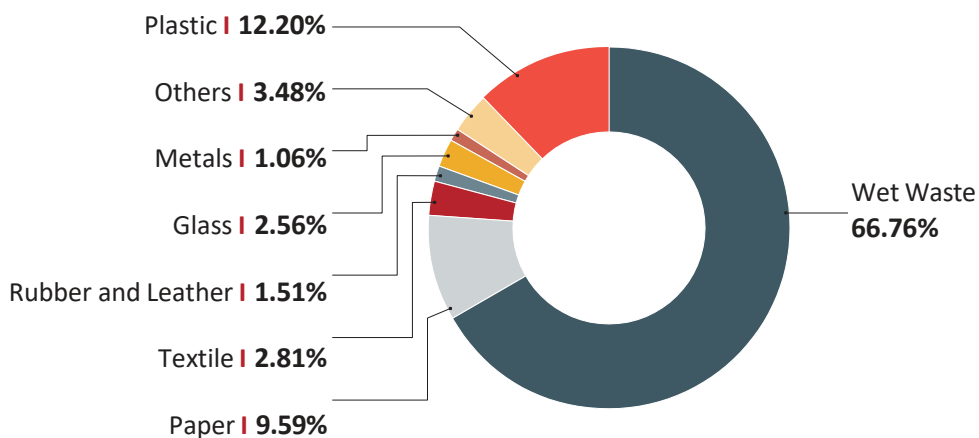


The range and average composition of municipal waste in the pilot cities is represented in Table 8.

Table 8: Average municipal waste composition in 20 cities

Component	Range (%)	Average (%)
Wet Waste	53-80	66.76
Dry Waste	20-47	33.36
Paper	4.8-20.7	9.59
Textile	1.1-4.7	2.81
Rubber and Leather	0.2-3.5	1.51
Glass	1-6.3	2.56
Metals	0.3-3.3	1.06
Others	2-5.6	3.48
Plastic	8-17	12.20

Figure 8: Average Municipal waste composition



(a). Wet Waste

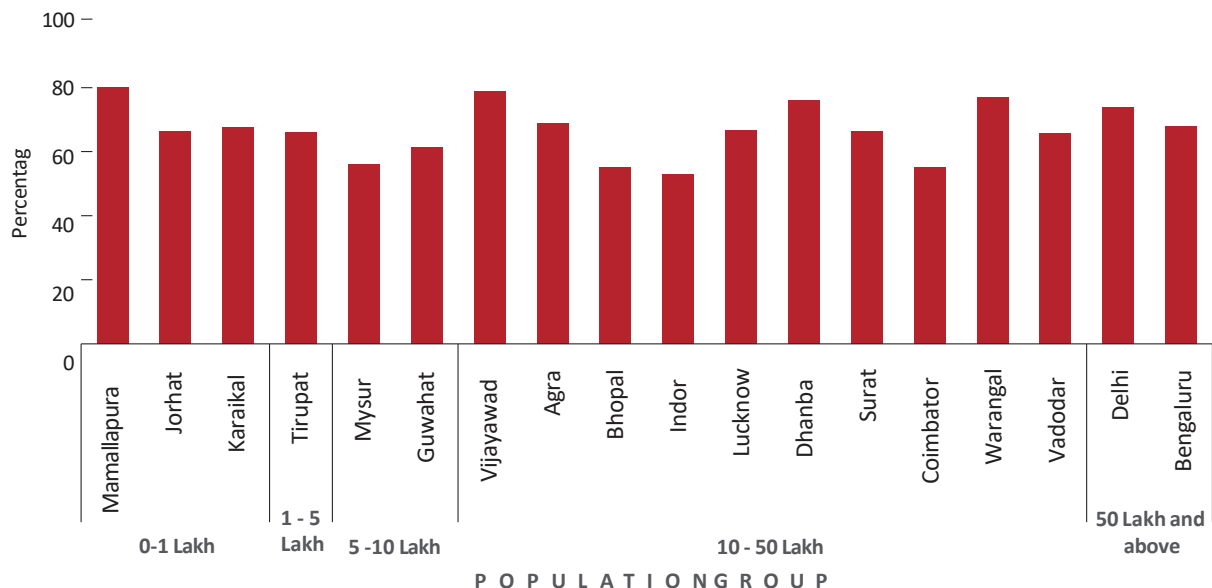
The percentage of wet waste in the total municipal waste in the cities lies between the range of 53% to 80%. Out of the cities surveyed, in 9 cities, namely, Guwahati, Tirupati, Jorhat, Karaikal, Bengaluru, Vadodara, Surat, Lucknow and Agra, the wet waste percentage lies in the range of 60% to 70%. In Five cities, namely, Delhi

(SDMC), Dhanbad, Warangal, Vijayawada, and Mamallapuram the wet waste are in the range of 70% to 80% of the total municipal waste. The wet waste component is less than 60% in four cities, namely, Bhopal, Coimbatore, Indore and Mysuru.

The highest percentage of wet waste was observed in Mamallapuram and Vijayawada at 80% and 79%, respectively. It can be observed that in these two cities, the contribution of paper to the waste stream is much lower than in other cities. It lies in the range of 4-5%, whereas in other cities, the average contribution of paper waste is around 9%. This is due to the increase in usage of banana leaves as a packaging alternative to plastic. The contribution of plastic waste is also the least in these two cities, at 8% and 9%, respectively.

The cities with lowest wet waste content are Indore and Coimbatore, at 53% and 55%, respectively. The wet waste content in the municipal solid waste in various cities is depicted below in Figure 9.

Figure 9: Percentage of wet waste in municipal solid waste in different cities



(b). Dry Waste

The total dry waste content in the Municipal Solid Waste in the selected cities is given in Figure 10.

The percentage of dry waste in the total municipal waste in the cities lies in the range of 20% to 47%. Out of the cities surveyed, in four cities, namely Mamallapuram, Vijayawada, Warangal, and Dhanbad, the dry waste percentage was found to be below 25%. In ten cities, the dry waste percentage is in the range of 25% to 40%. The dry waste component is above 40% in four cities, namely, Bhopal, Coimbatore, Indore and Mysuru.

The highest percentage of dry waste content was observed in Indore at 47%, and in Bhopal and Coimbatore at 45%. In these three cities, the contribution of paper to the waste stream is much higher than in other cities, in the range of 14.1% to 20.7%, whereas in other cities the average contribution of paper waste is around 9%. In these three cities, it was observed that the percentage of samples selling alternatives was the highest; increase in usage of paper as an alternative (such as paper bags, envelopes, cups, glasses, plates, straws, etc.) to SUPs could be one of the reasons for this trend.

An opposite trend can be observed in cities where dry waste percentage is low. In these cities, the paper content in the waste stream is found to be low. In the four cities with lowest dry waste percentage, the contribution of paper waste to the total waste was in the range 4 to 5.5 percent.

The dry waste content in the municipal solid waste in pilot cities is depicted below in Figure 10.

Figure 10: Percentage of dry waste in municipal solid waste in different cities



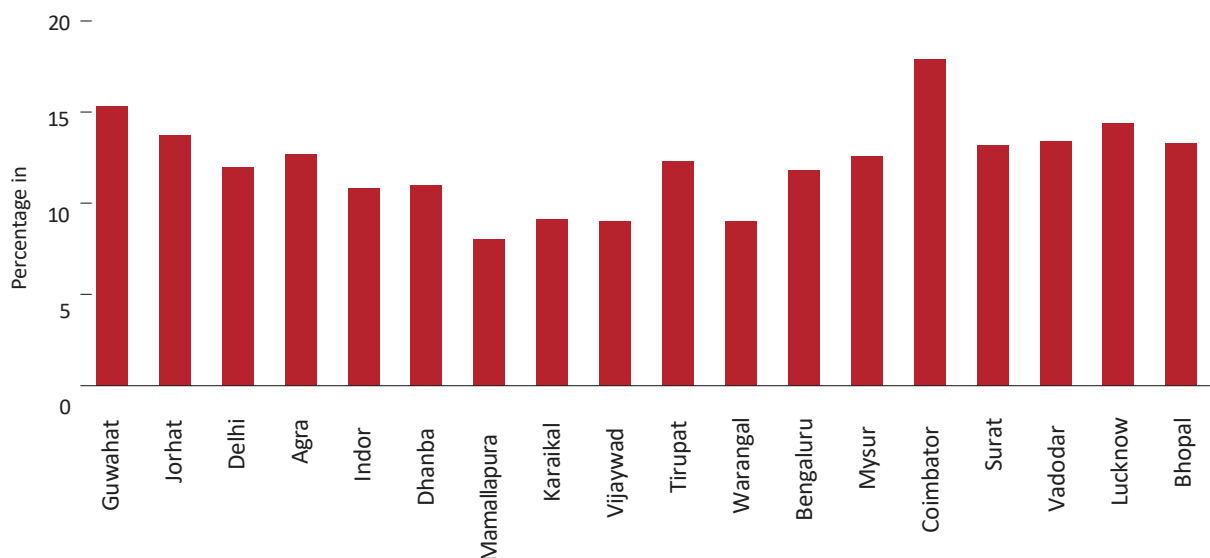
(c). Plastic waste

The average percentage of plastic waste in the total stream was observed to be around 12.2%. The plastic waste percentages in cities ranged from 8% to 17%. The percentage of plastic waste (including banned SUP products) was observed to be as follows in pilot cities:

- The highest percentage of plastics was observed in Coimbatore at 17.9%, followed by Guwahati and Jorhat at 15.3% and 13.7%, respectively.
- The lowest percentage of plastic waste was observed in Mamallapuram at 8% and Vijayawada and Warangal at 9%; Karaikal follows with a plastic component of 9.1%.

The percentage of plastics in the municipal solid waste of different cities are illustrated in Figure 11.

Figure 11: Plastic percentage in MSW of pilot cities.



3.2.2 Plastic Inventory

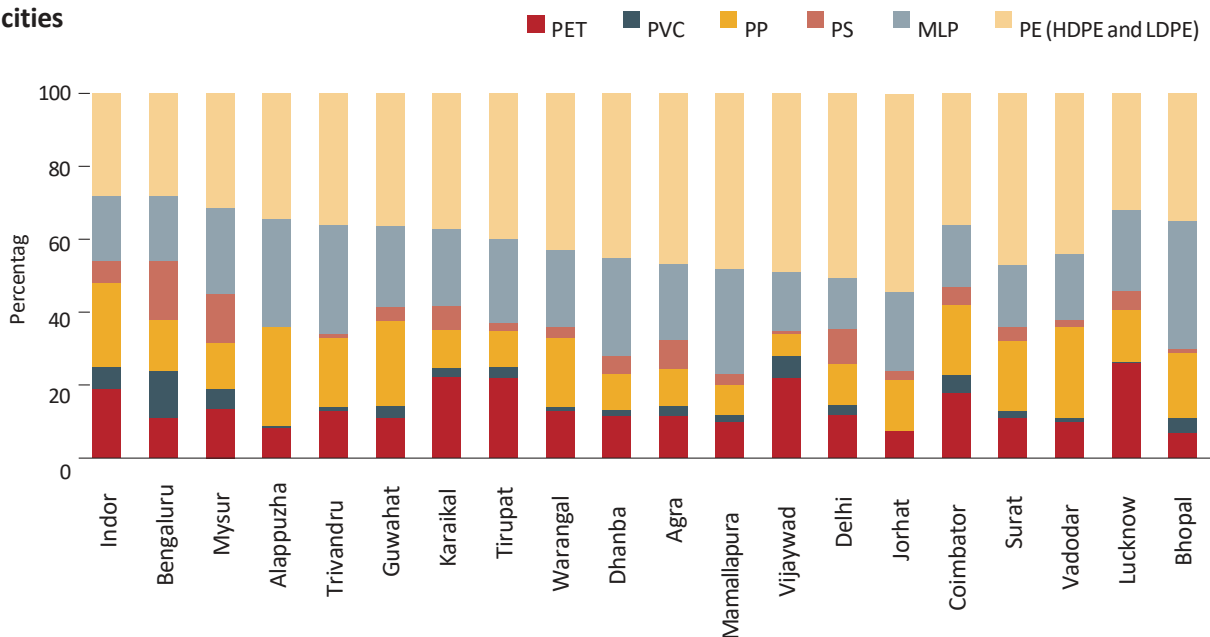
Plastics were inventoried into seven types as per the IS 14534:1998 guidelines. All the plastics items obtained in the samples were weighed to determine the composition of plastic waste. Plastic categorisation becomes extremely important because of the varying uses and recyclability of these materials. It also helps in developing plastic waste management systems, setting up infrastructure for recycling etc. The composition of different types of plastics in the pilot cities is given in Table 9 and Figure 12, and the average composition in Figure 13.

Table 9: Composition of plastic waste in pilot cities

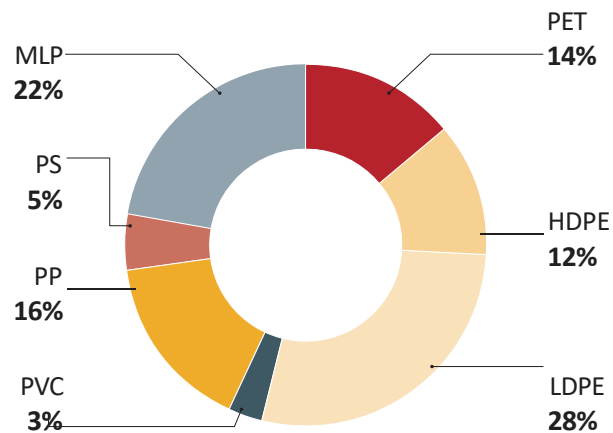
City	PET	HDPE	LDPE	PVC	PP	PS	MLP
Guwahati	11	6.3	30	3.4	23.3	3.9	22.2
Jorhat	7.5	6.36	47.9	0	14.09	2.5	21.53
Delhi (SDMC)	11.9	7.2	43.3	2.8	11.2	9.5	14.1
Indore	19	16	11	6	23	6	18
Bhopal	7	12	22	4	18	1	35
Dhanbad	11.6	10.5	34.7	1.7	9.9	4.9	26.7
Agra	11.5	9.5	37.3	2.9	10.1	7.9	20.8
Lucknow	26	10	22	0.5	14	5.5	22
Mamallapuram	10	7	40	2	8	3	29
Coimbatore	18	19	17	5	19	5	17
Karaikal	22.4	8.2	29	2.5	10.3	6.6	21
Vijaywada	22	15	35	6	6	1	16
Tirupati	22	19	21	3	10	2	23
Trivandrum	13	12	24	1	19	1	30
Alappuzha	8.3	15.6	18.9	0.6	27.1	0	29.5
Warangal	13	9	35	1	19	3	21
Bengaluru	11	15	13	13	14	16	18
Mysore	13.5	16.8	14.6	5.6	12.4	13.7	23.4
Surat	11	10	37	2	19	4	17
Vadodara	10	10	34	1	25	2	18
AVERAGE	14.0	11.7	28.3	3.2	15.6	4.9	22.2

(Note: All the values in the table are in percentage of the total plastic waste in the cities)

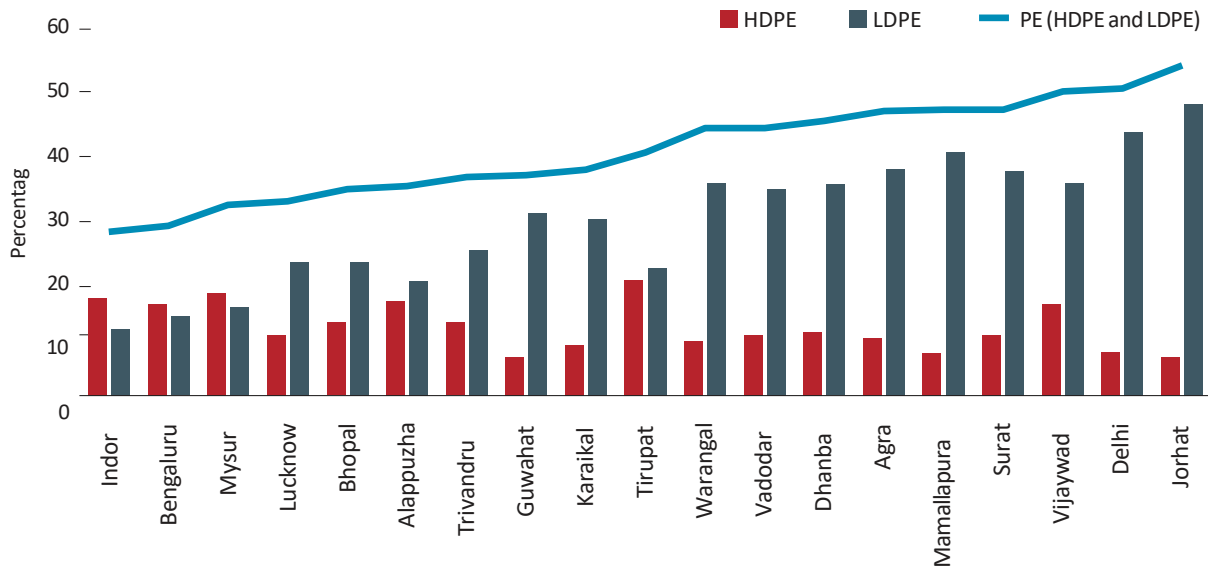
Figure 12: Plastic composition in pilot cities



The average composition of plastic waste in pilot cities are depicted below.

Figure 13: Average Plastic composition**(a). LDPE and HDPE**

In all cities, PE (both HDPE and LDPE together) formed the largest component of plastic waste. On an average, PE accounted for about 40% of the total plastic waste, ranging from 27% (the least observed) in Indore to about 54.3% in Jorhat. In all cities, except in Indore (27%) and Bengaluru (28%), the proportion of PE in total plastic waste was higher than 30%. Of the 40% PE, LDPE makes up for the bigger share (approximately 28%), while HDPE accounts for about 12%. This high consumption of LDPE can be attributed to the daily usage of disposable milk packets, LDPE carry bags, and the increased use of LDPE in packaging materials especially by e-commerce companies. HDPE waste mostly consisted of hard packaging of FMCG goods like Shampoo bottles, Detergent and Laundry packaging and chocolate boxes, etc.

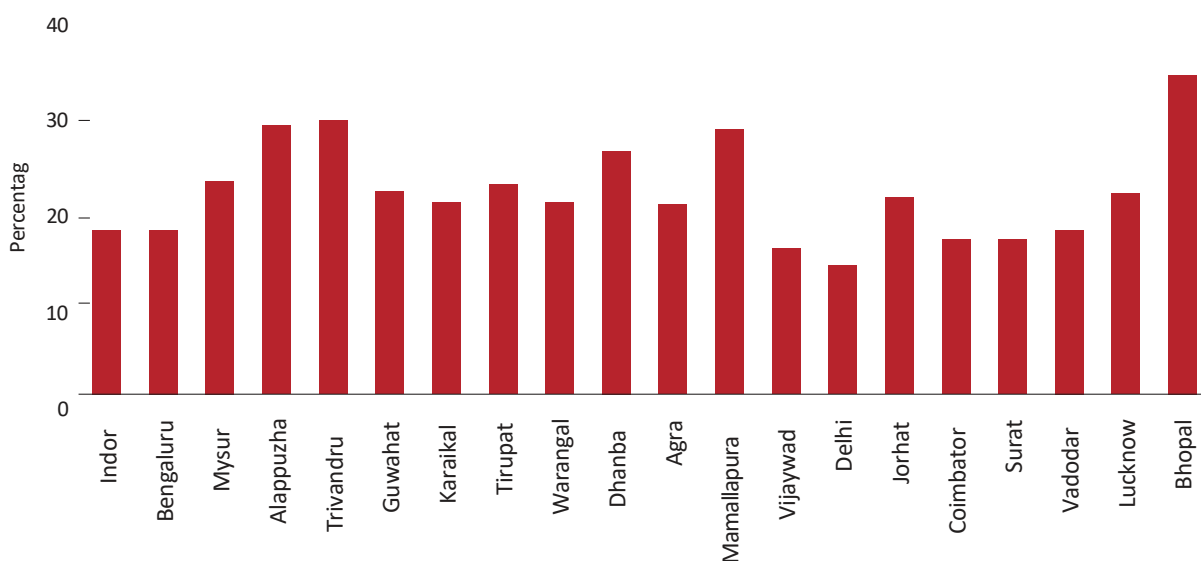
Figure 14: Percentage composition of PE in cities**(b). MLPs**

After PE, Multi-Layer Plastics (MLPs) are the largest contributors to plastic waste. It accounts for 22% of the total plastic waste. MLPs are the most widely used material in the packaging of almost all kinds of FMCG products. Almost all packaged goods ranging from chocolate wrappers, biscuits, snacks, shampoos, chips, groceries, etc. are packed using MLPs. MLPs are made by laminating several thin sheets of various materials like Aluminium, paper, plastic, etc. together to form a single wrapper. The separation of these materials for recycling is very difficult and requires advanced technologies, making MLPs one of the hardest materials to recycle. MLPs are the least recycled plastics across the world.

The proportion of MLPs in the waste stream in cities ranges from 14.1% in Delhi (SDMC) to 35% in Bhopal.

Out of the cities studied, the MLP percentage mostly ranged between 14% to 24%. About 15 cities lie in this range. In five cities, namely, Coimbatore, Dhanbad, Trivandrum, Alappuzha and Mamallapuram, the MLP

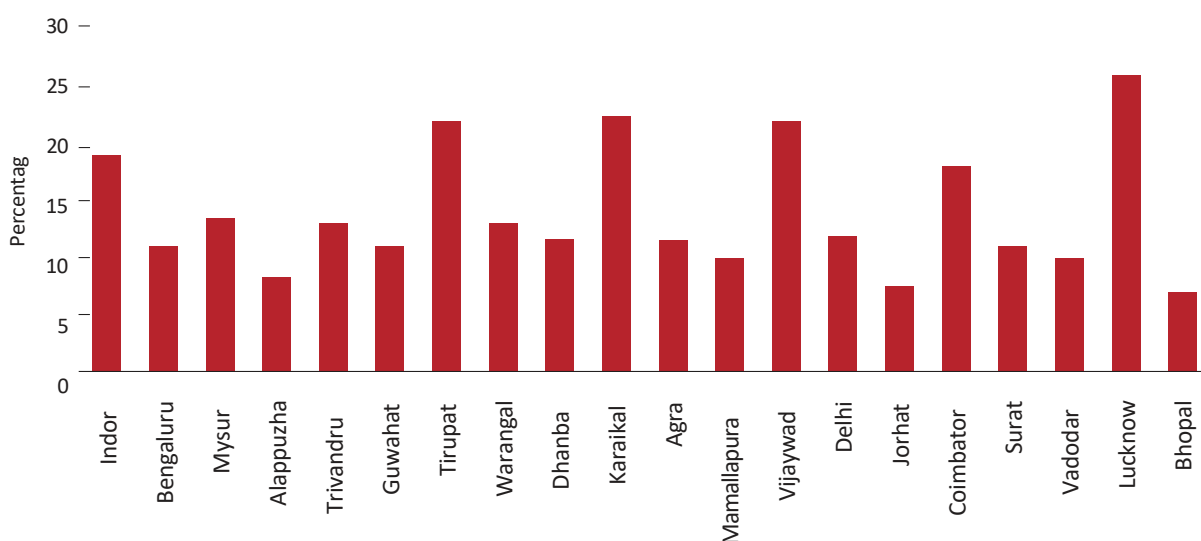
composition was between 25% to 35%.

Figure 15: Percentage of MLP in cities

(c). Polyethylene Terephthalate (PET)

On an average, PET contributes about 14% of the total plastic waste in cities. The PET percentage varies from about 7% (observed in Bhopal) to 26% (in Lucknow). In Karaikal, the PET percentage was 22.4% of the total plastic waste. It should be noted that, due to an extraordinary circumstance, the PET percentage in Karaikal was higher than usual due to the spread of Cholera epidemic. This led to a sudden surge in the sale and use of PET bottles due to high consumption of packaged drinking water, coconut water, etc. A 22% contribution by PET to the total waste stream was also observed in Vijayawada and Tirupati. Even in Indore and Coimbatore, the proportion of PET in total plastic waste was about 19% and 18%, respectively.

In all other cities, the PET percentage was in the range of 7% to 14%. The percentage of PET in different cities is presented below in Figure 16.

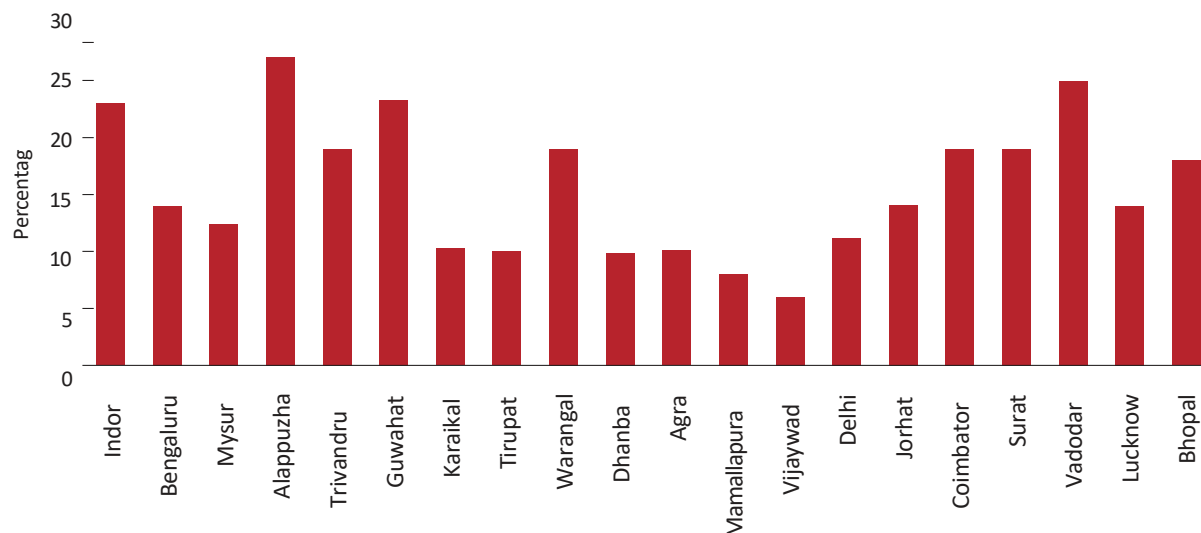
Figure 16: Percentage of PET in selected cities

(d). Polypropylene (PP)

On an average, Polypropylene (PP) made up about 15.6% of the total plastic waste. The contribution of PP to the total plastic waste stream lies between 6% to 27.1%. The lowest proportion of PP in the plastic waste stream was observed in Vijayawada, whereas the highest was observed in Alappuzha (27.1%). Due to its high strength, resilience to wear and tear, sun, water, and bacteria, PP is used widely in the manufacturing of plastic goods as well as in packaging. It is used for manufacturing items like utensils, houseware like boxes, buckets, toys, rigid packaging, and also in certain kinds of flexible packaging. Most items made of PP are designed for long-term

use. The recyclability of PP is also high. In 11 cities out of 20, the percentage of PP in the total plastic waste was between 14% to 27.1%.

Figure 17: PP percentage in different cities

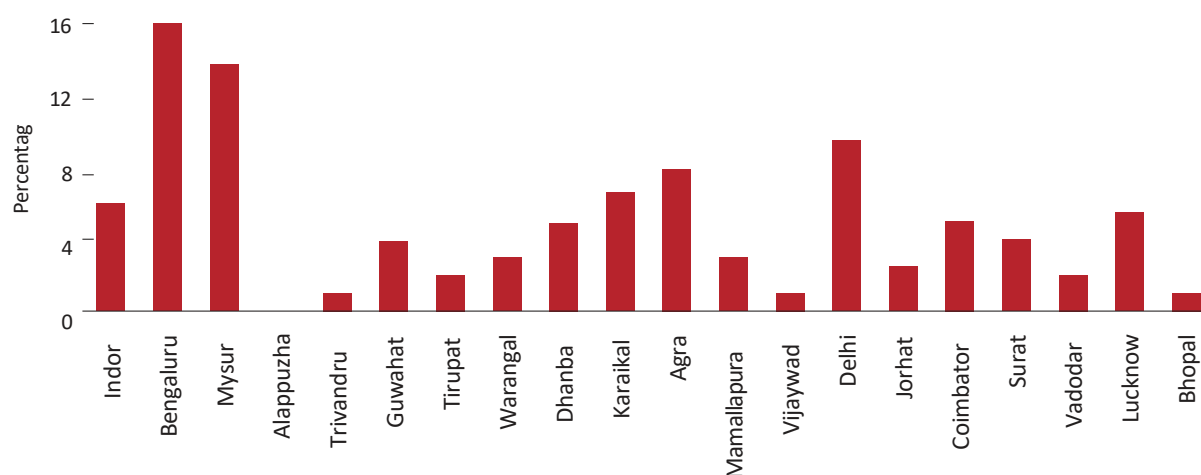


(e). Poly-Styrene (PS)

Polystyrene is a versatile form of plastic used for making hard plastic products as well as lightweight plastic products. Expanded Polystyrene (EPS) is a lightweight foam type material, used for manufacturing packaging materials for appliance insulation, food service, and packaging crockery and cutlery, automobile parts, etc. On average, PS was 5% of the total plastic waste in the pilot cities. The proportion of PS varied widely. It ranges from less than 1% in Alappuzha to about 16% in Bengaluru. In Mysuru also, the percentage of PS in the total plastic waste was 13.7%. The next highest proportion of PS in plastic waste was observed in Delhi (SDMC), with 9.5%. In most cities, PS in the waste stream was observed in the form of disposable plates, cups, and insulation packaging. The PS content was observed to be high in samples of waste collected from commercial areas.

Certain cities like Alappuzha, Vijayawada, Thiruvananthapuram, Tirupati, Warangal, and Mamallapuram has very little proportion of PS, i.e., less than 3%, in the plastic waste stream. The city-wise percentage of PS in the total plastic waste is presented in Figure 18 below.

Figure 18: PS percentage in MSW



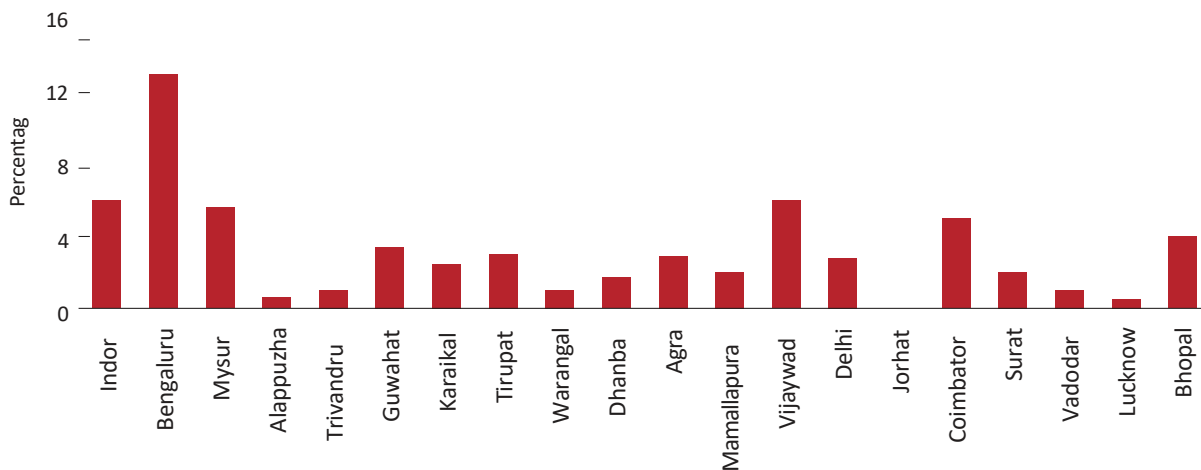
Note: In Alappuzha the negligible per cent is also because most of the PS item is handed over with paper, which is collected separately.

(f). Poly-Vinyl Chloride (PVC)

PVC is mostly used in construction and building materials like pipes, plumbing materials, windows, etc., and also in the packaging of certain edible items like dairy products, beverages, etc. The percentage of PVC in the waste stream was around 3.2%. The proportion of PVC in the total plastic waste during the inventory study, ranged

from negligible in Jorhat (less than 1%), to about 13% in Bengaluru. In most cities, it was less than 6% of the total plastic waste.

Figure 19: PVC percentage in MSW



3.2.3 Banned SUP Products

The banned Single-Use Plastic Products (SUPs) by MoEFCC is categorised into six major types for the purpose of the inventory study. They are Plastic sticks, Carry bags, Plastic sheets, Cutlery, Wrappings and Films, and Others.

- Plastic sticks include earbuds, balloon sticks, candy sticks, ice-cream sticks, straws and stirrers.
- Cutlery items include plates, trays, cups, glasses, spoons, forks and knives
- Wrapping and film include films on the sweet box, invitation card and cigarette packet
- Others include plastic flags, PVC banners (<100 μ) and thermocol decorations

As explained above, the average percentage plastic in the total municipal solid waste is about 12.2%. Of the total plastic waste, banned SUPs accounted for about 20%. In other words, on an average, banned SUPs account for about 2.4% of the total municipal waste (by weight).

The proportion of banned SUPs in pilot cities ranges from 5% to about 45% of the total plastic waste. In Coimbatore, the percentage of banned SUPs in total plastics was found to be least (only 5.1%), indicating very less usage of banned SUPs in the city. However, in three cities, Delhi (SDMC), Jorhat and Guwahati, the banned SUPs account for more than 30% of total plastic waste. In Jorhat, the proportion of banned SUPs to the total plastics is exceptionally high, accounting for 45.6% of the total plastic waste generated in the city. The percentage of banned SUPs in total plastic waste are depicted in Table 10 and Figure 20 below.

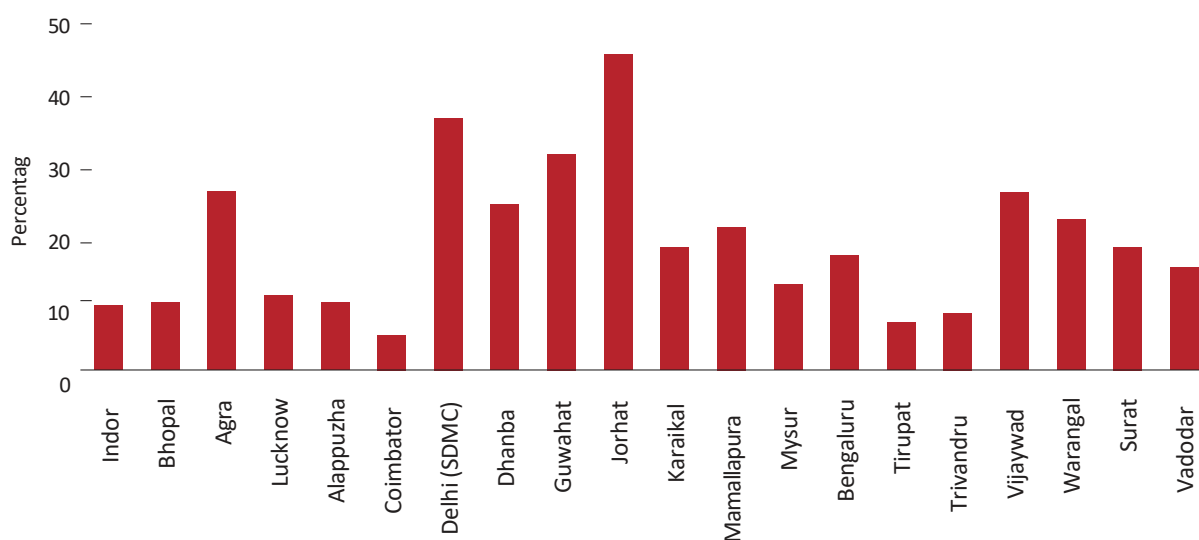
Table 10: Percentage of Banned SUPs in Total Plastic waste

Population group	City	Percentage of Banned Sups in total Plastic waste (%)	Average (population group wise)
0-100,000	Mamallapuram	20.66	27.96
	Jorhat	45.56	
	Karaikal	17.65	
100,000-500,000	Alappuzha	9.78	8.33
	Tirupati	6.88	
500,000-1,000,000	Thiruvananthapuram	8.23	17.24
	Mysuru	12.32	
	Guwahati	31.18	

Table 10 continued

Population group	City	Percentage of Banned Sups in total Plastic waste (%)	Average (population group wise)
1,000,000-5,000,000	Vijayawada	25.65	15.45
	Agra	25.73	
	Indore	9.31	
	Bhopal	9.79	
	Dhanbad	23.92	
	Lucknow	10.76	
	Warangal	21.78	
	Surat	7.75	
	Vadodara	14.77	
	Coimbatore	5.08	
5,000,000 above	Delhi (SDMC)	36.39	26.47
	Bengaluru	16.54	

Figure 20: Proportion of Banned SUPs in total plastic waste



(a). Composition of Banned SUPs

Plastic carry bags formed the largest portion of banned SUPs in almost all cities. It accounts for about 80% (by weight) of the total banned SUPs.

- The percentage of carry bags in total banned SUPs ranged from 14% in Bengaluru to 98% in Alappuzha. In Bengaluru the percentage of cutlery was much higher.
- Cutlery items, i.e., Spoons, Forks, Plates, Trays and Knives, formed the next largest proportion of banned SUPs in almost all cities. The average percentage of cutlery items in total banned SUPs is around 12%. The proportion of cutlery items varies in the range of 2% to 38%, depending on the usage in different cities. In Alappuzha, the usage of cutlery items was observed to be very minimal. Here, cutlery items contribute only 1.8% of the total banned items. The highest contribution of cutlery items to banned SUPs was observed in Indore and Bengaluru, with 37.8% and 30.5%, respectively.
- On average, Plastic sheets below 50 microns, contribute to about 3% of the total banned SUPs in different cities. The highest use of plastic sheets was noted in Vijayawada with a percentage of almost 38%, almost equal to the percentage of carry bags. It was observed that in Vijayawada, plastic sheets were being used in the packaging of food for takeaway in small eating joints, packaging of sweets, and baked goods, in sweet shops, bakeries, etc. In Bengaluru, the proportion of plastic sheets was observed to be 5.7%. In thirteen cities, the proportion

of

plastic sheets to the total waste was less than 1%, and no significant amount of plastic sheets with a thickness of less than 50 microns could be obtained during the inventory. These cities include Guwahati, Jorhat, Delhi (SDMC), Agra, Lucknow, Dhanbad, Mamallapuram, Karaikal, Thiruvananthapuram, Alappuzha, Warangal, Surat and Vadodara.

- On an average, plastic sticks contributed about 2% of the total waste generated by banned SUPs. Plastic sticks included earbuds, balloon sticks, candy sticks, ice-cream sticks, straws, and stirrers, however, straws, contributed the most under this category. Especially in samples from commercial areas which housed roadside juice shops, a significant amount of straws could be obtained. In most cities, earbuds, candy sticks, and balloon sticks were found in very small quantities. Plastic Ice cream stick was not observed in most cities. The highest proportion of plastic sticks was found in Bengaluru, about 16% of the total banned SUPs. Here, straws and balloon sticks formed the largest proportion. In Bhopal, Mysuru and Vijayawada, the proportion of plastic sticks was around 4% of the total weight of banned SUPs. In the rest of the cities, the proportion of plastic sheets was less than 2% of the total SUPs.
- Wrappings/films on sweet boxes, invitation cards, and cigarette packets contributed to about 1.1% of the total waste generated by banned SUPs. It is to be noted that small quantities of wrappings/films were obtained in all the cities. It was observed that the wrapping on sweet boxes and on cigarette films mainly contributed to this portion of the waste. Wrappings/films on invitation cards were observed in very small quantities. In almost all the cities, except in Mysuru and Bengaluru, where the percentages were 3.4% and 13.4%, respectively, the proportions of plastic films in the total waste was between 1%-2%. In Bengaluru, wrapping films on sweet boxes and invitation cards were obtained in slightly larger quantities.
- Plastic flags, PVC banners, and Thermocol decorations were categorised into the “others” category. They contributed to about 2.1% of the weight of total banned SUP products. The highest proportion was observed in Bengaluru and Mysuru, with a percentage of 19.6% and 8.6%, respectively. In Bengaluru, PVC banners and plastic flags used in political rallies mainly contributed to this weight. In Mysuru, certain amounts of thermocol decorations, and PVC banners with a thickness of less than 100 microns was observed in the sample during inventory. It must also be noted here that the weight of PVC banners is significantly higher than the weight of most banned SUPs. In all other cities, the proportion of ‘others’ category was between 0 to 3%. In cities, where the study was conducted in the months of April, May, and June, the percentage of flags and flag sticks in the waste stream was almost nil because of the seasonal nature of these products. However, in cities where the Inventory was conducted during the end of July and in early August, a small proportion of flags and flag sticks could be observed.
- The percentages of all banned SUPs are given below in Table 11 and Figure 21.

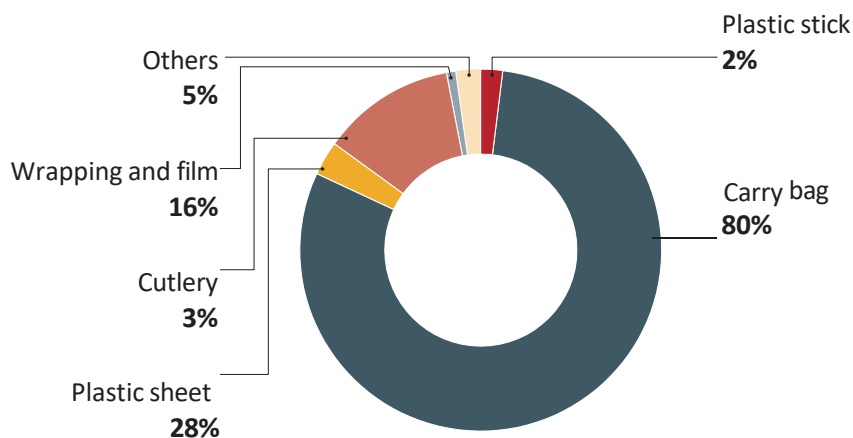
Table 11: Composition of banned SUPs in cities

Banned SUP	Plastic stick	Carry bag	Plastic sheet	Cutlery	Wrapping and film	Others
Guwahati	0.32	76.18	0	23.45	0.05	0
Jorhat	1.6	92.9	0	5.3	0.1	0
Delhi (SDMC)	0.29	92.53	0	7.09	0.09	0
Agra	0.46	85.68	0	13.67	0.18	0
Lucknow	0.35	93.42	0.05	5.11	0.5	0.56
Indore	0.6	56.1	1.5	37.8	1.6	2.3
Bhopal	3.43	84.28	1.2	9.23	0.26	1.6
Dhanbad	0.24	92.35	0.06	7.09	0.1	0.16
Mamallapuram	1.96	85.02	0.02	12.9	0.1	0
Coimbatore	0.435	93.358	2.121	3.852	0.125	0.109
Karaikal	1.48	89.43	0.08	7.58	0.12	1.32
Vijayawada	4.21	37.54	37.93	16.04	0.79	3.48

Banned SUP	Plastic stick	Carry bag	Plastic sheet	Cutlery	Wrapping and film	Others
Tirupati	0.22	95.27	1.44	2.62	0.18	0.27
Trivandrum	0.86	92.28	0	3.55	0.49	2.82
Allapuzha	0.12	98.11	0	1.77	0	0
Warangal	1.13	88.16	0	10.01	0.17	0.54
Bengaluru	16.34	14.43	5.74	30.45	13.44	19.59
Mysore	3.39	57.93	3.04	23.62	3.42	8.6
Surat	1.57	85.91	0.4	10.78	0.12	1.22
Vadodara	1.46	87.86	0.27	9.9	0.11	0.4
Average	2.02	79.94	2.69	12.09	1.1	2.15

(Note: All the values in the table are in percentage of the total banned SUPs in the cities)

Figure 21: Average composition of banned SUPs



Overall, carry bags and cutlery items accounted for 90% of the banned SUPs in the waste stream. The other banned items were less than 10% (by weight).

3.3 Results and Findings: SUPs in the Market

In 20 surveyed cities, 137 markets were surveyed to assess the sales of SUPs and availability of alternatives.

(a). City-wise status

The city-wise result of the market survey is given in Table 12 below.

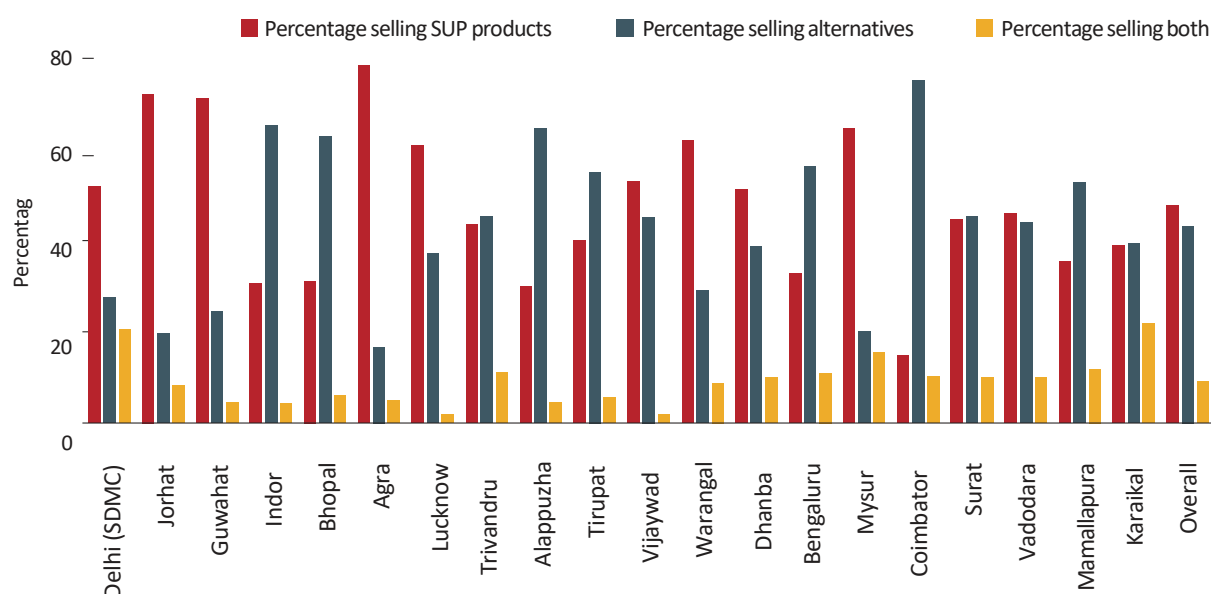
Table 12: City-wise sales of SUP products

City selling	Percentage of sample	Percentage of sample	Percentage selling both	Overall percentage of sample selling SUP
	selling only SUPs	only alternatives		
Delhi (SDMC)	52%	28%	21%	72%
Jorhat	72%	20%	8%	80%
Guwahati	71%	24%	4%	76%
Indore	31%	65%	4%	35%
Bhopal	31%	63%	6%	37%
Agra	78%	17%	5%	83%
Lucknow	61%	37%	2%	63%
Thiruvananthapuram	44%	45%	11%	55%
Alappuzha	30%	65%	5%	35%
Tirupathi	40%	55%	5%	45%
Vijayawada	53%	45%	2%	55%
Warangal	62%	29%	9%	71%
Dhanbad	51%	39%	10%	61%
Bangalore	33%	56%	11%	44%
Mysuru	65%	20%	15%	80%
Coimbatore	15%	75%	10%	25%
Surat	45%	45%	10%	55%
Vadodara	46%	44%	10%	56%
Mamallapuram	35%	53%	12%	47%
Karaikal	39%	39%	22%	61%
Overall (Average)	48%	43%	9%	57%

Note: One sample means one shop and one product category matrix. For example, one medical shop selling five types of SUPs will be equal to five samples.

On an average, 57% samples surveyed in 20 cities were still selling or using the banned SUPs. Out of this, only 48% sold SUP products, while 9% sold both SUP and alternatives. It was also found that 43% of the samples sold only alternatives to SUPs.

- The percentage of samples selling only SUP products in the pilot cities ranged from 15% to 78%. The highest percentage of samples selling/using banned SUPs was observed in Agra, Uttar Pradesh. Here, 78% of the samples still sold/used only SUP products. The lowest percentage was observed in Coimbatore (15%). After Coimbatore, Alappuzha had the lowest percentage, with only 30% of samples selling SUPs. In Indore, Bhopal, Bengaluru, Mamallapuram, and Karaikal, the percentage of samples selling SUPs was in the range of 31-39%. In Tirupati, Surat, Vadodara and Thiruvananthapuram the percentage of samples selling SUPs was in the range 40% to 46%. In Delhi (SDMC), Dhanbad, and Vijayawada, the percentage of samples selling SUPs ranged between 50% to 55%. In Lucknow, Warangal and Mysuru, more than 60% samples sold SUPs. More than 70% of samples sold SUP products in Jorhat, Guwahati, and Agra.
- The percentage of samples selling only alternatives to SUPs varied between 17% and 75%. The highest percentage of alternatives to SUPs was observed in Coimbatore and Alappuzha, while the lowest percentage was in Agra. Overall, in 7 cities Indore, Tirupati, Bhopal, Bengaluru, Mamallapuram, Coimbatore and Alappuzha the proportion of samples selling only alternative products was higher than 50%. In Agra, Jorhat and Mysuru the percentage of samples selling alternatives was 20% or below.

Figure 22: City wise scenario of sales/availability of banned SUPs

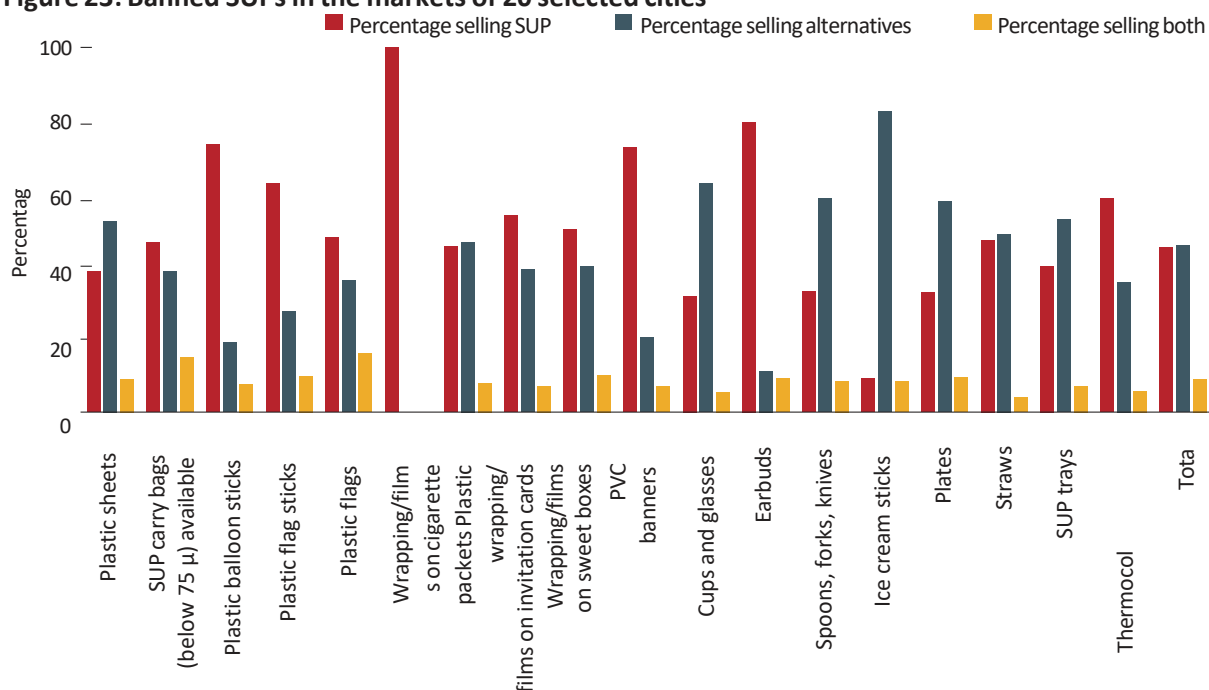
Overall, just before and after the bans were enforced, SUPs were being sold/used widely in the market. Close to 60% of all the samples were selling SUPs. Here, the highlight is that 43% of the samples were also selling/using the alternatives.

(b). Product-wise status

From the survey, it is noted that alternatives are available for almost all banned SUPs. Other than films on cigarette packets, alternatives are also sold in the market in varying degree. Table 13 and Figure 23 provide the product-wise sales on SUPs and the availability of its alternatives in 20 selected cities.

Table 13: Product-wise sales of SUPs and alternatives in pilot cities

Banned SUP items	Percentage selling only SUPs	Percentage selling only alternatives	Percentage selling both	Total percentage selling SUPs
Ice cream sticks	9%	82%	8%	17%
Cups and glasses	32%	63%	5%	37%
Spoons, forks, knives	33%	59%	9%	42%
Plates	33%	58%	10%	43%
SUP trays	40%	53%	7%	47%
Plastic sheets	39%	52%	9%	48%
Straws	47%	49%	4%	51%
Plastic wrapping/films on invitation cards	45%	47%	8%	53%
PVC banners below 100 μ	50%	40%	10%	60%
Wrapping/films on sweet boxes	54%	39%	7%	61%
SUP carry bags (below 75 μ) available	47%	38%	15%	62%
Plastic flags	48%	36%	16%	64%
Thermocol decorative	59%	36%	6%	65%
Plastic flag sticks	63%	28%	10%	73%
SUP candy sticks	73%	21%	7%	80%
Plastic balloon sticks	73%	19%	8%	81%
Earbuds	80%	11%	9%	89%
Wrapping/films on cigarette packets	100%	0%	0%	100%

Figure 23: Banned SUPs in the markets of 20 selected cities

The results clearly highlights that for SUP products such as Ice cream sticks and cutlery (cups, glasses, Spoons, forks, knives, plates and trays), alternatives are being widely sold/used. For SUP items like plastic balloon sticks, flag sticks, candy sticks and earbuds though alternatives are available, the usage is still on the lower side.

The market survey indicates that alternatives are slowly emerging to replace banned SUPs. The product wise list of alternatives being widely sold is given in Table 14 below.

Table 14: Alternatives available for banned SUP items

Banned SUP items	Alternatives
Plastic sheets	Paper sheets, Aluminium sheets, Aluminium foils, Banana leaves
Plastic carry bags (<75 μ)	Paper bags, Cloth bags, Reusable plastic bags, Non-woven carry bags, Handy-craft bags.
Plastic balloon sticks	Rubber balloon sticks, Wooden sticks, Yarn and Thread
Plastic flag sticks	Wooden sticks, Rubber sticks, Paper sticks
Plastic flags	Metal flags, Paper flags, cloth flags
Plastic films on cigarette packets	Nil
Plastic films on invitation cards	Paper cards without films, Paper envelopes
Plastic films on sweet boxes	Cardboard boxes, Hard plastic containers
PVC banners (<100 μ)	Above 230 GSM, Cloth banners
Plastic candy sticks	Wooden sticks
Plastic cups and glasses	Steel crockery, Glass crockery. Paper crockery, ceramicware, Earthen clay cups and glasses, Sugar bagasse crockery, Areca-nut disposable crockery, Sal leaf cups
Plastic earbuds	Wooden earbuds, Bamboo earbuds, Reusable steel earbuds
Plastic spoons, forks and knives	Steel cutlery, Wooden disposable cutlery, Aluminium cutlery
Plastic ice-cream sticks	Wooden sticks
Plastic plates	Paper plates, Steel plates, Hard ceramic plates, Hard plastic plates, Wooden plates, Banana Leaves, Earthen clay plates, pattal
Plastic straws	Paper straws, edible wafer straw
Plastic trays	Aluminum trays, Cardboard box trays

Thermocol decorative items

Paper décor, Inflatable balloon décor, tissue paper décor

3.4 Robustness of Methodology

One of the major objective of this study was to develop a statistically robust methodology. To test the robustness, a two-step check was used:

1. Selection of cities with a wide diversity in population and waste distribution.
2. Standard deviation was used to check the outliers within the city data from each day, and compared separately for residential, commercial and dumpsites.

The methodology was tested in different cities with wide diversity and was able to adopt and accommodate the variations to provide consistent and efficient results. The results obtained from this methodology was compared with the visible analysis of the waste received on ground and was found to represent the actual scenario. Further, the methodology was able to capture the data set in all condition without any replicability issues in various conditions.

The Standard Deviation (SD) is a single number that summarises the variability in a data set, thus simplifying the interpretation. It is useful in capturing both the variability and the uniformity at the same time from a given data set, and thus a good and easy indicator for analysing the data set. A smaller value of SD indicates that the values in the data set are relatively consistent and a higher value signifies higher variability and spread.

In the cities:

- The SD of the composition of waste during elaborate five days of the sampling period in all cities was less than 10%. As the composition of the waste did not show a huge variation on a daily basis, this means the sampling procedure is robust.
- The waste composition variability was also low, which means the data capturing template and procedure is robust.
- The variability in samples from residential, commercial and mixed use was less than 10%.

Overall, the on ground usability of the methodology was tested in 20 cities and was ascertained by its ability to capture consistent and reliable data set, which was also tested by the SD values indicates that the methodology is robust. (The low SD values for city-wise, product-wise and economic activity-wise for cities of varying population and waste composition indicates the ability of the methodology to be replicated in various condition and also capture consistent and reliable data set).

BOX4: GOOD PRACTICES IN PLASTIC WASTE AND SUP MANAGEMENT

During the course of implementation of the study, efforts were made to understand how some of the Indian cities fared better than other cities in implementing the SUP ban. This box highlights some of the practices observed during the study, which can be replicated in other cities.

1. Indore

Importance of awareness and communication and availability of alternatives

Indore is ranked as the cleanest city of the country for the past five times in a row as per the Swachh Survekshan survey, conducted by the Ministry of Housing and Urban Affairs (MoHUA). The city was able to bring in behavioral change at the mass level for source segregation by an intensive awareness and communication strategy. To ensure that the SUP ban is effectively implemented in the city, the city administration has followed the same process of involving citizens through effective awareness and communication drives on SUP availability in the market followed by a robust monitoring system.

The major problem of generation of plastic waste is being tackled at the initial stage by reducing the availability of plastic products and increasing access to sustainable alternatives. The Indore Municipal Corporation has successfully launched vigorous campaigns to make the city plastic-free.

Some of the campaigns which has helped the city are as follows:

- i). Setting up of the Jhola (cloth bag) banks at different market places in the city, where people get reusable cloth bags and paper bags at a minimal price. One can use the cloth bags a number of times and then exchange the same with a new one at the Jhola bank.

Box 4 continued

- ii). Identified city markets were targeted and a large number of alternatives were introduced in the market with the help of school children and residents. The school students were engaged in making paper envelopes and residents were engaged in making cloth bags from old clothes which were distributed among the shopkeepers for use.
- iii). The campaign has been extended to a few selected religious institutions, where shopkeepers at these establishments have been involved in eliminating the usage of SUPs from the premises. The same will be extended to all religious institutions in the city.

2. Thiruvananthapuram

Source segregation and focus on plastic recycling

The city of Thiruvananthapuram has a unique decentralised approach to manage the municipal waste. The city currently does not have any centralised solid waste management facility, like landfills or dumpsites. At present, more than 40% of the households are managing the biodegradable waste by themselves. For non-biodegradable waste, the Thiruvananthapuram Municipal Corporation (TMC) has developed a calendar for collecting different types of non-biodegradable waste. For example, weekly collection is organised for plastic waste, and monthly collection for glass, rubber, leather and textile waste.

TMC has set-up MRFs for collection of non-biodegradable waste with the help of SHGs and private agencies, and has also introduced an app 'Smart Thiruvananthapuram'. This app enables users to find out the nearest recycling facility. Recyclables are extracted from MRFs and sold to authorised recyclers whereas non-recyclables are disposed off by the state government-owned Clean Kerala Company. The Clean Kerala Company ensures that all plastic including sanitary waste is properly discarded.

The mechanism has helped the city to collect plastic waste in an organised manner and has increased the recycling rate of collected plastics, be it carry bags or even MLPs.

3. Tamil Nadu

Fines and penalties have worked in Tamil Nadu

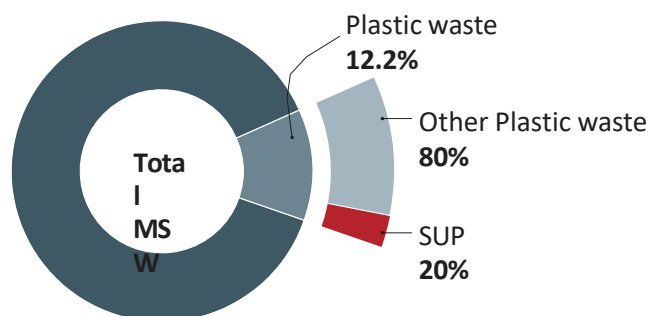
In 2018, Tamil Nadu was one of the few states to have implemented the plastic ban through a state Gazette notification. This notification provided time and had banned most of the listed SUP items at the time. Since then, relentless policing, fines, penalties and seizure have shown results in the state, both in rural as well as urban areas.

The fines and penalties have been imposed at all levels, be it the supplier, small and large vendors or the manufacturers, and thus targets the entire supply chain, from the production to the use of disposable plastics. The effectiveness of the ban depends upon how strictly it is being implemented by the local authorities. In the state, the public is encouraged to report violators and their locations through the means of an app. Thus, the public pressure on the authorities and the agencies has also worked in favour of the relative success of the ban in the state.

4. Conclusion and Way Forward

The key findings of the study are:

- Plastic waste accounts for 12.2% of the total municipal waste in the selected 20 cities. This is almost double the national average (6.9%) as per the Central Pollution Control Board, 2015. The plastic waste composition in selected cities varied from 8% to 17%. In most of the cities, it was between 10 to 14%.
- The composition of plastic waste in selected cities shows that PE (HDPE + LDPE) is the major contributor which constitutes around 40% of the total plastic waste, followed by MLPs which is around 20%. In PE, LDPE has the bigger share, which can be attributed to the daily usage of disposable milk packets, carry bags, and the increased use of LDPE in packaging materials especially by e-commerce companies. In totality, LDPE and MLPs accounted for about 50% of the total plastic waste.
- Banned SUPs accounted for about 20% of the plastic waste. In other words, on an average, banned SUPs account for about 2.4% of the total municipal waste (by weight). The proportion of banned SUPs in selected cities ranged from 5% to about 45% of the total plastic waste.



- Carry bags constituted the major proportion of the banned SUPs, accounting for 80% of the banned SUPs. Cutlery items were the other prominent banned SUPs, and accounted for around 12%. The other banned SUPs were around 8% (by weight).
- The use and availability of banned SUPs are still prevalent in the markets across the country. On an average, 57% of the samples surveyed in 137 markets across 20 cities were found to be using/selling banned SUP items. Out of this, 48% of samples only sold SUP products, while 9% sold both SUP and alternatives. The percentage of shops selling only SUP products in the cities ranged from 15% in Coimbatore to 78% in Agra.
- 43% of the samples were found to be using/selling alternatives to the banned SUPs. Alappuzha, Coimbatore and Indore are the cities where more than 65% of the surveyed samples were found to be using/selling alternatives only.
- Except for wrapping/films on cigarette packets, alternatives for all banned SUPs are available in the market.
- SUP items like plastic balloon sticks, flag sticks, candy sticks and earbuds are still being widely used whereas the use of most cutlery items like spoons, forks, knives, cups and glasses, plates and trays, availability/usage of alternatives is higher. Ice-cream sticks seems to be completely replaced with alternatives.

In general, it was found that though alternatives are available, most establishments are hesitant to use or want to delay its usage as much as possible due to the cost factor. The cost of the available alternatives to the SUPs are on higher side. For example, a packet of plastic spoons which has 100 units costs around ₹30 per packet, whereas the available alternatives like wooden spoons same quantity (100 units) would cost anywhere around ₹100 to ₹140, which is 3 to 5 times the cost of plastic. The sudden increase in the demand of the alternatives and decline in the demand of SUPs has further escalated the gap. This has resulted in high-end brand owned establishments switching to alternatives whereas smaller vendors like roadside eateries and juice centres are finding it difficult to replace.

Most of the alternatives are again of single-use nature, like paper cups, kullads, wooden spoons, paper straws, etc. The recycling capacity of most of the alternatives to SUP products is the same and a challenge in recycling these alternatives can be foreseen. Therefore, alternatives with multi-use should be promoted and made available, which will ultimately help in reducing the pollution burden.

Overall, except for few cities, most of the cities (both big and small) are finding it challenging to implement the ban. Few cities have already started giving some grace period. For accelerating the progress towards a successful SUP ban, all possible efforts should be done by involving citizens, creating awareness, providing alternatives and better infrastructure, and imposing fines and penalties, wherever necessary. There are examples of good practices documented in country (*refer BOX 4: Good practices in plastic waste and SUP management*) which can be replicated for better results.

4.1 The Way Forward

The methodology developed for the compliance assurance is robust and can be used by the regulatory authorities to plan the next steps in improving the compliance with SUP ban. The following are few key suggestions emerging from the study:

- Similar SUP inventory studies should be undertaken in all major cities of all states to assess the status of the ban and gaps in implementation.
- The study can be taken up further for studying the implications for SPCBs/PCCs/ULBs towards understanding the impact of SUP ban.
- The study should be repeated at an interval of every six months to assess the progress.
- Research studies focused on providing multi-use alternatives to SUPs should be developed in association with industries.
- Continuous effort is required to bring down the cost of the alternatives.
- Improvement in infrastructure to support collection and treatment of the SUPs as well as alternatives, and the recycling potential of alternative to SUP items should be enhanced.

Annexure 1

Specified role of SPCBs/PCCS and Local authorities as per directions issued by CPCB under Section 5 of Environmental (Protection) Act, 1986

1. Role of SPCBs/PCCs

- Random inspection of Plastic waste raw material suppliers to check that plastic raw material is not supplied to banned SUP producers
- Meeting of SPCBs/PCCs with DMs for issuing of Public Notice
- District-wise identification of major Stockists/ retailers/ sellers of banned SUP items
- Directions to identified Stockists / retailers/ sellers to take necessary action to ensure zero inventory by June 30, 2022. Commercial licenses issued shall be cancelled if found to be selling banned SUP items.
- Fresh commercial licenses to be issued to the Stockists/ retailers/sellers with the condition that they shall not be selling banned SUP items
- Structured Market Survey to be conducted by third party identified by SPCBs/PCCs
- Identification of banned SUP producers through backward integration and taking action against them
- Organisation of Workshops for MSMEs jointly with CIPET to facilitate shifting to production of Plastic Alternatives
- Plan for Awareness Campaign. To organise meeting workshops/webinars for all key stakeholders and key ministries directly or indirectly involved or associated with the production, storage, distribution, stocking and sale of banned SUP items.
- To take penal action levy EC on violators of stipulated conditions
- Meeting with local authorities to appraise them about their roles and responsibilities.

2. Role of Local authorities

- Random inspection of market areas to check the usage of banned SUP item, and survey of municipal solid waste for presence of banned SUP items.
- District-wise identification of major Stockists/ retailers/ sellers of banned SUP items
- Identification of banned SUP producers through backward integration and taking action against them
- Monitoring through SUP App
- Conduction of Structured field inspection, as per format provided by CPCB.

Annexure 2

Questionnaire for Market Survey

A. Generic Information

City Name:

Market Name:

Date of Survey:

Name of Surveyor:

- The questions will capture the responses on usage of SUP.
- Like, Are plastic earbuds available? If YES, tick the corresponding box. If Alternative is available, tick NO or if BOTH (SUP and alternative) is available tick the corresponding box.
- Wherever alternative is available note down the type of alternatives for each product.

1. Medical shop (3 Nos.)

Shop (Name)	Ear buds			Carry bags		
	Yes	No	Both	Yes	No	Both
1:						
2:						
3:						

Alternatives available:

- Ear Buds:
- Carry bags:

2. Restaurant and roadside eateries (7 Nos.)

Shop Name	Carry bags			Straw			Plastic sheet			Plate			Cups			Glass			Spoon			Fork			Knives			Tray		
	Y	N	B	Y	N	B	Y	N	B	Y	N	B	Y	N	B	Y	N	B	Y	N	B	Y	N	B	Y	N	B	Y	N	B

Alternatives available:

- Carry bags
- Straw
- Plastic sheet
- Plate
- Cups
- Glass
- Spoon
- Fork
- Knives
- Tray

3. Vegetable, fish and meat shops (5 nos.)

Shop (Name)	Carry bags		
	Yes	No	Both
1.			
2.			
3.			
4.			
5.			

Alternatives:

- Carry bags

4. General Store, Stationary shop and Decoration shop (5 Nos.)

Shop (Name)	Candy stick			Invitation card film			Thermocol decorations		
	Yes	No	Both	Yes	No	Both	Yes	No	Both
1.									
2.									
3.									
4.									
5.									

Alternatives

- Candy sticks
- Invitation cards
- Thermocol decorations

5. Printer (2 Nos.)

Shop (Name)	PVC Banner < 100 micron			Invitation card film		
	Yes	No	Both	Yes	No	Both
1:						
2:						

Alternatives

- PVC Banner
- Invitation card film

6. Sweet shop (3)

Shop (Name)	Film on Sweet Box			Tray			Carry bags		
	Yes	No	Both	Yes	No	Both	Yes	No	Both
1:									
2:									
3:									

Alternatives

- Film on sweet box
- Tray
- Carry bags

7. Paan Shop (2 Nos)

Shop (Name)	Film on Cigarette pack		
	Yes	No	Both
1:			
2:			

Alternative

- Film on Cigarette pack

8. Roadside toy seller (Balloon + Flags) – 5 Nos.

Shop/Vendor (Name)	Balloon stick			Flags			Flag stick		
	Yes	No	Both	Yes	No	Both	Yes	No	Both
1:									
2:									
3:									
4:									
5:									

Alternative

- Balloon stick
- Flags
- Flag stick

9. Ice cream cart (3 Nos.)

Shop/Vendor (Name)	Ice Cream Stick		
	Yes	No	Both
1:			
2:			
3:			

Alternative

- Ice Cream Stick

B. A brief note on observation made at religious/tourist place and market areas.

- **Religious place**
 - Usage
 - Disposal
- **Tourist Place**
 - Usage
 - Disposal
- **Market Areas**
 - Usage
 - Disposal

NOTE: Take pictures of alternatives available and different types of SUPs being used as decorative.

Annexure 3

Training Toolkit

This toolkit intends to train the city administration and their staff on using the methodology for compliance assessment through quantification and characterisation of Plastic and SUP items in municipal waste. Before starting the process, the logistic arrangements and resources required for it, and the hazards and risk associated should be understood.

A. Equipment/Apparatus and Human Resource

1. HDPE liner to make a platform for sorting and quantification which will help in eliminating possibility of leachate contaminating the soil and the surroundings.
2. Fibre, Plastic or Metal Containers for storing and weighing each waste component, labelled accordingly for storing different fractions (like paper, textile, glass, metals, etc.). or subsequently sacks can be used except for the storing and quantifying wet waste.
3. Electronic weighing scale, 2 weighing scale (1 scale of 250 kg capacity and accuracy of ± 10 g, and second smaller with accuracy of ± 1 g or less)
4. Shovels, Rakes, Brooms (push and hand), First Aid kit, and other PPEs (such as safety boots, gloves, apron/jacket, etc.)
5. For the sorting and quantification exercise, at least two helpers and five sorters will be required along with one coordinator to monitor and oversee the whole process.

B. Hazards and Risks

1. Review the hazards and procedures with the operating and sorting personnel prior to conducting the field activities.
2. Sharp objects, such as nails, razor blades, hypodermic needles and pieces of glass, are present in solid waste. Personnel should be instructed of this danger, and they should brush waste particles aside while sorting rather than projecting their hands with force into the mixture. Personnel handling and sorting solid waste should wear appropriate protection, such as heavy leather gloves, dust masks and safety boots.
3. During the processes of unloading waste from collection vehicles and handling waste with heavy equipment, projectiles may issue from the mass of waste. The projectiles can include flying glass particles from breaking glass containers and metallids from plastic and metal containers that burst under pressure when run over by heavy equipment. The problem is particularly severe when the waste handling surface is of high compressive strength, for example, concrete. Personnel should be informed of this danger and wear eye and head protection if in the vicinity of either the collection vehicle unloading point or heavy equipment, or both.
4. Select a location for the discharge of designated loads, manual sorting activities, and weighing operations that is flat, level, and away from the normal waste handling and processing areas.
5. Weigh storage containers each day, or more frequently, if necessary, in order to maintain an accounting of the tare weight.
6. Containers of liquids or other potentially dangerous wastes (domestic hazardous waste and biomedical waste like used masks, etc.) shall be put aside and handled by the crew chief.

C. Calibration

1. All weighing scale shall be calibrated according to the manufacturer's instructions. Take appropriate corrective action if the readings are different from those of the calibration weights.
2. The weight of containers and sacks should be noted at the beginning and the same should be subtracted from the measurements while noting the data.

D. The process

The entire process is divided into 7 steps as detailed below;

Step 1: Identify the major waste disposal sites

The major waste disposal sites of a city, which could either be landfills in the case of cities collecting unsegregated waste or Material Resource Facilities (MRF) in case of cities with a good rate of source segregation, should be identified.

Step 2: Mark the catchment area

Divide the city based on the area catered by the landfill/MRF. All wards catered by the landfill/MRF should be mapped and classified into the following 5 major categories based on their socio-economic characteristics/ land use:

- High-income residential wards;
- Middle-income residential wards;
- Economically Weaker Section (EWS) residential wards/ slums;
- Commercial wards; and
- Mixed commercial and residential wards.

See Table 1 on guidance on classification of wards.

Table 1: Classification of different wards

Wards	Example of housing type/land use
EWS/Low-income group/Slums	Single room residents, areas with low rentals/ slum areas. Lowest property tax or tax exempted or unauthorised settlement.
Middle income	Apartments, single detached houses without garden. Median tax rate.
High income	Single detached houses with parking and garden, Luxury condominiums, and high- rise buildings. Highest tax rate.
Mixed commercial and residential	Areas where both commercial and residential complexes are present in an equal ratio or areas where waste from both commercial establishments as well as residential houses are collected in equal ratio

The socio-economic characteristics of the city should be analysed to understand the population characteristics and determine the proportion of the population residing in each economic strata/ land use. The number of samples to be sorted from each category should be fixed based on the population proportions observed in the city, to eliminate any biases in the selection of samples and ensure representativeness.

Socio-economic characteristic of the catchment area

The basic idea of collecting waste from different socio-economic strata/land use is to make sure that the waste sample is representative of the catchment area waste profile, and there is no biasness while selecting the sample size. In case of catchment areas where such predefined bifurcation is not available, the bifurcation of wards is based upon the predominant nature. For example, wards with more than 50% high income residences is classified as High income wards, wards with more than 50% low income residents is classified as low income wards and so on. In case where even such bifurcation is not possible in that case areas (pockets) with such socio- economic characteristic needs to be identified and vehicles from these pockets is selected.

Step 3: Determine sample size

The sample size should be determined based on ASTM (D5231- 92). For Indian conditions, for determining the composition of plastic waste, 30 to 35 samples should be collected over a period of five days (6-7 samples per day) from the catchment areas of each landfill/MRF facility. If a city has only one landfill site, then 30-35 samples should be collected. If the city has two landfills, then 60-70 samples are to be collected. One sample is equal to one vehicle load of waste.

At least one sample should be collected from each socio-economic strata/land use, i.e., one sample each from High income, Mixed-income, and Low-income residential wards, Commercial wards, and Mixed residential

and commercial wards. However, based on the proportion of population, the number of samples from certain socio-economic strata/land use can be increased. For example, if the catchment area is predominantly mixed residential, then the number of samples from the mixed residential wards can be increased to 2. Similarly, if the catchment area is predominantly commercial, and mixed commercial and residential, then two samples each from commercial, and mixed commercial and residential wards can be collected. The number of samples from each economic stratum should remain constant on all days throughout the Inventory study.

What does step 1 to 3 mean, let us understand it through examples

All major landfill/MRF needs to be identified, this will help in deciding the number of samples. For cities where waste is collected and sent to landfills directly the landfill will be selected, and for cities where MRF are operational these MRFs are selected. Accordingly the waste from the catchment area, catered by the facility needs to be mapped and categorised as per different socio-economic characteristic.

Scenario 1: All the waste of the city is collected and sent directly to the 1 landfill catering the entire city area. Here the landfill is identified as the major waste disposal site. Since there is only 1 landfill catering the entire city, the number of samples would be 30 – 35 to be collected over a period of five days (6-7 samples per day) on random basis, but atleast 1 sample from each socio-economic strata. And depending upon the predominance of the population (High-income, middle-income, or low income) the other sample (i.e. sample number 6 and 7) can be collected accordingly.

Scenario 2: The city is divided into 2 zones, and all the waste collected from each zone is sent to the MRF. The waste after resource recovery is sent to a sanitary landfill site outside the city premises. Here MRF will be selected as the major waste disposal site.

Scenario 3: The city is served by 2 landfills, one half of the city is catered by first landfill and the other half by second landfill. The waste before going to these landfills is sent to MRF for resource recovery. In this case also the MRF will be selected as major waste disposal site, as it is the first entry point where collected waste is reaching without any recovery or cherry picking.

As a general hypothesis, in cities where only landfills are present (as in Jorhat), we will identify that. In cities where no landfill is present (as in Thiruvananthapuram), the MRF or the resource recovery centre will be identified, and in cities where both landfill and MRFs are present (as in Surat), we will select the first entry point where collected waste is reaching without any recovery or cherry picking.

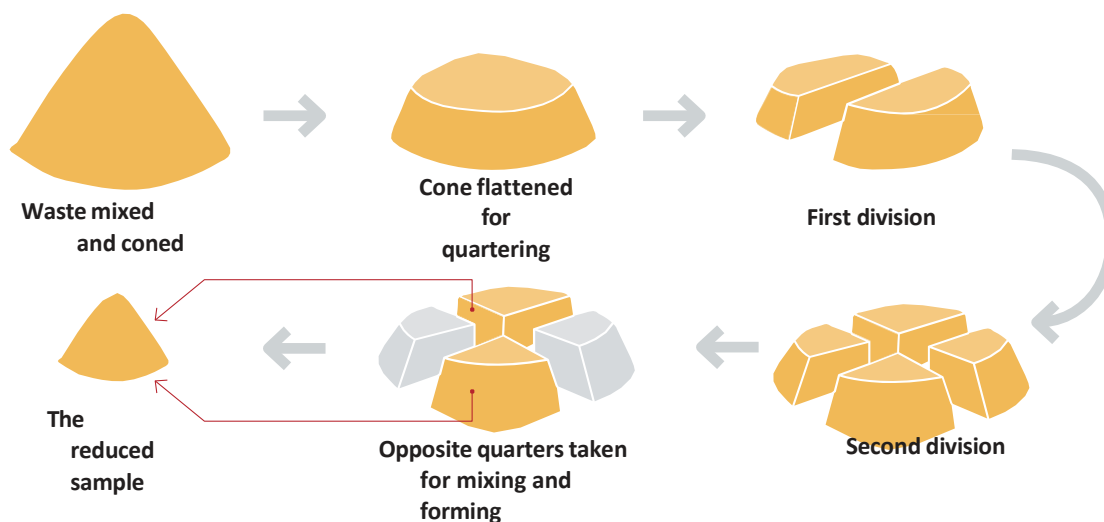
Step 4: Sample collection: Identify the vehicles collecting waste from each socio-economic strata/land use. Every day, select vehicles randomly from each socio-economic strata/land use. Make sure that the waste collectors are not removing valuable plastics/ dry wastes beforehand.

Remember:

- The number of samples from each economic stratum should remain constant on all days throughout the Inventory study.
- The assessment can be done in decentralise way also, but the assessment needs to be done on the same day and the resource requirement will increase. This will also create logistical issues, so it is advisable to carry out the entire assessment at one selected place.

Step 5: Sample preparation: The entire truckload of waste (approximately 400 - 500 kgs) should be discharged in a designated area. Use the Quartering and coning method to reduce the size of the sample to the range of 100 to 125 kg.

Method: Unload an entire truckload of waste on ground or on to a sheet, divide the waste into four parts. Select 2 samples positioned diagonally opposite to each other for the next step, and discard the other two as shown in the figure. Repeat this process once again, to reduce the size of the sample from 400-500 kg to 100-125 kg.



Sampling in cities with segregated waste collection

In cities where waste collection is being done separately i.e. dry and wet fraction is being collected separately, the following sampling procedure should be used:

- If mixed dry waste is being collected, then in that case select the vehicle of dry waste from each economic stratum. Reduce it to 100 – 125 kg by quartering and coning method.
- If all the dry waste is collected separately. That is, glass, cloth, rubber and leather, domestic hazardous, sanitary, plastic, E-waste etc. are collected separately, then in that case take 30 – 50 kg of plastic waste from each economic strata for quantification and characterisation.

Step 6: Sorting and quantifying

Sorting of sampled waste is done in 3 level;

Level 1: Dry waste sorting

The dry waste should be further sorted into seven primary sorting categories:

- Paper
- Rubber and Leather
- Metal
- Glass
- Plastics, and
- Others (including medical waste, Sanitary waste, Hazardous substances, etc). The weight fraction of each seven components should be measured.

Level 2: Plastic waste sorting

The total plastic waste, sorted and weighed from above, should further be sorted into 7 secondary categories, as per the IS 14534:1998 guidelines. Each sub-category should be weighed and registered in the data sheet.

Table 2: Categories of plastic

Category Type	Short Name	Scientific Name	Uses	Quantification (Kg/Kg of municipal waste)
1	PET	Polyethylene terephthalate	Soft drink bottles	
2	HDPE	High-density polyethylene	Bottles, carry bags, playground equipment etc.	
3	PVC	Polyvinyl chloride	Pipe, Window profile, fencing, flooring, shower curtains, lawn chairs and children's toys etc.	
4	LDPE	Low-density polyethylene	Plastic bags, carry bags, various containers, dispensing bottles, wash bottles, tubing etc.	
5	PP	Polypropylene	Auto parts, industrial fibers, food containers, dishware etc.	
6	PS	Polystyrene	Cafeteria trays, plastic utensils, toys, video cassettes and cases, clamshell containers, insulation board etc.	
7	Others	-	Multilayer Packaging and Laminates, Bakelite, Polycarbonate, Nylon SMC, FRP etc.	

Level 3: Banned SUPs waste sorting

All the 20 banned SUP products obtained from the waste samples should be separated from the plastic wastes and weighed as per the Table 3 below.

Table 3: Different categories of SUPs

Sr. No.	SUP items (banned)	Quantification (kg/kg of plastic waste)	Percentage
1	Plastic sticks	Ear buds	
2		Balloon	
3		Candy	
4		Ice-cream	
5		Straw	
6	Carry bags	< 75 μ	
7	Plastic sheets	< 50 μ	
8	Cutlery items	Plates	
9		Cups	
10		Glasses	
11		Spoons	
12		Forks	
13		Knives	
14		Trays	
15	Plastic wrapping and packaging films	Sweet Box	
16		Invitation cards	
17		Cigarette packets	
18	Others	Plastic flags	
19		PVC banners <100 μ m	
20		Polystyrene for decorations	
	Total		

But before starting the sorting and quantification exercise a flat space needs to be identified and a set-up needs to be prepared, as shown in the figure below.

A. Reference how the set-up of the sorting facility should be done



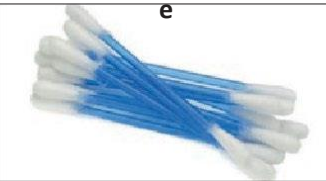







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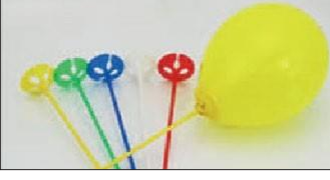



Material required for inventory

- HDPE liner
- 2 Drums (50 L)
- Weighing machine (big and small)
- Shade for workers, PPE, shovels and other equipment explained above
- Fibre, Plastic or Metal Containers or Big Sacks

The helpers and sorters should be provided with appropriate personal protection equipment (PPE) for their safety, and should be trained to identify different type of plastics and the banned SUP items, as provided in Table and chart below.

B. Single-Use Plastic reference chart

Product	Image
1. Plastic Earbuds	
2. Plastic sheets below 50 microns	
3. Carry bags below 75 microns	
4. Plastic cutlery (spoons, forks)	
5. Straws	
6. Plastic plates, cups, glasses	
7. SUP knives (mostly used for cake cutting)	
8. SUP Trays	








Product	Image
9. Wrappings on Invitation cards	
10. Thermocol decorative items	
11. Wrapping on sweet boxes (Plastic sheet wrapped on sweet boxes/fruit baskets)	
12. Wrapping/Films on cigarette packets	
13. Plastic Balloon sticks	
14. Plastic stirrers	
15. Plastic Flags	
16. Plastic Candy sticks	

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C. Guideline for classifying and identifying different types of plastics (pictorial illustration in English and Hindi)

GUIDELINES FOR PLASTIC WASTE CHARACTERISATION FOR INVENTORISATION STUDY

Classification of different types of plastics

 PET (Polyethylene Teraphthalate)	 HDPE (High Density Polyethylene)	 PVC (Polyvinyl Chloride)
Water bottles, softdrink bottles, Juice bottles/Rigid cosmetic jars/ Microwavable containers	Shampoo Bottles/Toys/Chemical Containers/Pipe Systems/Recycling Bins/Flower Pots	Water pipes/Insulation wiring and cables/Biomedical drips and tubings
		
 LDPE (Low Density Polyethylene)	 PP (Polypropylene)	 PS (Polystyrene)
Carry bags (grocery, dry cleaning, bread, bin liners)/Plastic wraps/ Milk pouch/Squeezable bottles	Bottle lids/Straws/Lunch boxes/ Take-out food containers/Ice cream containers/Syrup bottles	Foam packaging/Teacups, plates and disposable cutlery/Containers/ Yoghurt container
		
 0 (Others)		
Multilayered packaging of chips, biscuits etc.	Source: As per BIS classification of plastics	

HOW TO IDENTIFY THE PLASTICS FOR CARRYING OUT THE INVENTORISATION WORK

- 1** Most of the plastic products will have a symbol of either of the 7 categories mentioned, look out for the symbol at either the side or bottom of the plastic item.
- 2** If symbol is not present, identify by mentioned abbreviations.
- 3** If nothing is mentioned, identify by the examples of products mentioned for your reference, however, this is very unlikely.

Step 7: Data Analysis

The results of inventory for each day should be registered on the daily basis. The wet and dry waste fraction of each day is consolidated at the end of 5 days to find out the average composition. A standard deviation check on the data from each day is done to find the outliers. Smaller value of standard deviation means the sampling is consistent. A sample sheet for daily data entry for inventory is as provided in Table 4 and 5 below.

Table 4: Daily data entry sheet

Category	Sample 1			Sample 2		Sample 3
	(Residential)			(Commercial area)		(Dumpsite)
	(High income)	(Middle income)	(Low income)	(Mixed commercial and residential)	(Commercial area)	
Name of the area						
Name of the volunteer coordinating the same						
Name of driver/helper						
Waste received at the facility (kg)						
Sampling waste quantity (kg)						
Total Wet waste (kg)						
Total Dry waste (kg)						
Paper (kg)						
Textile (kg)						
Rubber and Leather (kg)						
Glass (kg)						
Metals (kg)						
Others (kg)						
PET (kg)						
HDPE (kg)						
LDPE (kg)						
PVC (kg)						
PP (kg)						
PS (kg)						
MLP (kg)						
TOTAL Plastic (kg)						
% plastic of total						
% dry waste						
% wet waste						
% plastic of dry waste						

Table 5: Inventory sheet for banned SUP items to be updated daily

Sr. No.	SUP items (banned)		Quantity (kg) (Residential + Commercial)	Dumpsite analysis (kg)
1	Plastic sticks	Ear buds		
2		Balloon		
3		Candy		
4		Ice-cream		
5		Straw		
6	Carry bags	< 75 μ		
7	Plastic sheets	< 50 μ		
8	Cutlery items	Plates		
9		Cups		
10		Glasses		
11		Spoons		
12		Forks		
13		Knives		
14		Trays		
15	Plastic wrapping and packaging films	Sweet Box		
16		Invitation cards		
17		Cigarette packets		
18	Others	Plastic flags		
19		PVC banners <100 μ m		
20		Polystyrene for decorations		
	Total (kg)			
		%age of banned SUP of total plastic waste		

Annexure 4

Comparative Analysis with earlier study conducted in 2015

In 2015 Central Pollution Control Board (CPCB) carried out a study which included assessment, quantification of plastics waste in dump sites of major 60 cities and suggesting the viable and appropriate recycling technologies (Based on “Zero” waste concept) with following Terms of References (ToR);

TERMS OF REFERENCES (ToR) OF THE STUDY

- To assess the type, nature and quantum of plastics waste in the country through field survey and physical assessment at the MSW sites at 60 towns and Cities.
- Establish a Co-ordination mechanism with local Municipal/Metro corporations in identifying the dump grounds/ Localities of higher waste generation for the physical assessment/characterization of MSW as per the prescribed methodology.
- To report on the existing methodology for collection of waste by urban local bodies/Municipal bodies in different states of the country.
- To suggest the viable and appropriate recycling technologies at major cities with investment estimation for effective Plastics waste Management (based on “Zero Waste Concept”)
- Suggest Road Map/Recommendations for Plastics Waste Management as per the data available from the study for different towns and cities of the country.

The study used ASTM Method (D5231-92) method as the guiding principle for the assessment and quantification of plastics waste at Dump sites. The 1000 Kg of fresh Municipal Solid Waste (MSW) arriving at dumpsites on different days from different sources in vehicles like trucks/lorry, was used to prepare the sample for assessment and quantification. The sample was reduced to 125Kg of Municipal Solid Waste (MSW) from 1000Kg the various types of plastics like PET, PE Based (LDPE/HDPE), PVC, PP, PS and OTHER was sorted out and segregated.

Comparison of the methodology used in this study (2022) with the one used in CPCB study in 2015;

The objective of both the study was completely different where in the CPCB study the focus was on the plastic waste and its potential for recycling, whereas in this study the focus was to assess the availability of Single-Use Plastic (SUP) in the city. The focus of this study, 2022 has been two-fold to capture the supply as well as the usage of SUP in the city and thus a two-pronged methodology is used to capture the usage in waste stream and the availability in the market.

1. The CPCB study, 2015 collected samples from the dump site, whereas in this study (2022) the samples were collected from the first entry point where waste is reaching without any recovery or cherry picking. This helps in analysing the usage of SUP in the city by the households.
2. The present study, 2022 tries to capture the variation from different socio-economic strata of the city by collecting representative samples from different income group and economic activity, such as residential, commercial, and mixed residential and commercial area.
3. This study, 2022 also focuses on capturing the SUP items being used and sold in the market and its alternatives available in each city, which reflects upon the compliance of SUP ban in the city.

There are some common cities which was part of both the studies, a change from earlier study 2015 to the present condition 2022 is as reflected in the table below;

Table 1: Change in the percentage of plastic in total MSW from 2015 to 2022

Sr No	Name of the common city	Plastic waste percentage in total MSW in CPCB study, 2015	Plastic waste percentage in total MSW in this study, 2022	Change from 2015 to present (2022) in percentage increase
1	Agra	7.9	12.7	61.6
2	Lucknow	5.9	14.4	144.0
3	Dhanbad	5.0	11	119.1
4	Vadodara	4.6	13.4	193.2
5	Coimbatore	9.5	17.9	89.0
6	Indore	8.8	10.8	22.6
7	Surat	12.5	13.2	5.6
8	Bangalore	8.5	11.8	39.1
9	Guwahati	5.0	15.3	203.6
10	Bhopal	6.6	13.3	101.8

The table above shows that the usage of plastic in all cities have increased, in some cities this increase has been marginal whereas in some it has been like three folds as in Guwahati. The overall results shows that the proportion of plastics in municipal solid waste has almost doubled in India, from 6.9% in 2015 to 12.2% in 2022.

Annexure 5

Cities Case Files

Agra

The city of Agra is located on the banks of River Yamuna in the state of Uttar Pradesh in India. It is located 206 kms away from the national capital New Delhi and 378 kms west of the state capital Lucknow. Spread over an area of 10, 863 sq. km, the city houses a population of 1.58 million as per Census 2011. The total waste generation in Agra is estimated to be 900-925 TPD, as per the information shared by Agra Municipal Corporation. Residential establishments contribute 70% of this waste, and commercial establishments contribute to 30%, which is sent to the dumpsite.

1. Single-use Plastic Waste Inventory

In Agra, the municipal waste was collected from six Residential areas, High-income residential (Ward No. 81 Kamla Nagar and Ward No. 74 Jaipur House), Middle-income Residential areas (Ward No. 75 Awaz Vikas and Ward No. 78 Shaheed Nagar), and Low-income residential areas (Ward No. 14-Kachhpura and Ward No. 18-Raj Nagar), and two wards each from Mixed Commercial & Residential (Ward No. 29-Khandari Ward No. 64-Belaganj), and Commercial areas (Ward No. 92-Sanjay Place/Wazirpura Ward No. 79-Motiganj) were chosen for taking the samples. A sample from the dumpsite was also collected and characterised to assess the quantity of plastic and SUPs taken out for recycling/reuse.

The inventorisation study in Agra was conducted from 13 to 17 May 2022 at a designated place, near one of the transfer stations, where waste from all the selected wards were brought for inventory.

Results of inventory

Banned SUPs account for 24.7% of the total plastic waste in Agra. The most common banned SUPs found in the waste stream are carry bags, accounting for more than 86% (by weight) of all the banned SUPs. Cutlery items, the other prominent banned SUPs, accounted for 13.67% of the total banned SUPs. The contribution of the rest of the banned SUPs was less than 1%.

Table 1: Banned SUPs in the waste stream

Sl. no.	Banned SUPs	Percentage of total banned SUPs (%)
1	Plastic sticks	0.46
2	Carry bags	85.68
3	Plastic sheets	0.00
4	Cutlery items	13.67
5	Wrapping and film	0.18
6	Others	0.00

Note:

- Plastic sticks include earbuds, balloon sticks, candy sticks, ice-cream sticks, straws and stirrers
- Cutlery items include plates, trays, cups, glasses, spoons, forks and knives
- Wrapping and film include films on the sweet box, invitation card and cigarette packet
- Others include plastic flags, PVC banners (<100 μ) and thermocol decorations

2. Market Survey of Single-use Plastics

To assess the availability of banned SUP items and its alternatives within the municipal boundaries, a market survey was carried out in selected market areas in different zones, in the month April and May 2022.

Table 2: Markets selected for the survey

Sl. No.	Zone	Market name
1	North	New Agra and Delhi Gate
2	South	Tajganj and Rajpur Chungi
3	East	Belanganj and Jeevni mandi
4	West	Bodla Market and Lohamandi

The survey covered 280 shops in the four selected markets in Agra. The results are as provided as below.

Figure 1: Sale of SUPs and alternatives in Agra

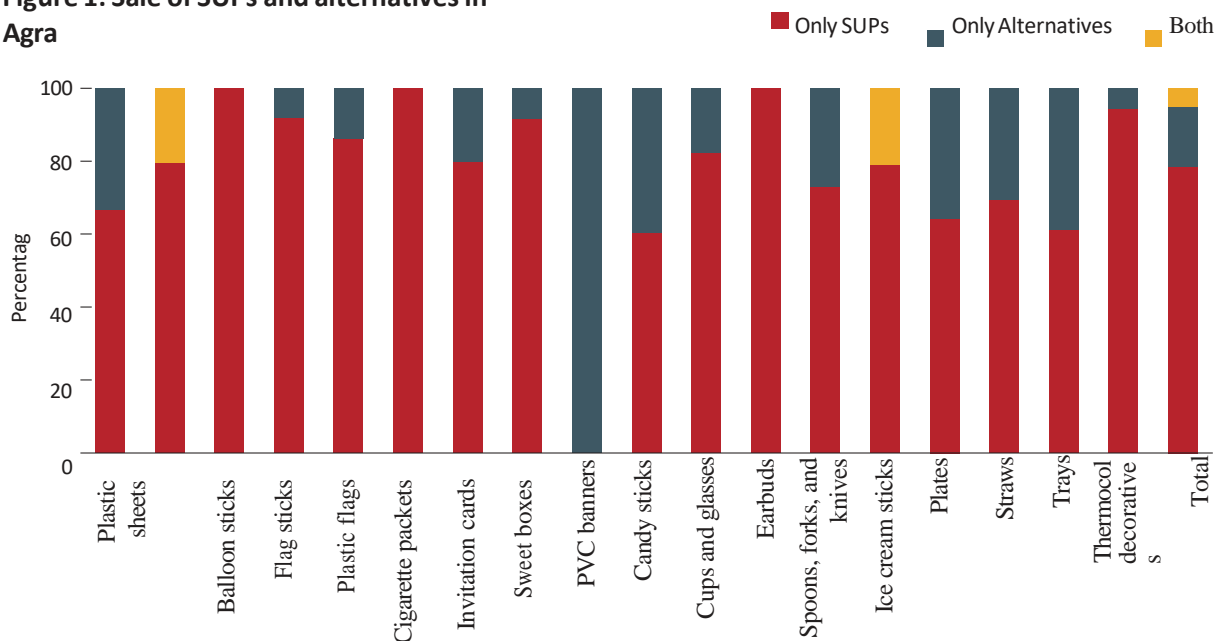
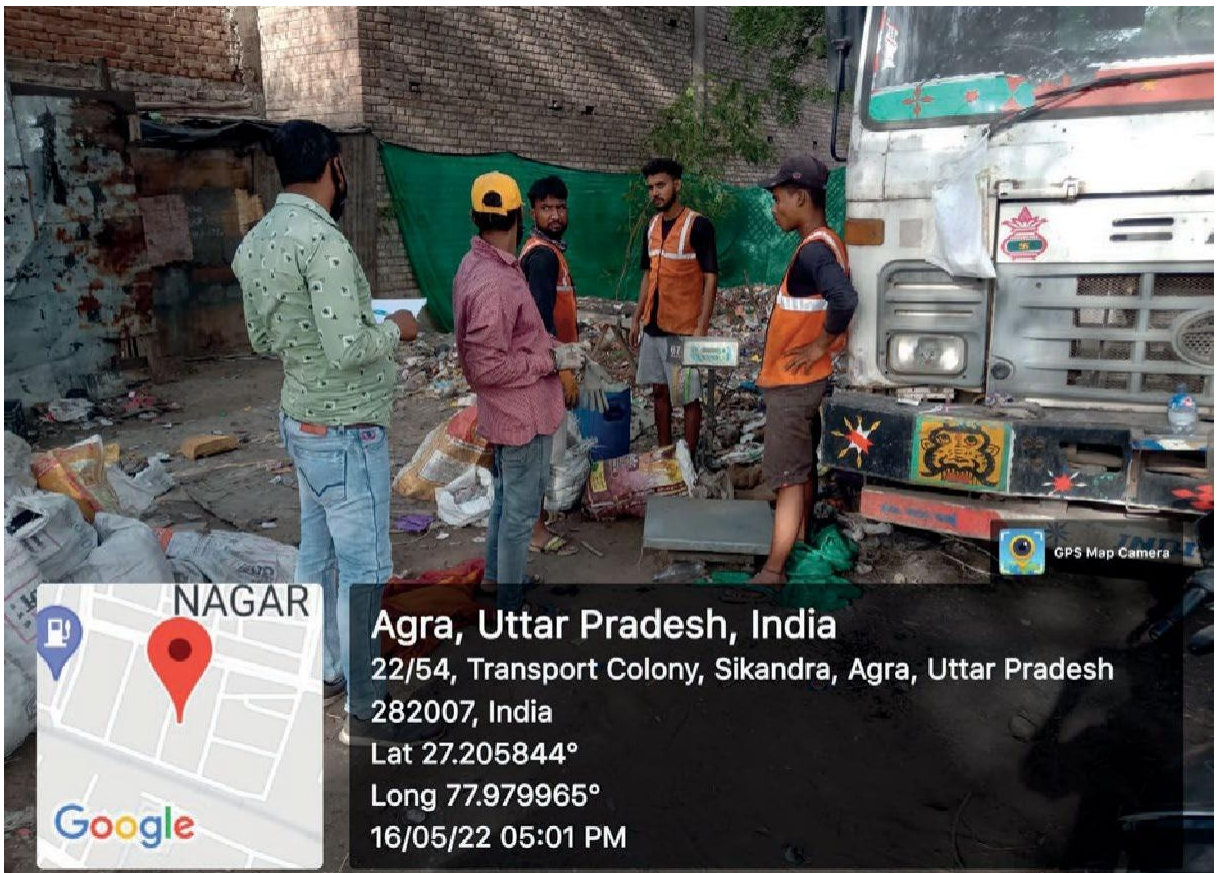


Table 3: Types of alternatives to SUPs in Agra

Banned SUP items	No. of alternative s available	Type 1	Type 2	Type 3	Type 4
Plastic sheets	1	Paper sheets			
Plastic carry bags (below 75 microns)	2	Paper bags	Cloth Bags		
Plastic balloon sticks	0				
Plastic flag sticks	1	Wooden			
Plastic flags					
Plastic flags	1	Paper Flags			
Plastic films on cigarette packets	0				
Plastic films on invitation cards	1	Paper invitations			
Plastic films on sweet boxes	1	Paper boxes without films			
PVC banners (below 100 microns)	1	Above 100-micron flex	Above 200 microns		
Plastic candy sticks	1	Paper			
Plastic cups and glasses	4	Ceramic Cups	Paper Cups	Sal Leaf cups	Steel Cups, Steel Glasses
Plastic earbuds	0				
Plastic spoons, forks and knives	1	Wooden stick			
Plastic Ice cream sticks	1	Wooden stick			
Plastic plates	3	Steel plates	Hard Plastic Plates	Ceramic plates	
Plastic straws	1	Paper straws			
Plastic trays	2	Steel tray	Reusable plastic tray		
Thermocol decorative	1	Tissue paper décor			



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Alappuzha

Alappuzha, commonly known as Alleppey, is a district located in the southernmost state of Kerala. Alappuzha town is located in the district of Alappuzha. The town is located 55 km from Kochi and 155 kms away from Thiruvananthapuram. As per Census 2011, Alappuzha town has a population of 1.74 lakh. The estimated population in 2021 was 1.8 lakh with about 48,000 households, and the approximate daily floating population of the town is 20,000. The town is an attractive tourist destination, well-known for the Kerala backwaters and beautiful beaches.

1. Single-use Plastic Waste Inventory

In Alappuzha, the household waste is segregated into various categories at the household level, and are collected separately. The municipality collects the plastic waste from the households periodically, the inventory samples were taken from this collection.

The waste samples were collected from three residential wards (Ward 16, 26 and 30) and two commercial wards (Ward 31 and 24). Inventory was conducted on about 150-200 kg of plastic waste collected from residential wards, commercial wards, every day.

The city has a good rate of source segregation, and the inventorisation study was conducted from 24 to 26 July 2022 at the Material Recovery Facility managed by Harithakarma Sena.

Results of inventory

Banned SUPs account for 9.3% of the total plastic waste in Alappuzha. The most common banned SUPs found in the waste stream are carry bags, accounting for more than 98% (by weight) of all the banned SUPs. Cutlery items, the other prominent banned SUPs, accounted for just 1.7% of the total banned SUPs. The contribution of the rest of the banned SUPs was less than 0.2%.

Table 1: Banned SUPs in the waste stream

Sl. no.	Banned SUPs	Percentage of total banned SUPs (%)
1	Plastic sticks	0.12
2	Carry bags	98.11
3	Plastic sheets	0.00
4	Cutlery items	1.77
5	Wrapping and film	0.00
6	Others	0.00

Note:

- Plastic sticks include earbuds, balloon sticks, candy sticks, ice-cream sticks, straws and stirrers
- Cutlery items include plates, trays, cups, glasses, spoons, forks and knives
- Wrapping and film include films on the sweet box, invitation card and cigarette packet
- Others include plastic flags, PVC banners (<100 µ) and thermocol decorations

2. Market Survey of Single-use Plastics

To assess the availability of banned SUP items and its alternatives within the municipal boundaries, a market survey was carried out in selected market areas in different zones, in the month of April and May 2022.

Table 2: Markets selected for the survey

Sl. No.	Zone	Market name
1	North	New Bazaar
2	South	Mullakkal
3	East	Beach market
4	West	Kalarcode

The survey covered 137 shops in four selected markets in Alappuzha. The results are provided as below.

Figure 1: Sale of SUPs and alternatives in Alappuzha

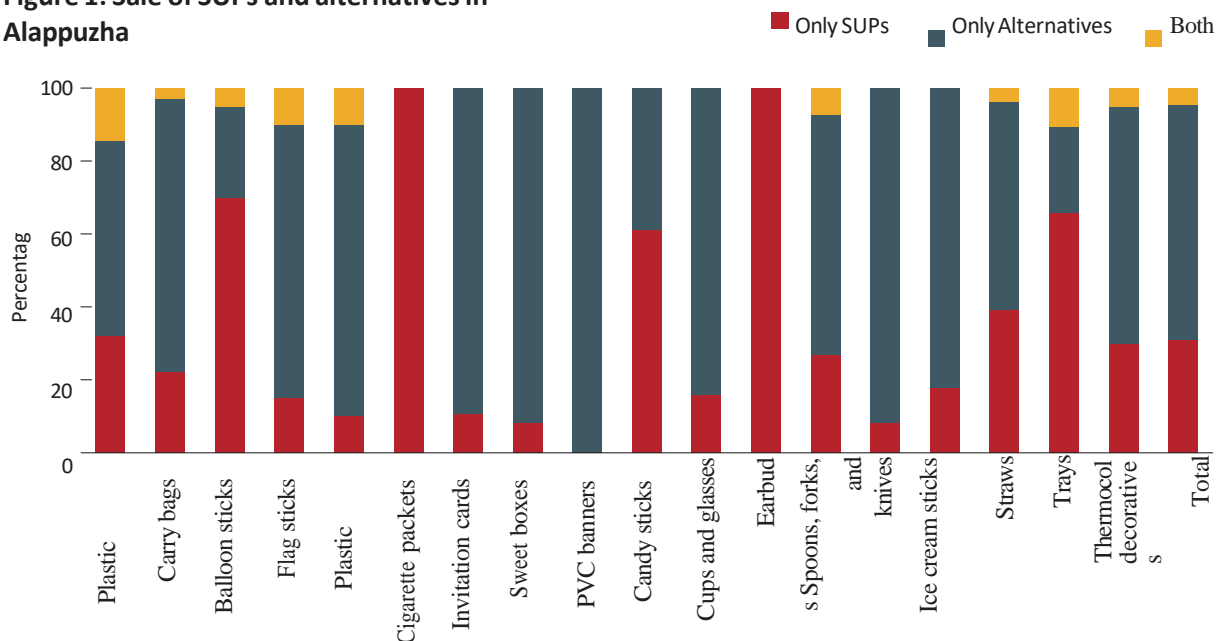


Table 3: Types of alternatives to SUPs in Alappuzha

Banned SUP items	No. of alternatives available	Type 1	Type 2	Type 3	Type 4
Plastic sheets	2	Paper sheets	Banana Leaves		
Plastic carry bags (<75 μ)	1	Paper bags			
Plastic balloon sticks	1	Wooden stick			
Plastic flag sticks	1	Wooden stick			
Plastic flags	1	Cotton/cloth Flags			
Plastic films on cigarette packets	0				
Plastic films on invitation cards	1	Paper cards without films			
Plastic films on sweet boxes	1	Paper box without films			
PVC banners (<100 μ)	1	Cloth banners			
Plastic candy sticks	1	Paper sticks			
Plastic cups and glasses	2	Glass cups	Paper cups		
Plastic earbuds	0				
Plastic spoons, forks and knives	1	Steel cutlery			
Plastic ice-cream sticks	1	Wooden stick			
Plastic plates	3	Steel	Paper plates	Ceramic	
Plastic straws	1	Paper straws			
Plastic trays	1	Paper trays			
Thermocol decoratives	1	Paper decor			



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Bengaluru

Bengaluru is the capital of Karnataka and is located in the south eastern part of the state. In 2007, the Karnataka Government merged the Bangalore Mahanagara Palike with 8 urban local bodies and 111 villages around the city to form a single administrative body, and renamed it as Bruhat Bengaluru Mahanagara Palike (BBMP). The BBMP is the administrative body in charge of civic amenities in the city and its municipal solid waste (MSW) management. BBMP consists of 198 wards, with a total area of 741 sq. km, and is the fourth largest Municipal Corporation of India.

1. Single-use Plastic Waste Inventory

In Bengaluru, the inventory was done on door to door dry waste samples collected from three residential wards, High income ward (Ward no. 174 HSR Layout), Middle income ward (Ward No. 132 Attiguppe) and Low income ward (Ward No. 146 Lakkasandra), one mixed commercial and residential ward (Ward No. 189 Hongasandra), and one commercial ward (Ward No. 190 Mangammanapalya)

(Note: ITC-WOW has been assigned to collect the dry waste from these localities and the wet waste is collected by the separate concessionaire assigned by the municipality).

The inventorisation study in Bengaluru was conducted from 30 May to 3 June 2022 at the Material Recovery Facility operated by ITC. The dry waste collected from door to door collection is brought at the facility for resource recovery.

Results of inventory

Banned SUPs account for about 17% of the total plastic waste in Bengaluru. The most common banned SUPs found in the waste stream are cutlery items, accounting for more than 30% (by weight) of all the banned SUPs. PVC banners and plastic flags (mostly from different political parties) and plastic sticks, is the other prominent banned SUPs, accounted for 19.59% and 16.34% respectively of the total banned SUPs.

Table 1: Banned SUPs in the waste stream

Sl. no.	Banned SUPs	Percentage of total banned SUPs (%)
1	Plastic sticks	16.34
2	Carry bags	14.43
3	Plastic sheets	5.74
4	Cutlery items	30.45
5	Wrapping and film	13.44
6	Others	19.59

Note:

- Plastic sticks include earbuds, balloon sticks, candy sticks, ice-cream sticks, straws and stirrers
- Cutlery items include plates, trays, cups, glasses, spoons, forks and knives
- Wrapping and film include films on the sweet box, invitation card and cigarette packet
- Others include plastic flags, PVC banners (<100 μ) and thermocol decorations

2. Market Survey of Single-use Plastics

To assess the availability of banned SUP items and its alternatives within the municipal boundaries, a market survey was carried out in selected marked areas in different zones, in the month of May and June 2022.

Table 2: Markets selected for the survey

Sl. No.	Zone	Market name
1	North	Yelahanka Market and Malleshwaram Market
2	South	K R Market and Madiwala Market
3	East	Russell Market and Shivaji Market
4	West	Yeshwanthpur Market and Kengeri Market

The survey covered 279 shops in four selected markets in Bengaluru. The results are provided as below.

Figure 1: Sale of SUPs and alternatives in Bengaluru

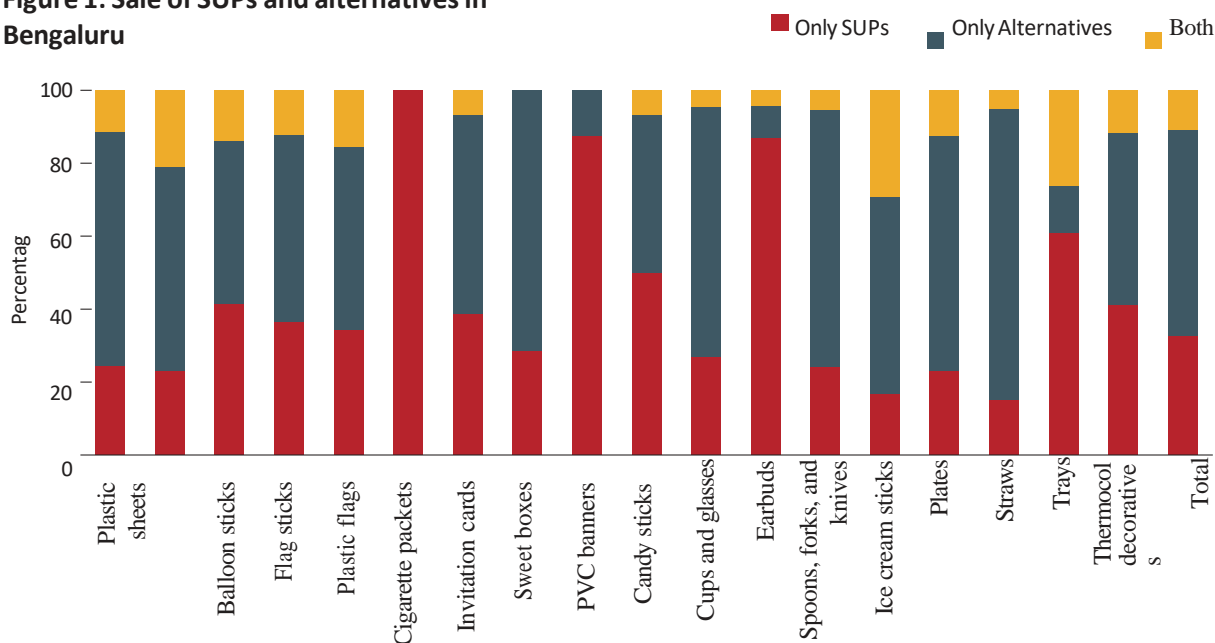


Table 3: Types of alternatives to SUPs in Bengaluru

Banned SUP items	No. of alternatives available	Type 1	Type 2	Type 3	Type 4
Plastic sheets	2	Aluminium sheets	Banana leaves		
Plastic carry bags (<75 μ)	4	Paper Bags	Cloth bags	Cardboard box	Handicraft bag
Plastic balloon sticks	3	Wooden sticks	Latex rubber sticks	Paper sticks	
Plastic flag sticks	3	Wooden sticks	Rubber sticks	Cloth stick	
Plastic flags	2	Cloth flags	Paper flags		
Plastic films on cigarette packets	0				
Plastic films on invitation cards	1	Paper cards without films			
Plastic films on sweet boxes	1	Cardboard/paper box without film			
PVC banners (<100 μ)	2	Cloth banners	Above 230 GSM		
Plastic candy sticks	3	Edible candy sticks	Paper stick	Wooden stick	
Plastic cups and glasses	2	Paper cups and glasses	Steel cups and glasses		
Plastic earbuds	1	Paper earbuds			
Plastic spoons, forks and knives	2	Steel cutlery	Wooden cutlery		
Plastic ice-cream sticks	1	Wooden sticks			
Plastic plates	5	Ceramic plates, reusable plastic plates	Steel	Nutwood plates, wooden plates	Earthen mud cutlery (pingani)
Plastic straws	2	Paper straws	Edible straws		
Plastic trays	1	Aluminium trays			
Thermocol decoratives	2	Paper décor	Cloth decor		



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Bhopal

Bhopal is the capital city of the Indian state of Madhya Pradesh and the administrative headquarters of both Bhopal district and Bhopal division. It is known for its various natural and artificial lakes. Bhopal is spread across an area of 413.5 sq km. with 19 zones and 85 wards in the corporation. Bhopal is one of the top 10 ranked cities in the Swachh Survekshan ranking 2022. As per Census 2011, the total population of the city was 19.2 lakhs, and the estimated population of the city in 2021 is about 24 lakhs.

1. Single-use Plastic Waste Inventory

In Bhopal, the municipal waste was collected from three residential wards one sample each from different economic strata, High-income residential (Ward No. 43 and 44), Middle-income Residential areas (Ward No. 4 and 8), and Low-income residential areas (Ward No. 13, 18 and 20), and one sample each from Mixed Commercial & Residential (Ward No. 4 and 7), and Commercial areas (Ward No. 32 and 44) were chosen for inventory. The rate of segregation of waste in Bhopal is high and the inventory was carried out on the dry waste collected from these areas.

The inventorisation study in Bhopal was conducted from 24 to 28 July 2022 at one of the Material Recovery Facility at Beragarh. The dry waste collected from the selected wards were brought to the facility for inventory.

Results of inventory

Banned SUPs account for about 9.8% of the total plastic waste in Bhopal. The most common banned SUPs found in the waste stream are carry bags, accounting for more than 84% (by weight) of all the banned SUPs. Cutlery items, the other prominent banned SUPs, accounted for 9.2% of the total banned SUPs. The contribution of the rest of the banned SUPs was less than 5%.

Table 1: Banned SUPs in the waste stream

Sl. no.	Banned SUPs	Percentage of total banned SUPs (%)
1	Plastic sticks	3.43
2	Carry bags	84.28
3	Plastic sheets	1.20
4	Cutlery items	9.23
5	Wrapping and film	0.26
6	Others	1.60

Note:

- Plastic sticks include earbuds, balloon sticks, candy sticks, ice-cream sticks, straws and stirrers
- Cutlery items include plates, trays, cups, glasses, spoons, forks and knives
- Wrapping and film include films on the sweet box, invitation card and cigarette packet
- Others include plastic flags, PVC banners (<100 μ) and thermocol decorations

2. Market Survey of Single-use Plastics

To assess the availability of banned SUP items and its alternatives within the municipal boundaries, a market survey was carried out in selected marked areas in different zones, in the month of July and August 2022.

Table 2: Markets selected for the survey

Sl. No.	Zone	Market name
1	North	New Market
2	South	MP Nagar and Vitthal Market
3	East	Chowk Bazar and Railway Station
4	West	DIG Bunglow and Beragarh

The survey covered 235 shops in four selected markets in Bhopal. The results are provided as below.

Figure 1: Sale of SUPs and alternatives in Bhopal

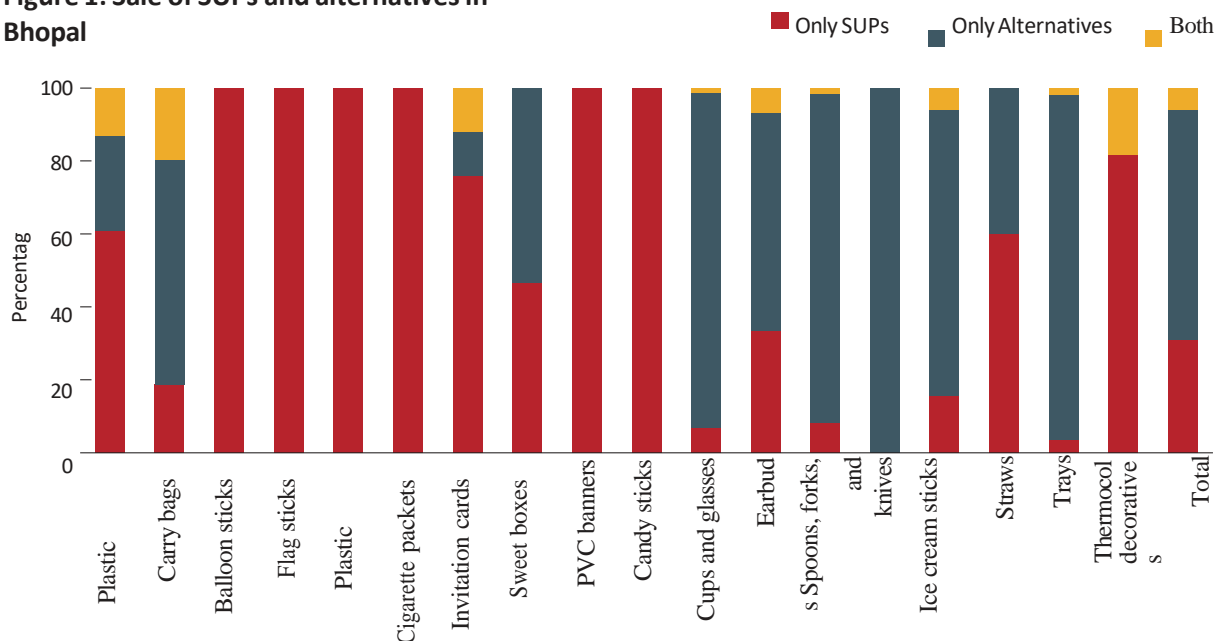


Table 3: Types of alternatives to SUPs in Bhopal

Banned SUP items	No. of alternatives available	Type 1	Type 2	Type 3	Type 4
Plastic sheets	2	Paper sheet	Aluminium foil		
SUP carry bags (below 75 μ) available	3	Paper bag	Cloth Bag	Woven Bag	
Plastic balloon sticks	0				
Plastic flag sticks	0				
Plastic flags	0				
Wrapping/films on cigarette packets	0				
Plastic wrapping/films on invitation cards	1	Paper envelope			
Wrapping/films on sweet boxes	2	Paper envelope	Cloth		
PVC banners below 100 μ	0				
SUP candy sticks	0				
Cups and glassess	4	Glasses made of glass	Paper cup and clay cups	Steel Glass	Reusable fibre cup and glasses
Earbuds	1	Wooden stick			
Spoons forks knives	3	Steel spoon, fork, knives	Wooden fork, spoon and knives	Fibre (reusable)	
Ice cream sticks	1	Wooden stick			
Plates	3	Steel plates	Paper plates	Fibre (reusable plates)	
Straws	3	Paper straws	Steel	Wooden	
SUP trays	2	Paper tray	Reusable tray		
Thermocol decorative	1	Paper			



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Coimbatore

Coimbatore, also known as Kovai or Covai, is one of the major metropolitan cities in the Indian state of Tamil Nadu. It is located on the banks of the Noyyal River and surrounded by the Western Ghats. Coimbatore is the second largest city in Tamil Nadu after Chennai and the 16th largest urban agglomeration in India as per the census 2011. It is administered by the Coimbatore Municipal Corporation and is the administrative capital of Coimbatore District. In 1981 Coimbatore formed as third municipal corporation in Tamil Nadu after Chennai and Madurai. As per the Census 2011, urban agglomeration population of Coimbatore was of 21.4 lakh; the estimated population for 2021 is over 28.6 lakh.

1. Single-use Plastic Waste Inventory

In Coimbatore, the municipal waste was collected from three residential wards one sample each from different economic strata, High-income residential (Ward No. 69 and 70), Middle-income Residential areas (Ward No. 43 and 39), and Low-income residential areas (Ward No. 35 and Ward No. 70 Brooke bond road back side area), and one sample each from Mixed Commercial & Residential (Ward No. 44 NSR road, and Poo market area in Ward 70 and 82), and Commercial areas (Ward No. 48, Ward No. 68 Gandhi Puram and Ward No. 67 Vada Covai) were chosen for inventory. The rate of segregation of waste in Coimbatore is high and the inventory was carried out on the dry waste collected from these areas. A sample from the dumpsite was also collected and characterised to assess the quantity of plastic and SUPs taken out for recycling/reuse.

The inventorisation study in Coimbatore was conducted from 25 to 29 July 2022 at one of the transfer stations provided by the municipal corporation. The dry waste collected from the households from selected wards were brought at the transfer station for inventory.

Results of inventory

Banned SUPs account for about 5% of the total plastic waste in Coimbatore. The most common banned SUPs found in the waste stream are carry bags, accounting for more than 93% (by weight) of all the banned SUPs. Cutlery items, the other prominent banned SUPs, accounted for 3.9% of the total banned SUPs. The contribution of the rest of the banned SUPs was less than 3%.

Table 1: Banned SUPs in the waste stream

Sl. no.	Banned SUPs	Percentage of total banned SUPs (%)
1	Plastic sticks	0.4
2	Carry bags	93.4
3	Plastic sheets	2.1
4	Cutlery items	3.9
5	Wrapping and film	0.1
6	Others	0.1

Note:

- Plastic sticks include earbuds, balloon sticks, candy sticks, ice-cream sticks, straws and stirrers
- Cutlery items include plates, trays, cups, glasses, spoons, forks and knives
- Wrapping and film include films on the sweet box, invitation card and cigarette packet
- Others include plastic flags, PVC banners (<100 μ) and thermocol decorations

2. Market Survey of Single-use Plastics

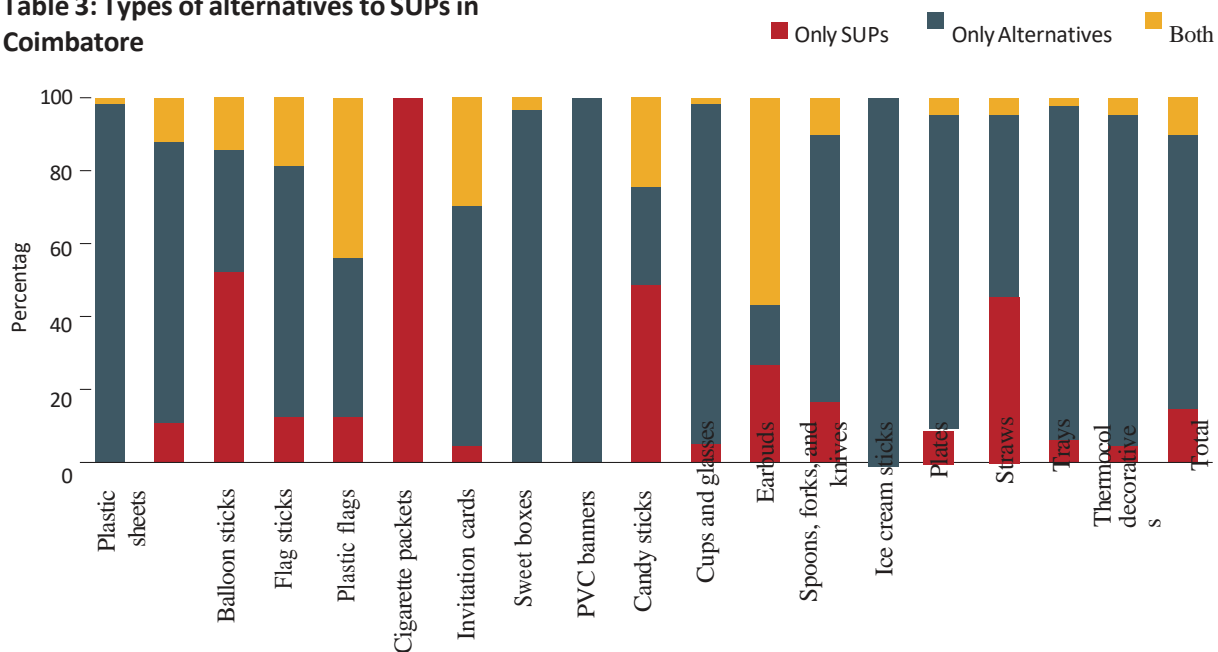
To assess the availability of banned SUP items and its alternatives within the municipal boundaries, a market survey was carried out in selected market areas in different zones, in the month of July 2022.

Table 2: Markets selected for the survey

Sl. No.	Zone	Market name
1	Central	Railway station, Ukkadam
2	North	MTP Road, Thudiyalur
3	South	Palakkad Road, Kuniyamuthur
4	West	Venkitapuram, Vadavalli
5	East	Avinasi Road, Trichy Road

The survey covered 302 shops in four selected markets in Coimbatore. The results are as provided below.

Figure 1: Sale of SUPs and alternatives in Coimbatore

Table 3: Types of alternatives to SUPs in Coimbatore

Banned SUP items	No. of alternatives available	Type 1	Type 2	Type 3	Type 4	Type 5
Plastic sheets	3	Silver foil	Banana leaf	Paper roll		
Plastic carry bags (below 75 microns)	4	Cloth bags	Biodegradable bags	Paper bags	Handicraft bags	
Plastic balloon sticks	2	Wooden sticks	Thread			
Plastic flag sticks	2	Wooden sticks	Thread			
Plastic flags	1	Paper flag				
Plastic films on cigarette packets	0					
Plastic films on invitation cards	1	Paper Envelope				
Plastic films on sweet boxes	1	Paper boxes				
PVC banners (below 100 microns)	4	Above 100-micron flex	300 GSM	Above 125 microns.	200-micron banners	
Plastic candy sticks	1	Wooden stick				
Plastic cups and glasses	4	Ceramic Cups	Hard acrylic cups	Steel cups, glass cups	Sugarcane Bagasse bio-degradable cups	
Plastic earbuds	2	Wooden stick earbuds	Paper based			
Plastic spoons, forks, and knives	2	Steel spoon, fork, knives	Wooden fork, spoon, knives			
Plastic Ice cream sticks	1	Wooden stick				
Plastic plates	5	Steel plates	Biodegradable Sugarcane Bagasse Plates	Ceramic plates	Hard Acrylic plates	Palm and bamboo tree-based plates
Plastic straws	1	Paper straws				
Plastic trays	3	Steel tray	Acrylic trays	Wooden trays		
Thermocol decorative	2	Hard Plastic décor items	Reusable foam materials			



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Delhi (SDMC)

Delhi, officially called the National Capital Territory of Delhi (NCT) is a union territory comprising New Delhi, the capital city of India. It is situated along the west bank of the Yamuna River, and is surrounded by the state of Haryana on three sides, and by Uttar Pradesh on the east.

The Municipal Corporation of Delhi is one of the largest municipal bodies in the world providing civic services to approximately 20 million citizens of Delhi. Until May 2022, it was divided into 3 civil bodies, titled, the East Delhi Municipal Corporation (EDMC), South Delhi Municipal Corporation (SDMC), and the North Delhi Municipal Corporation (NDMC). The SDMC spans an area of 656.9 sq km. and comprises a population of about 65 lakh. It is divided into 4 main zones, namely Central Zone, South Zone, West Zone, and Najafgarh Zone constituting 104 municipal wards.

1. Single-use Plastic Waste Inventory

In SDMC, the municipal waste was collected from three Residential areas, High-income residential (Ward No. 2S), Middle-income Residential areas (Ward No. 3S), and Low-income residential areas (Ward No. 4S), and one sample each from Mixed Commercial & Residential (Ward No. 1S), and Commercial areas (Ward No. 6S). A sample from the dumpsite was also collected and characterised to assess the quantity of plastic and SUPs taken out for recycling/reuse.

The inventorisation study in SDMC was conducted from 26 to 29 May 2022 at the transfer station at Raghubir Nagar. The door to door waste collected from households of selected wards was brought to the transfer station for inventory.

Results of inventory

Banned SUPs accounted for about 36% of total plastic waste in Delhi (SDMC). The most common banned SUP found in the waste stream are carry bags, accounting for more than 92% (by weight) of all the banned SUPs. Cutlery items, the other prominent banned SUPs, accounted for 7.09% of the total banned SUPs. The contribution of the rest of the banned SUPs was less than 0.3%.

Table 1: Banned SUPs in the waste stream

Sl. no.	Banned SUPs	Percentage of total banned SUPs (%)
1	Plastic sticks	0.29
2	Carry bags	92.53
3	Plastic sheets	0.00
4	Cutlery items	7.09
5	Wrapping and film	0.09
6	Others	0.00

Note:

- Plastic sticks include earbuds, balloon sticks, candy sticks, ice-cream sticks, straws and stirrers
- Cutlery items include plates, trays, cups, glasses, spoons, forks and knives
- Wrapping and film include films on the sweet box, invitation card and cigarette packet
- Others include plastic flags, PVC banners (<100 μ) and thermocol decorations

2. Market Survey of Single-use Plastics

To assess the availability of banned SUP items and its alternatives within the municipal boundaries, a market survey was carried out in selected market areas in different zones, in the month of March and May 2022.

Table 2: Markets selected for the survey

Sl. No.	Zone	Market name
1	Najafgarh	Dwarka sector 12 and Dabri-mor market
2	West	Tilak Nagar and Rajori Garden
3	South	Malviya Nagar and Yusuf Sarai
4	Central	Lajpat Nagar and South Extension

The survey covered 277 shops in four selected markets in SDMC. The results are as provided below.



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Dhanbad

Dhanbad is located in the Eastern state of Jharkhand, and shares a border with West Bengal. Dhanbad is known as the Coal Capital of India, with more than 100 coal mines. The Dhanbad Municipal Corporation (DMC) constitutes an area of 355.77 sq km. It is divided into 55 municipal wards, and houses a population of about 2.8 million (as per Census 2011). The DMC was formed in 2006 by combining the erstwhile Dhanbad Municipality, Jharia NAC, Sindri NAC, Katras NAC, Chhatandh NAC, and 27 other census towns located in and around Dhanbad. There are about 2,20,783 households in Dhanbad.

1. Single-use Plastic Waste Inventory

In Dhanbad, the municipal waste was collected from three residential wards every day. The residential wards from where waste was collected during the five study are Ward number 21, 22, 23, 25, 28. Similarly, waste was collected from two commercial wards every day. Commercial waste was collected from Ward number 23, 24 and 27. Ward 23 is a mixed ward. It has residential as well as a large commercial area from where waste is collected separately. From Ward 23, both residential and commercial samples were collected.

A sample from the dumpsite was also collected and characterised to assess the quantity of plastic and SUPs taken out for recycling/reuse.

The inventorisation study in Dhanbad was conducted from 26 to 30 June 2022 at one of the transfer stations, where door to door waste collected from identified wards were brought for inventory.

Results of inventory

Banned SUPs account for about 24% of the total plastic waste in Dhanbad. The most common banned SUPs found in the waste stream are carry bags, accounting for more than 92% (by weight) of all the banned SUPs. Cutlery items, the other prominent banned SUPs, accounted for 7% of the total banned SUPs. The contribution of the rest of the banned SUPs was less than 1% of the total plastics by weight.

Table 1: Banned SUPs in the waste stream

Sl. no.	Banned SUPs	Percentage of total banned SUPs (%)
1	Plastic sticks	0.24
2	Carry bags	92.35
3	Plastic sheets	0.06
4	Cutlery items	7.09
5	Wrapping and film	0.10
6	Others	0.16

Note:

- Plastic sticks include earbuds, balloon sticks, candy sticks, ice-cream sticks, straws and stirrers
- Cutlery items include plates, trays, cups, glasses, spoons, forks and knives
- Wrapping and film include films on the sweet box, invitation card and cigarette packet
- Others include plastic flags, PVC banners (<100 μ) and thermocol decorations

2. Market Survey of Single-use Plastics

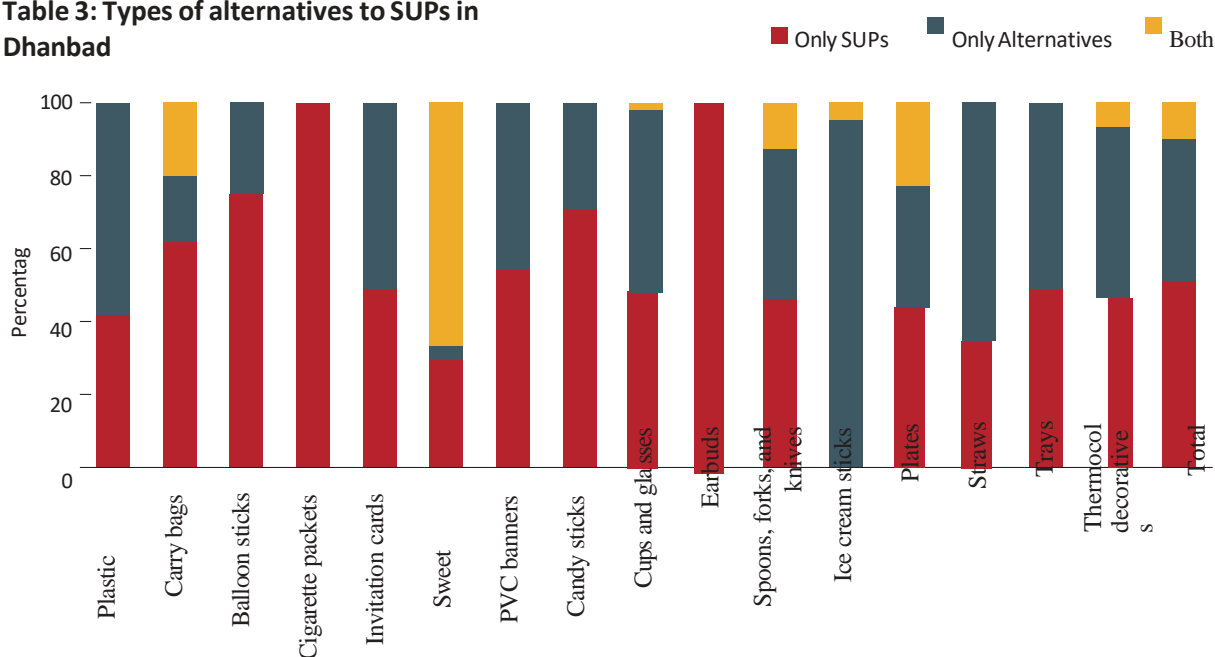
To assess the availability of banned SUP items and its alternatives within the municipal boundaries, a market survey was carried out in selected market areas in different zones, in the month of April and May 2022.

Table 2: Markets selected for the survey

Sl. No.	Zone	Market name
1	North	Hirapur, Bartand
2	South	Digwadih, Sindri
3	East	Jharia, Phusbunglow
4	West	Katrasgarh, Putki

The survey covered 259 shops in four selected markets in Dhanbad. The results are as provided below.

Figure 1: Sale of SUPs and alternatives in Dhanbad

Table 3: Types of alternatives to SUPs in Dhanbad

Banned SUP items	No. of alternative s available	Type 1	Type 2	Type 3	Type 4
Plastic sheets	2	Aluminium sheets	Paper sheets		
Plastic carry bags (<75 μ)	2	Paper Bags	Cloth bags		
Plastic balloon sticks	1	Latex rubber sticks			
Plastic films on cigarette packets	0				
Plastic films on invitation cards	1	Paper cards without films			
Plastic films on sweet boxes	1	Cardboard/ paper box without film			
PVC banners (<100 μ)	1	Above 100 microns			
Plastic candy sticks	1	Paper stick			
Plastic cups and glasses	3	Paper cups and glasses	Steel cups and glasses	Hard plastic/ ceramic cups	
Plastic earbuds	0				
Plastic spoons, forks and knives	2	Steel cutlery	Wooden cutlery		
Plastic ice-cream sticks	1	Wooden sticks			
Plastic plates	2	Ceramic plates, reusable plastic plates	Steel		
Plastic straws	1	Paper straws			
Plastic trays	2	Aluminium trays	Paper trays		
Thermocol decorative items	1	Paper décor			
Thermocol decorative items.	1	Paper decorative items			

Plastic flags and flag sticks was not found during the survey.



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Guwahati

Guwahati, the capital city of Assam, is also known as the gateway of North-East and is the largest city in the entire North-Eastern Region. It is situated between the southern bank of the Brahmaputra River and the foothills of the Shillong plateau. Dispur, a part of Guwahati, serves as the capital of Assam. The Guwahati municipal corporation (GMC) is the administrative body that looks after civic amenities, including the town's municipal solid waste (MSW) management. It consists of 60 wards (delimited from 31 wards), with a total area of 216.79 sq km.

1. Single-use Plastic Waste Inventory

In Guwahati, the municipal waste was collected from six residential wards, High-income residential (Ward Nos. 33 and 37), Middle-income residential areas (Ward Nos. 26 and 31), and Low-income residential areas (Ward Nos. 20 and 23), two mixed commercial and residential wards (Ward 18 and 32), and two commercial wards (Ward 17 and 39).

A sample from the dumpsite was also collected and characterised to assess the quantity of plastic and SUPs taken out for recycling/reuse.

The inventorisation study in Guwahati was conducted from 7 to 10 May 2022 at a designated place where all the waste were brought and characterised. The rate of segregation in Guwahati is poor.

Results of inventory

Banned SUPs accounted for about 30% of total plastic waste in Guwahati. The most common banned SUP found in the waste stream are carry bags, accounting for more than 76% (by weight) of all the banned SUPs. Cutlery items, the other prominent banned SUPs, accounted for 23% of the total banned SUPs. The contribution of the rest of the banned SUPs was less than 1%.

Table 1: Banned SUPs in the waste stream

Sl. no.	Banned SUPs	Percentage of total banned SUPs (%)
1	Plastic sticks	0.32
2	Carry bags	76.18
3	Plastic sheets	0.00
4	Cutlery items	23.45
5	Wrapping and film	0.05
6	Others	0.00

Note:

- Plastic sticks include earbuds, balloon sticks, candy sticks, ice-cream sticks, straws and stirrers
- Cutlery items include plates, trays, cups, glasses, spoons, forks and knives
- Wrapping and film include films on the sweet box, invitation card and cigarette packet
- Others include plastic flags, PVC banners (<100 µ) and thermocol decorations

2. Market Survey of Single-use Plastics

To assess the availability of banned SUP items and its alternatives within the municipal boundaries, a market survey was carried out in selected market areas in different zones, in the month of April and May 2022. In each zone, major markets, which represented diversity in economic activities, were selected.

Table 2: Markets selected for the survey

Sl. No.	Zone	Market name
1	North	Fancy Bazar and Lakhtokia
2	South	Six Mile
3	East	Ganeshguri
4	West	Maligaon and Adabari

The survey covered 172 shops in four selected markets in Guwahati. The results are as provided below.

Figure 1: Sale of SUPs and alternatives in Guwahati

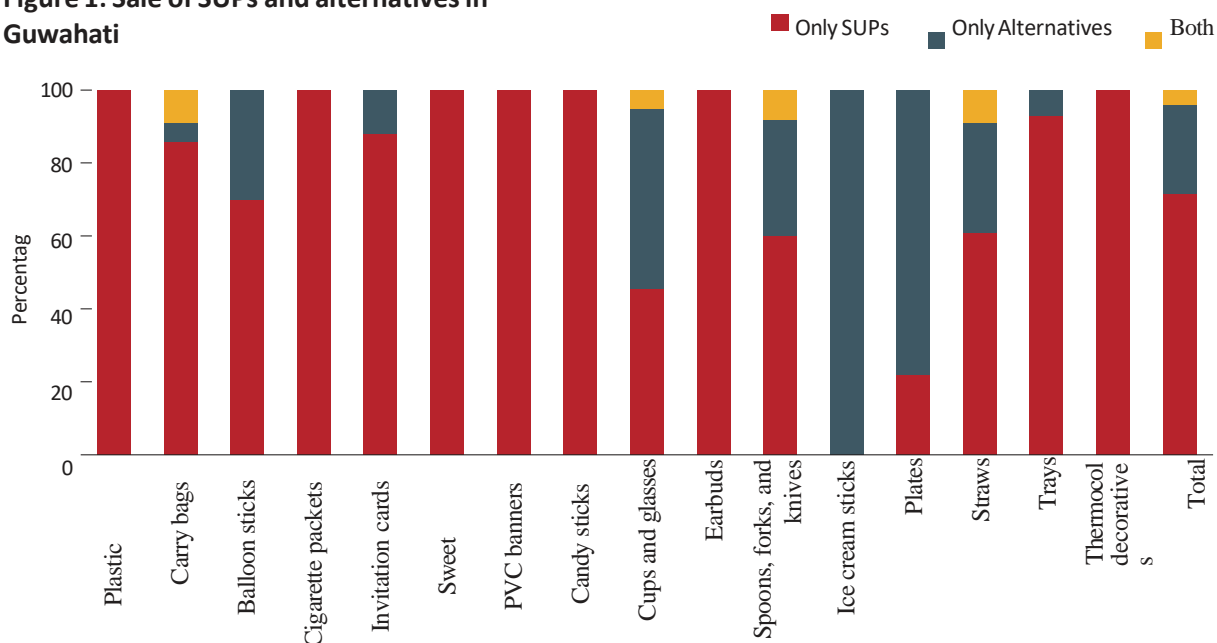


Table 3: Types of alternatives to SUPs in Guwahati

Banned SUP items	No. of alternatives available	Type 1	Type 2	Type 3	Type 4	Type 5
Plastic sheets	0					
Plastic carry bags (below 75 microns)	4	Paper bag	Paper envelope	Cloth Bag	Woven Bag	
Plastic balloon sticks	2	Thread	Ribbon			
Plastic films on cigarette packets	0					
Plastic films on invitation cards	1	Paper cards without lamination				
Plastic films on sweet boxes	0					
PVC banners (below 100 microns)	0					
Plastic candy sticks	0					
Plastic cups and glasses	3		Paper cup and glasses	Steel Glass	Reusable cup and glasses	
Plastic earbuds	0					
Plastic spoons, forks and knives	2	Steel spoon, fork, knives	Wooden fork, spoon and knives			
Plastic Ice cream sticks	1	Wooden stick				
Plastic plates	5	Steel plates	Paper plates	Areca nut leaf plates	Ceramic plates	Aluminium foils
Plastic straws	1	Paper straws				
Plastic trays	1		Reusable tray			
Thermocol decorative	0					
Plastic sheets	0					
Thermocol decoratives	2	Paper décor	Cloth decor			



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Indore

It is the largest city in Madhya Pradesh, and is regarded as the commercial capital of the state. It is located at a distance of 190km from the capital city of Bhopal and is spread over an area of 3898 sq km. As per the Census 2011, the population of Indore is estimated to be 32,76,697. Indore city presents a happy blend of historical past and promises of rapid future modernisation. Indore has been part of the Swachh Survekshan survey since its inception and ranked 25th place in 2016. It has been ranked as India's cleanest city for three years in a row as per the Swachh Survekshan for 2017, 2018 and 2019.

1. Single-use Plastic Waste Inventory

In Indore, the municipal waste was collected from six residential wards High-income residential (Ward Nos. 45 and 47), Middle-income Residential areas (Ward Nos. 26 and 27), and Low-income residential areas (Ward Nos. 24 and 46), two mixed commercial and residential wards (Ward 25, 43) and two commercial areas from (Ward 57 and 47). Before the characterisation study, the waste collectors were trained not to take out any valuable dry waste from the sample.

A sample from the dumpsite was also collected and characterised to assess the quantity of plastic and SUPs taken out for recycling/reuse.

The inventorisation study in Indore was conducted from 7 to 12 May 2022 at the Material Recovery Facility, the town mostly collects segregated waste and all the collected waste is send to this facility for resource recovery.

Results of inventory

Banned SUPs accounted for approximately 12% of total plastic waste in Indore. The most common banned SUP product found in the waste stream are carry bags, accounting for 56.9% (by weight) of all the banned SUPs. Cutlery items, the other prominent banned SUPs, accounted for 36.9% of the total banned SUPs. The contribution of the rest of the banned SUPs like plastic sheets with thickness less than 50 microns, plastic wrappings on Invitation cards and sweet boxes, plastic films on cigarette packets, and other products adds up to 6% of the total weight.

Table 1: Banned SUPs in the waste stream

Sl. no.	Banned SUPs	Percentage of total banned SUPs (%)
1	Plastic sticks	0.72
2	Carry bags	56.89
3	Plastic sheets	1.48
4	Cutlery items	36.90
5	Wrapping and film	1.71
6	Others	2.31

Note:

- Plastic sticks include earbuds, balloon sticks, candy sticks, ice-cream sticks, straws and stirrers
- Cutlery items include plates, trays, cups, glasses, spoons, forks and knives
- Wrapping and film include films on the sweet box, invitation card and cigarette packet
- Others include plastic flags, PVC banners (<100 μ) and thermocol decorations

2. Market Survey of Single-use Plastics

To assess the availability of banned SUP items and its alternatives within the municipal boundaries, a market survey was carried out in selected market areas in different zones, in the month of April and May 2022.

Table 2: Markets selected for the survey

Sl. No.	Zone	Market name
1	North East	56 dukaan, Patnipura square, Malwa Mill
2	South East	Bhawarkua market, Sapnasangeeta Road
3	North West	Sangam Nagar, Banganga Side Market
4	South West	Bada Ganpati, Kalani Nagar

The survey covered 250 shops in four selected markets in Indore. The results are as provided below.

Figure 1: Sale of SUPs and alternatives in Indore

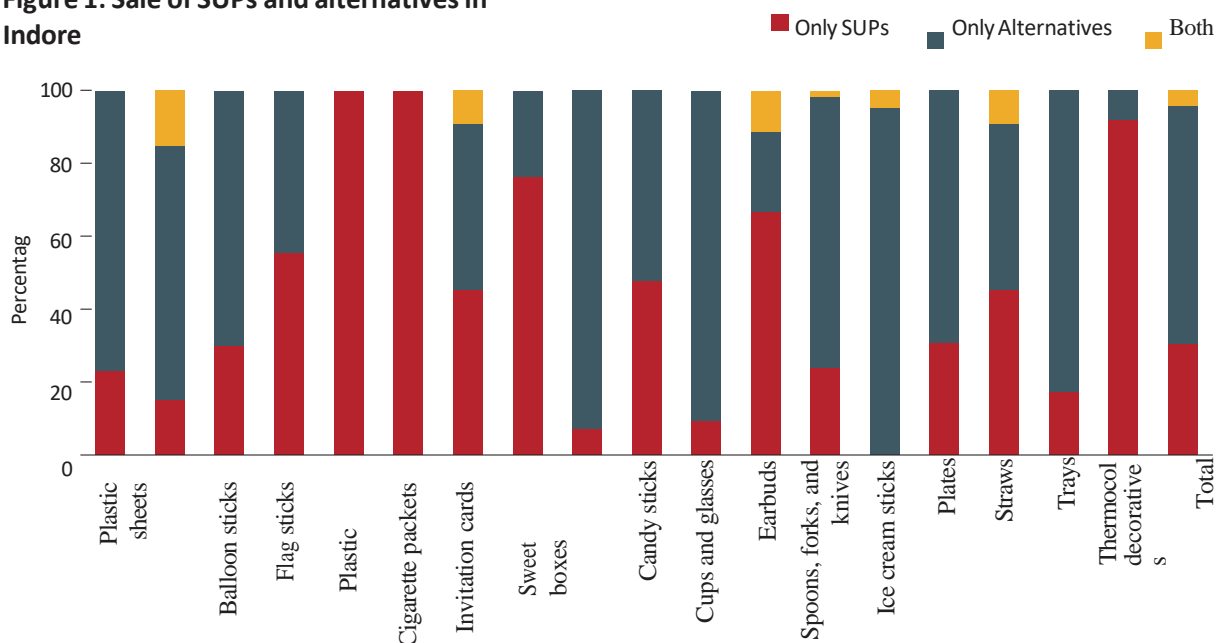


Table 3: Types of alternatives to SUPs in Indore

Banned SUP items	No. of alternatives available	Type 1	Type 2	Type 3	Type 4
Plastic sheets	1	Silver foil paper roll			
Plastic carry bags (below 75 microns)	1	Non-woven Carry bags			
Plastic balloon sticks	2	Wooden sticks	Thread		
Plastic flag sticks	2	Wooden sticks	Thread		
Plastic flags	0				
Plastic films on cigarette packets	0				
Plastic films on invitation cards	1	Paper Envelope			
Plastic films on sweet boxes	1	Paper boxes			
PVC banners (below 100 microns)	4	Above 100-micron flex	300 GSM	Above 125 microns.	200-micron banners
Plastic candy sticks	1	Wooden stick			
Plastic cups and glasses	4	Ceramic Cups	Hard acrylic cups	Steel cups, glass cups	Sugarcane Bagasse bio-degradable cups
Plastic earbuds	1	Wooden stick earbuds			
Plastic spoons, forks, and knives	1	Steel spoon, fork, knives			
Plastic Ice cream sticks	1	Wooden stick			
Plastic plates	4	Steel plates	Biodegradable Sugarcane Bagasse Plates	Ceramic plates	Hard Acrylic plates
Plastic straws	1	Paper straws			
Plastic trays	3	Steel tray	Acrylic trays	Wooden trays	
Thermocol decorative	1	Hard Plastic décor items			



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Jorhat

Jorhat is about 300 km away from the state capital Guwahati, situated on the southern bank of the Brahmaputra river. One of the major commercial hubs of Assam, Jorhat is also known as the cultural capital of the state. Bhogdoi river, a tributary of the Brahmaputra, passes through the city and is the primary source of water for its residents. As per the Census 2011, Jorhat Municipal Board (covering the outgrowth area) had a population of 1.27 lakh; the estimated population for 2020 is over 2.2 lakh.

1. Single-use Plastic Waste Inventory

In Jorhat, the municipal waste was collected from three residential wards (Ward No. 3, 7 and 17), one mixed commercial and residential, and one commercial wards (Ward No. 8 and 12). Before the characterisation study, the waste collectors were trained not to take out any valuable dry waste from the sample. See Figure 3 for the location of the selected wards.

A sample from the dumpsite was also collected and characterised to assess the quantity of plastic and SUPs taken out for recycling/reuse.

The inventurisation study in Jorhat was conducted from 7 to 11 April 2022 at the landfill site. The waste segregation rate in the city is very poor.

Results of inventory

Banned SUPs account for about 46% of the total plastic waste in Jorhat. The most common banned SUPs found in the waste stream are carry bags, accounting for more than 91% (by weight) of all the banned SUPs. Cutlery items, the other prominent banned SUPs, accounted for 8.5% of the total banned SUPs. The contribution of the rest of the banned SUPs was less than 0.2%.

Table 1: Banned SUPs in the waste stream

Sl. no.	Banned SUPs	Percentage of total banned SUPs (%)
1	Plastic sticks	0.02
2	Carry bags	91.34
3	Plastic sheets	0.00
4	Cutlery items	8.49
5	Wrapping and film	0.14
6	Others	0.00

Note:

- Plastic sticks include earbuds, balloon sticks, candy sticks, ice-cream sticks, straws and stirrers
- Cutlery items include plates, trays, cups, glasses, spoons, forks and knives
- Wrapping and film include films on the sweet box, invitation card and cigarette packet
- Others include plastic flags, PVC banners (<100 μ) and thermocol decorations

2. Market Survey of Single-use Plastics

To assess the availability of banned SUP items and its alternatives within the municipal boundaries, a market survey was carried out in selected market areas in different zones, in the month of April and May 2022.

Table 2: Markets selected for the survey

Sl. No.	Zone	Market name
1	North	Chowk Bazaar
2	South	Tarazan Market
3	East	Gar Ali Market
4	West	Baruah Chariali

The survey covered 123 shops in four selected markets in Jorhat. The results are as provided below.

Figure 1: Sale of SUPs and alternatives in Jorhat

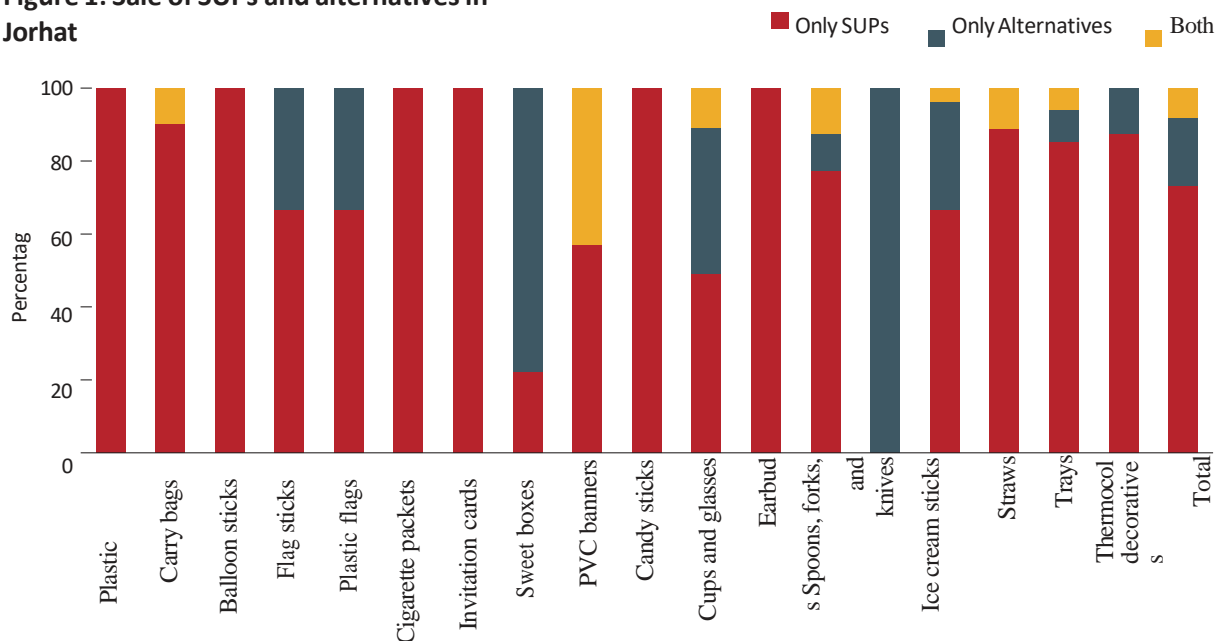


Table 3: Types of alternatives to SUPs in Jorhat

Banned SUP items	No. of alternatives available	Type 1	Type 2	Type 3	Type 4
Plastic sheets	0				
Plastic carry bags (<75 μ)	1	Paper bags			
Plastic balloon sticks	0				
Plastic flag sticks	1	Wooden			
Plastic flags	1	Paper			
Plastic films on cigarette packets	0				
Plastic films on invitation cards	0				
Plastic films on sweet boxes	1	Paper boxes without film			
PVC banners (<100 μ)	1	>100 μ flex			
Plastic candy sticks	0				
Plastic cups and glasses	4	Ceramic cups	Paper cups	Steel glasses and glass (material) glasses	Steel cup, ceramic cup and reusable ceramic cups
Plastic earbuds	0				
Plastic spoons, forks and knives	1	Steel spoon, fork and knife			
Plastic ice-cream sticks	1	Wooden stick			
Plastic plates	3	Steel plate	Laminated paper plates	Ceramic plates	
Plastic straws	1	Paper straws			
Plastic trays	2	Steel tray	Reusable plastic trays		
Thermocol decoratives	2	Tissue paper	Paper items		



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Karaikal

Karaikal is a small coastal town located in the Union Territory of Puducherry. It is surrounded by Nagapattinam and Tiruvarur districts of Tamil Nadu and the Bay of Bengal in the North, South, West and East, respectively. It lies at a distance of 140 kms from Puducherry and about 300 kms south of Chennai. The Arasalar river, a tributary of the Cauvery River flows through Karaikal, making it a part of the fertile Cauvery delta. According to 2011 Census, Karaikal is home to 21,320 households and has a total population of 86,838. The current estimated number of households in 2022 in Karaikal is 25,653 with a population is 1 Lakh. The town is spread over an area of 52 sq km. and is divided into 18 municipal wards.

1. Single-use Plastic Waste Inventory

In Karaikal, the municipal waste was collected randomly from six residential wards per day (Ward Nos. 15, 17, 4, 12, 11, 9 in 5 days) and two vehicles collecting commercial waste from wards 1 to 16.

A sample from the dumpsite was also collected and characterised to assess the quantity of plastic and SUPs taken out for recycling/reuse.

The inventorisation study in Karaikal was conducted from 4 to 8 July 2022 at the Material Recovery Facility, since the town mostly collects segregated waste and all the waste is collected and send to this facility for resource recovery before going to the dumpsite.

Results of inventory

Banned SUPs account for 17.6% of the total plastic waste in Karaikal. The most common banned SUPs found in the waste stream are carry bags, accounting for 90% (by weight) of all the banned SUPs. Cutlery items, the other prominent banned SUPs, accounted for 7.58% of the total banned SUPs. The contribution of the rest of the banned SUPs was about 3%.

Table 1: Banned SUPs in the waste stream

Sl. no.	Banned SUPs	Percentage of total banned SUPs (%)
1	Plastic sticks	1.48
2	Carry bags	89.43
3	Plastic sheets	0.08
4	Cutlery items	7.58
5	Wrapping and film	0.12
6	Others	1.32

Note:

- Plastic sticks include earbuds, balloon sticks, candy sticks, ice-cream sticks, straws and stirrers
- Cutlery items include plates, trays, cups, glasses, spoons, forks and knives
- Wrapping and film include films on the sweet box, invitation card and cigarette packet
- Others include plastic flags, PVC banners (<100 μ) and thermocol decorations

2. Market Survey of Single-use Plastics

To assess the availability of banned SUP items and their alternatives within the municipal boundaries, a market survey was carried out in selected market areas in different zones, in the month of June and July 2022.

Table 2: Markets selected for the survey

Sl. No.	Zone	Market name
1	North	Keezhakasakudy Market
2	South	Polican Street
3	East	Nehru Market
4	West	Dargah Market

The survey covered 140 shops in four selected markets in Karaikal. The results are as provided below.

Figure 1: Sale of SUPs and alternatives in Karaikal

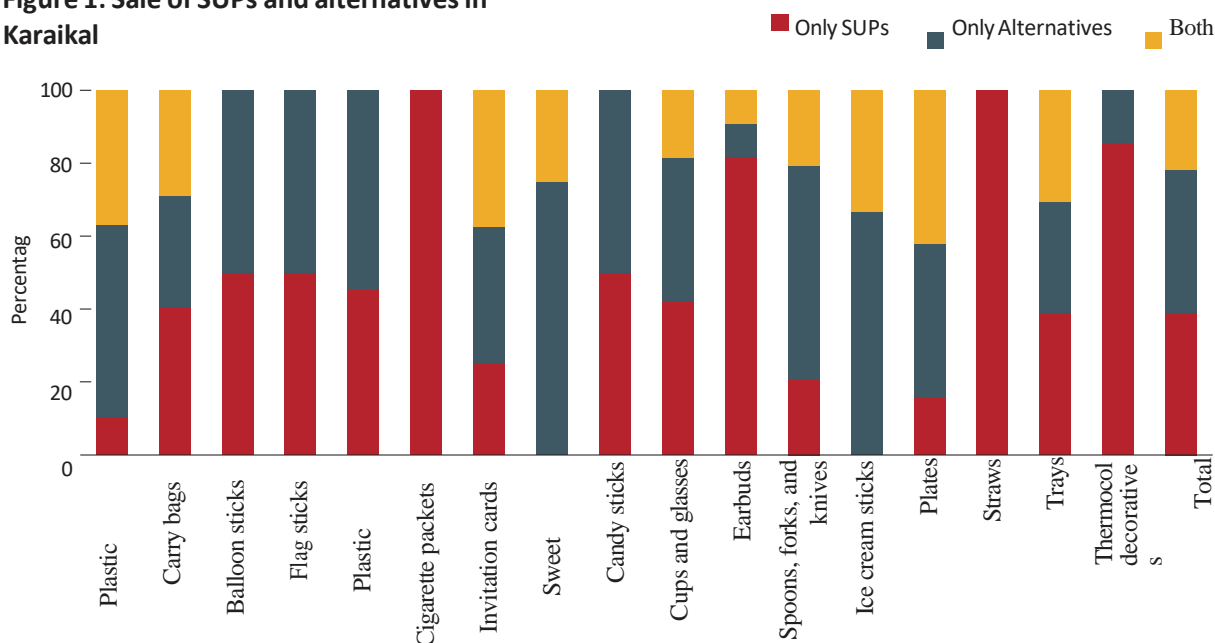


Table 3: Types of alternatives to SUPs in Karaikal

Banned SUP items	No. of alternatives available	Type 1	Type 2	Type 3	Type 4
Plastic sheets	2	Banana Leaves	Aluminium sheet (Silver cover sheets)		
Plastic carry bags (<75 µ)	3	Paper bags	Cloth bags	Bio-degradable carry bags	
Plastic balloon sticks	1	Wooden sticks			
Plastic flag sticks	1	Wooden sticks			
Plastic flags	2	Paper flags	Cotton cloth flags		
Plastic films on cigarette packets	0				
Plastic films on invitation cards	1	Paper cards			
Plastic films on sweet boxes	1	Cardboard/ Paper boxes			
PVC banners (<100 µ)	1	Cloth banners			
Plastic candy sticks	1	Wooden sticks			
Plastic cups and glasses	1	Steel cups and glasses			
Plastic earbuds	1	Bamboo earbuds			
Plastic spoons, forks and knives	1	Steel cutlery			
Plastic ice-cream sticks	2	Manufactured Wooden sticks	Tree sticks(twigs)		
Plastic plates	1	Steel plates			
Plastic straws	0				
Plastic trays	1	Aluminium trays			
Thermocol decoratives	1	Paper décor			



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Lucknow

Lucknow is the state capital and the second largest urban agglomeration in the state of Uttar Pradesh. The Lucknow Municipal Corporation (LMC) is the administrative body in charge of civic amenities in the city and its municipal solid waste (MSW) management. LMC consists of 8 zones and 110 wards, with a total area of 248 sq km. The city is ranked 12th in the Swachh Survekshan ranking 2021, the Central Government's annual cleanliness survey. As per Census 2011, Lucknow Municipal Corporation had a population of 28.17 lakh, the estimated population for 2021 is over 37.9 lakh.

1. Single-use Plastic Waste Inventory

Fresh municipal waste samples were collected directly from the vehicles transporting waste from various wards. In Lucknow, the municipal waste was collected randomly from five residential wards (Ward 27, 42, 66, 92 and 99), one sample each from different economic strata, one sample from three mixed commercial and residential wards (Ward 55, 102 and 104) on different days, and one commercial ward (Ward 21).

A sample from the dumpsite was also collected and characterised to assess the quantity of plastic and SUPs taken out for recycling/reuse.

The inventorisation study in Lucknow was conducted from 15 to 19 September 2022 at one of the transfer stations on Seth Ramjas Road, near Lucknow zoo. The door to door waste collected from the identified wards were brought at the transfer station for inventory.

Results of inventory

Banned SUPs account for about 11% of the total plastic waste in Lucknow. The most common banned SUPs found in the waste stream are carry bags, accounting for more than 93% (by weight) of all the banned SUPs. Cutlery items, the other prominent banned SUPs, accounted for 5.11% of the total banned SUPs. The contribution of the rest of the banned SUPs was less than 2%.

Table 1: Banned SUPs in the waste stream

Sl. no.	Banned SUPs	Percentage of total banned SUPs (%)
1	Plastic sticks	0.35
2	Carry bags	93.42
3	Plastic sheets	0.05
4	Cutlery items	5.11
5	Wrapping and film	0.50
6	Others	0.56

Note:

- Plastic sticks include earbuds, balloon sticks, candy sticks, ice-cream sticks, straws and stirrers
- Cutlery items include plates, trays, cups, glasses, spoons, forks and knives
- Wrapping and film include films on the sweet box, invitation card and cigarette packet
- Others include plastic flags, PVC banners (<100 µ) and thermocol decorations

2. Market Survey of Single-use Plastics

To assess the availability of banned SUP items and its alternatives within the municipal boundaries, a market survey was carried out in selected market areas in different zones, in the month of August and September 2022.

Table 2: Markets selected for the survey

Sl. No.	Zone	Market name
1	North	Gayatri market and Gol market
2	South	Bangla Bazar/Telibagh and Sadar Bazaar/ Kaka market
3	East	Chinhat and Bhootnath market
4	West	Rahmani market, Chanda market

The survey covered 333 shops in four selected markets in Lucknow. The results are as provided below.

Figure 1: Sale of SUPs and alternatives in Lucknow

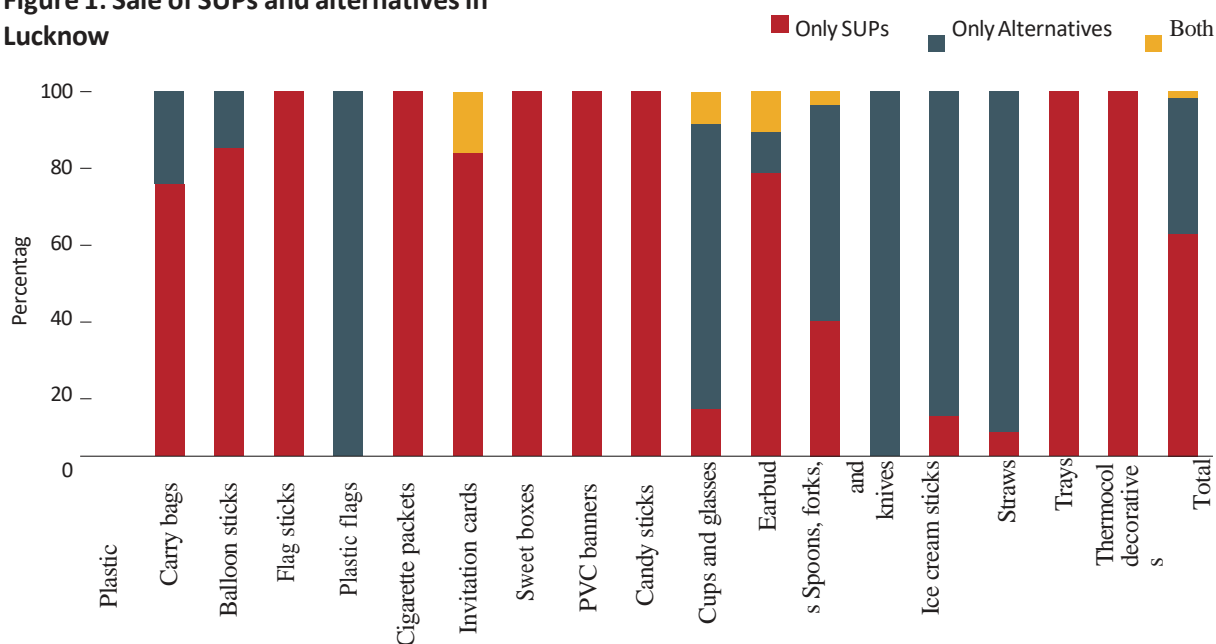


Table 3: Types of alternatives to SUPs in Lucknow

Banned SUP items	No. of alternatives available	Type 1	Type 2	Type 3	Type 4
Plastic sheets					
Plastic carry bags (<75 μ)	3	Paper bag	Cloth Bag	>75 microns	
Plastic balloon sticks	1	Wooden stick			
Plastic flag sticks	0				
Plastic flags	2	Paper	Cloth		
Plastic films on cigarette packets	0				
Plastic films on invitation cards	1	Paper cards without any wrapping			
Plastic films on sweet boxes	0				
PVC banners (<100 μ)	0				
Plastic candy sticks	0				
Plastic cups and glasses	4	Paper	Steel Glass	Ceramic	Glass
Plastic earbuds	1	Wooden stick			
Plastic spoons, forks and knives	2	Steel spoon, fork, knives	Wooden fork, spoon and knives		
Plastic ice-cream sticks	1	Wooden stick			
Plastic plates	4	Steel plates	Paper plates	Pattal (leaf plates)	aluminium foil
Plastic straws	1	Paper straws			
Plastic trays	0				
Thermocol decoratives	0				



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Mamallapuram

Mamallapuram also known as Mahabalipuram, is a coastal town located in the Chengalpattu district of the southern state of Tamil Nadu. It is situated on the Coromandel coast of Bay of Bengal, at a distance of 56 km south from Chennai, the capital city of Tamil Nadu. The town is spread across an area of 12.85 sq km. As per the SECC of 2011, the total population of the town is around 15,000. A total of 5,994 households reside in Mamallapuram. The current population (Census 2021) is around 20,000. It is best known for the UNESCO World Heritage Site of the Hindu Group of monuments at Mahabalipuram belonging to the 7th and 8th centuries.

1. Single-use Plastic Waste Inventory

Fresh municipal waste samples were collected directly from the vehicles transporting waste from various wards. As the population size in Mamallapuram is very small, one vehicle had the capacity to collect municipal waste from two to three municipal wards based on the size and population in the wards. Hence, five vehicles, three from Residential areas, High-income residential (Ward Nos. 4, 5, and 8), Middle-income Residential areas (Ward Nos. 9, 14, and 15), and Low-income residential areas (Ward Nos. 10, 11, 12, and 13), and 1 vehicle each from Mixed Commercial & Residential (Ward Nos. 6 & 7), and Commercial areas (Ward Nos. 2, 7, and 3) were chosen for taking the samples.

A sample from the dumpsite was also collected and characterised to assess the quantity of plastic and SUPs taken out for recycling/reuse.

The inventorisation study in Mamallapuram was conducted from 1 to 5 July 2022 at the Material Recovery Facility, since the town mostly collects segregated waste and all the waste is collected and send to this facility for resource recovery.

Results of inventory

Banned SUPs account for about 20.6% of the total plastic waste in Mamallapuram. The most common banned SUPs found in the waste stream are carry bags, accounting for more than 85% (by weight) of all the banned SUPs. Cutlery items, the other prominent banned SUPs, accounted for 12.9% of the total banned SUPs. The contribution of the rest of the banned SUPs was less than 2%.

Table 1: Banned SUPs in the waste stream

Sl. no.	Banned SUPs	Percentage of total banned SUPs (%)
1	Plastic sticks	1.96
2	Carry bags	85.02
3	Plastic sheets	0.02
4	Cutlery items	12.90
5	Wrapping and film	0.10
6	Others	0.00

Note:

- Plastic sticks include earbuds, balloon sticks, candy sticks, ice-cream sticks, straws and stirrers
- Cutlery items include plates, trays, cups, glasses, spoons, forks and knives
- Wrapping and film include films on the sweet box, invitation card and cigarette packet
- Others include plastic flags, PVC banners (<100 μ) and thermocol decorations

2. Market Survey of Single-use Plastics

To assess the availability of banned SUP items and its alternatives within the municipal boundaries, a market survey was carried out in selected market areas in different zones, in the month of June and July 2022.

Table 2: Markets selected for the survey

Sl. No.	Zone	Market name
1	North	Kovalam Road
2	South	Poonchery
3	East	Mahabalipuram Sea shore market
4	West	Tirukkallukundram Road

The survey covered 111 shops in four selected markets in Mamallapuram. The results are as provided below.

Figure 1: Sale of SUPs and alternatives in Mamallapuram

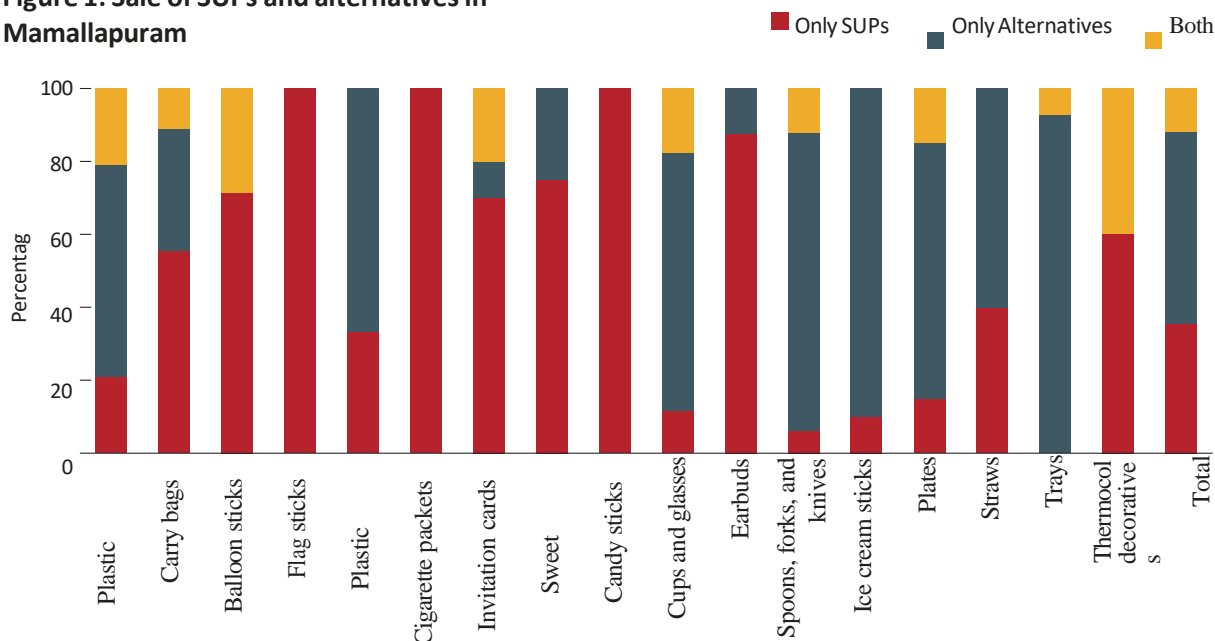


Table 3: Types of alternatives to SUPs in Mamallapuram

Banned SUP items	No. of alternatives available	Type 1	Type 2	Type 3	Type 4
Plastic sheets	2	Banana Leaves	Aluminium sheet		
Plastic carry bags (<75 μ)	3	Paper bags	Cloth bags	Aluminium pouches	
Plastic balloon sticks	1	Thread			
Plastic flag sticks	0				
Plastic flags	1	Paper flags			
Plastic films on cigarette packets	0				
Plastic films on invitation cards	1	Cards without films			
Plastic films on sweet boxes	1	Cardboard boxes without plastic film			
Plastic candy sticks	0				
Plastic cups and glasses	3	Steel cups and glasses	Glass crockery	Paper cups and glasses	
Plastic earbuds	1	Wooden earbuds			
Plastic spoons, forks and knives	2	Aluminium cutlery	Wooden knives		
Plastic ice-cream sticks	1	Wooden sticks			
Plastic plates	3	Steel plates	Paper plates	Aluminium foil	
Plastic straws	1	Paper straws			
Plastic trays	1	Aluminium trays			
Thermocol decorative items.	1	Paper decorative items			

Shops printing PVC banners could not be found in the town. Locals explain that they are generally purchased from Chennai or other nearby towns.



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Mysuru

Mysuru is a city located in the southern part of the Indian State of Karnataka. It is located in the foothills of the Chamundi Hills of the Western Ghats, and at a distance of 145 kms south-west from Bangalore, the IT hub of India. The Kaveri River and its tributary, the Kabini river flows through the northern and southern boundaries of the city, respectively. As per Census 2011, the total number of households in Mysuru is 2,15,061 with a population of 9,20,550.

1. Single-use Plastic Waste Inventory

In Mysuru, the inventory was done on door to door dry waste samples collected from three Residential areas, High-income residential (Ward No. 59), Middle-income Residential areas (Ward No. 5), and Low-income residential areas (Ward No. 10), and one from Mixed Commercial & Residential (Ward No. 63), and Commercial areas (Ward No. 49) were chosen for taking the samples.

(Note: ITC-WOW has been assigned to collect the dry waste from these localities and the wet waste is collected by the separate concessionaire assigned by the municipality).

The inventorisation study in Bengaluru was conducted from 02 to 06 July 2022 at the Material Recovery Facility operated by ITC. The dry waste collected from door to door collection is brought at the facility for resource recovery.

Results of inventory

Banned SUPs account for about 12.2% of the total plastic waste in Mysuru. The most common banned SUPs found in the waste stream are carry bags, accounting for more than 57.93% (by weight) of all the banned SUPs. Cutlery items, the other prominent banned SUPs, accounted for 23.62% of the total banned SUPs. Other SUPs like plastic flags, PVC banners and thermocol decorative items account for 8.6% of the total banned SUPs (by weight). The contribution of the rest of the banned SUPs was around 10%.

Table 1: Banned SUPs in the waste stream

Sl. no.	Banned SUPs	Percentage of total banned SUPs (%)
1	Plastic sticks	3.39
2	Carry bags	57.93
3	Plastic sheets	3.04
4	Cutlery items	23.62
5	Wrapping and film	3.42
6	Others	8.60

Note:

- Plastic sticks include earbuds, balloon sticks, candy sticks, ice-cream sticks, straws and stirrers
- Cutlery items include plates, trays, cups, glasses, spoons, forks and knives
- Wrapping and film include films on the sweet box, invitation card and cigarette packet
- Others include plastic flags, PVC banners (<100 µ) and thermocol decorations

2. Market Survey of Single-use Plastics

To assess the availability of banned SUP items and their alternatives within the municipal boundaries, a market survey was carried out in selected market areas in different zones, in the month of May and June 2022.

Table 2: Markets selected for the survey

Sl. No.	Zone	Market name
1	North	Maheshwara Layout,
2	South	Vidyaranyaपुरa, Kuvempu Nagara
3	East	Rajeev Nagar, Udayagiri circle
4	West	Saraswathi puram
5	Central	Mandi mohalla, Lokanayaka nagar circle

The survey covered 280 shops in four selected markets in Mysuru. The results are as provided below.

Figure 1: Sale of SUPs and alternatives in Mysuru

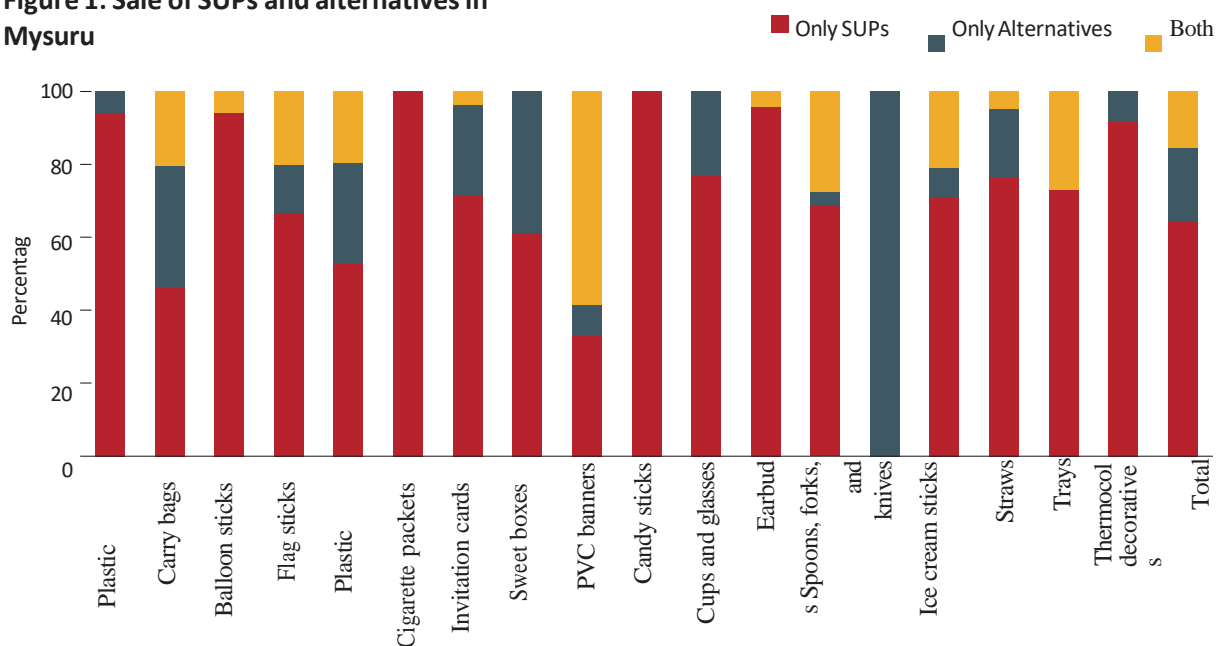


Table 3: Types of alternatives to SUPs in Mysuru

Banned SUP items	No. of alternatives available	Type 1	Type 2	Type 3	Type 4
Plastic sheets	2	Aluminium sheets	Banana leaves		
Plastic carry bags (<75 μ)	2	Paper Bags	Cloth bags		
Plastic balloon sticks	1	Wooden sticks			
Plastic flag sticks	3	Wooden sticks	Rubber sticks	Cloth stick	
Plastic flags	2	Cloth flags	Paper flags		
Plastic films on cigarette packets	0				
Plastic films on invitation cards	1	Paper cards without films			
Plastic films on sweet boxes	1	Cardboard/paper box without film			
PVC banners (<100 μ)	2	Cloth banners	Above 230 GSM		
Plastic candy sticks	0				
Plastic cups and glasses	2	Paper cups and glasses	Steel cups and glasses		
Plastic earbuds	1	Wooden earbuds			
Plastic spoons, forks and knives	2	Steel cutlery	Wooden cutlery		
Plastic ice-cream sticks	1	Wooden sticks			
Plastic plates	2	Ceramic plates, reusable plastic plates	Steel plates		
Plastic straws	1	Paper straws			
Plastic trays	1	Aluminium trays			
Thermocol decoratives	2	Paper décor			



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Surat

Surat is the second most populous city of Gujarat, which is situated on the bank of River Tapi. The Surat Municipal Corporation (SMC) is the administrative body in charge of civic amenities in the city and its municipal solid waste (MSW) management. SMC consists of 8 zones and 30 wards, with a total area of 461.6 sq km. The city is ranked second in the Swachh Survekshan ranking 2021, the Central government annual cleanliness survey. As per Census 2011, Surat Municipal Corporation had a population of 44.6 lakh; the estimated population for 2021 is over 57.3 lakh.

1. Single-use Plastic Waste Inventory

In Surat, the waste for inventory was collected from three residential areas, High-income residential (Vesu), Middle-income Residential areas (Bhatar), and Low-income residential areas (Dumas), and one from Mixed Commercial & Residential (Piplod), and one from Commercial areas (City Light) were chosen for taking the samples.

A sample from the dumpsite was also collected and characterised to assess the quantity of plastic and SUPs taken out for recycling/reuse.

The inventorisation study in Surat was conducted from 02 to 06 August 2022 at one of the Material Recovery Facility at Bhatar. The door to door collected waste, first goes to the MRF for resource recovery and then to the dumpsite at Khajod.

Results of inventory

Banned SUPs account for about 18% of the total plastic waste in Surat. The most common banned SUPs found in the waste stream are carry bags, accounting for more than 85% (by weight) of all the banned SUPs. Cutlery items, the other prominent banned SUPs, accounted for 10.8% of the total banned SUPs. The contribution of the rest of the banned SUPs was less than 4%.

Table 1: Banned SUPs in the waste stream

Sl. no.	Banned SUPs	Percentage of total banned SUPs (%)
1	Plastic sticks	1.57
2	Carry bags	85.91
3	Plastic sheets	0.40
4	Cutlery items	10.78
5	Wrapping and film	0.12
6	Others	1.22

Note:

- Plastic sticks include earbuds, balloon sticks, candy sticks, ice-cream sticks, straws and stirrers
- Cutlery items include plates, trays, cups, glasses, spoons, forks and knives
- Wrapping and film include films on the sweet box, invitation card and cigarette packet
- Others include plastic flags, PVC banners (<100 μ) and thermocol decorations

2. Market Survey of Single-use Plastics

To assess the availability of banned SUP items and its alternatives within the municipal boundaries, a market survey was carried out in selected market areas in different zones, in the month of August and September 2022.

Table 2: Markets selected for the survey

Sl. No.	Zone	Market name
1	North	Railway station and Chauta bazar
2	South	Sachin market and Vesu
3	East	Varacha and Hirabaug
4	West	Jahangirpura and Adajan

The survey covered 274 shops in total within these four selected markets in Surat. The results are as provided below.

Figure 1: Sale of SUPs and alternatives in Surat

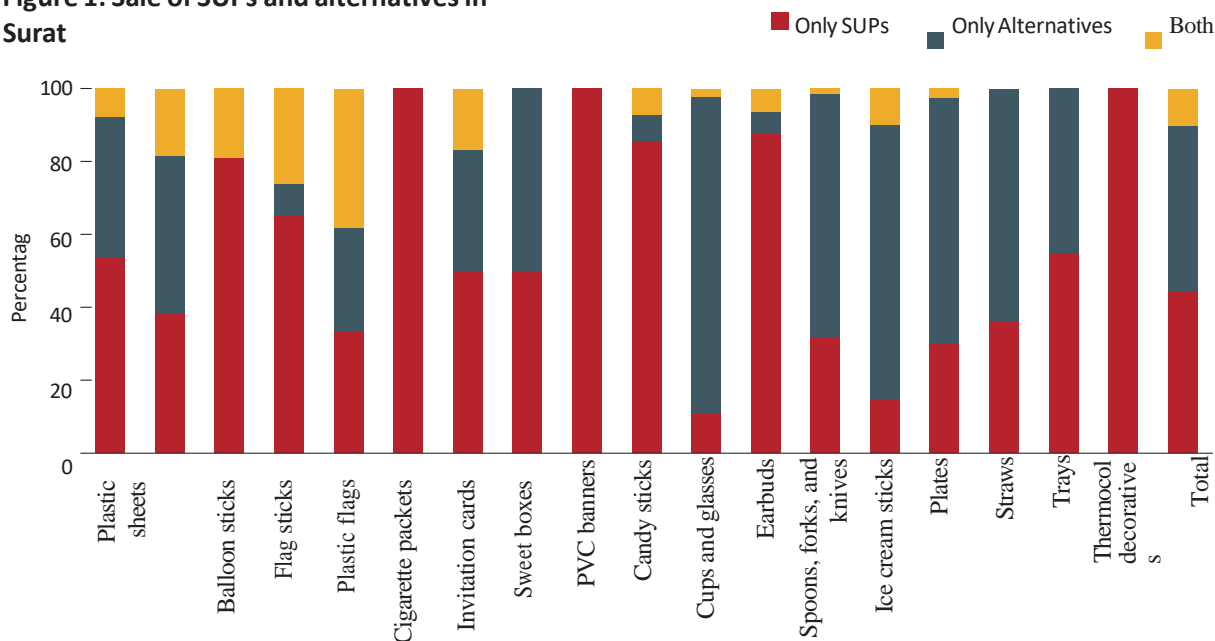


Table 3: Types of alternatives to SUPs in Surat

Banned SUP items	No. of alternatives available	Type 1	Type 2	Type 3	Type 4
Plastic sheets	2	Paper	Butter paper		
SUP carry bags (below 75 μ) available	4	Paper bag	Cloth Bag	>75 microns	Biodegradable bags
Plastic balloon sticks	1	thread			
Plastic flag sticks	1	Wooden stick			
Plastic flags	2	Paper	Cloth		
Wrapping/films on cigarette packets	0				
Plastic wrapping/films on invitation cards	1	Paper cards without any wrapping			
Wrapping/films on sweet boxes	2	Paper	Butter paper		
PVC banners below 100 μ	0				
SUP candy sticks	1	Wooden stick			
Cups and glassess	4	Glasses made of glass	Paper	Steel Glass	Ceramic
Earbuds	1	Wooden stick			
Spoons forks knives	2	Steel spoon, fork, knives	Wooden fork, spoon and knives		
Ice cream sticks	1	Wooden stick			
Plates	4	Steel plates	Paper plates	Ceramic	Aluminium foil
Straws	1	Paper straws			
SUP trays	2	wooden	Reusable tray		
Thermocol decorative	0				



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Tirupati

Tirupati city is located in the southeastern part of Andhra Pradesh. It falls under the Chittoor district of A.P and is situated at the foothills of the Eastern Ghats. The city is spread over an area of 27.44 sq km. It is located 550 kms from the capital city of A.P. The estimated population of the city in 2021 was 4.61 lakhs and a floating population of 1 lakh. There are 1,04,252 households and almost 10,000 commercial and industrial establishments in the city. The city is divided into 50 election wards in the municipality.

1. Single-use Plastic Waste Inventory

In Tirupati, the municipal waste samples were randomly collected from residential wards (Ward 5,6,8,13,14,19, 42, 43 and 47) and commercial wards (Ward 8, 10, 21, 28, 32, and 34). A high rate of source segregation was observed in Tirupati. Most of the vehicles collecting municipal waste were seen to be receiving segregated waste. Hence the inventory process was conducted on dry waste only.

A sample from the dumpsite was also collected and characterised to assess the quantity of plastic and SUPs taken out for recycling/reuse.

The inventorisation study in Tirupati was conducted from 30 June to 4 July 2022 at the Material Recovery Facility, since the town mostly collects segregated waste and all the waste is collected and send to this facility for resource recovery.

Results of inventory

Banned SUPs account for about 6.9% of the total plastic waste in Tirupati. The most common banned SUPs found in the waste stream are carry bags, accounting for more than 95.3% (by weight) of all the banned SUPs. Cutlery items, the other prominent banned SUPs, accounted for 2.6% of the total banned SUPs, which is relatively lower than most other cities of India. The contribution of the rest of the banned SUPs was less than 2%.

Table 1: Banned SUPs in the waste stream

Sl. no.	Banned SUPs	Percentage of total banned SUPs (%)
1	Plastic sticks	0.22
2	Carry bags	95.27
3	Plastic sheets	1.44
4	Cutlery items	2.62
5	Wrapping and film	0.18
6	Others	0.27

Note:

- Plastic sticks include earbuds, balloon sticks, candy sticks, ice-cream sticks, straws and stirrers
- Cutlery items include plates, trays, cups, glasses, spoons, forks and knives
- Wrapping and film include films on the sweet box, invitation card and cigarette packet
- Others include plastic flags, PVC banners (<100 µ) and thermocol decorations

2. Market Survey of Single-use Plastics

To assess the availability of banned SUP items and its alternatives within the municipal boundaries, a market survey was carried out in selected market areas in different zones, in the month of June and July 2022.

Table 2: Markets selected for the survey

Sl. No.	Zone	Market name
1	North	Anna Rao circle
2	South	Gandhi Road
3	East	Renigunta Road
4	West	S V Nagar

The survey covered 140 shops in total within these four selected markets in Tirupati. The results are as provided below.

Figure 1: Sale of SUPs and alternatives in Tirupati

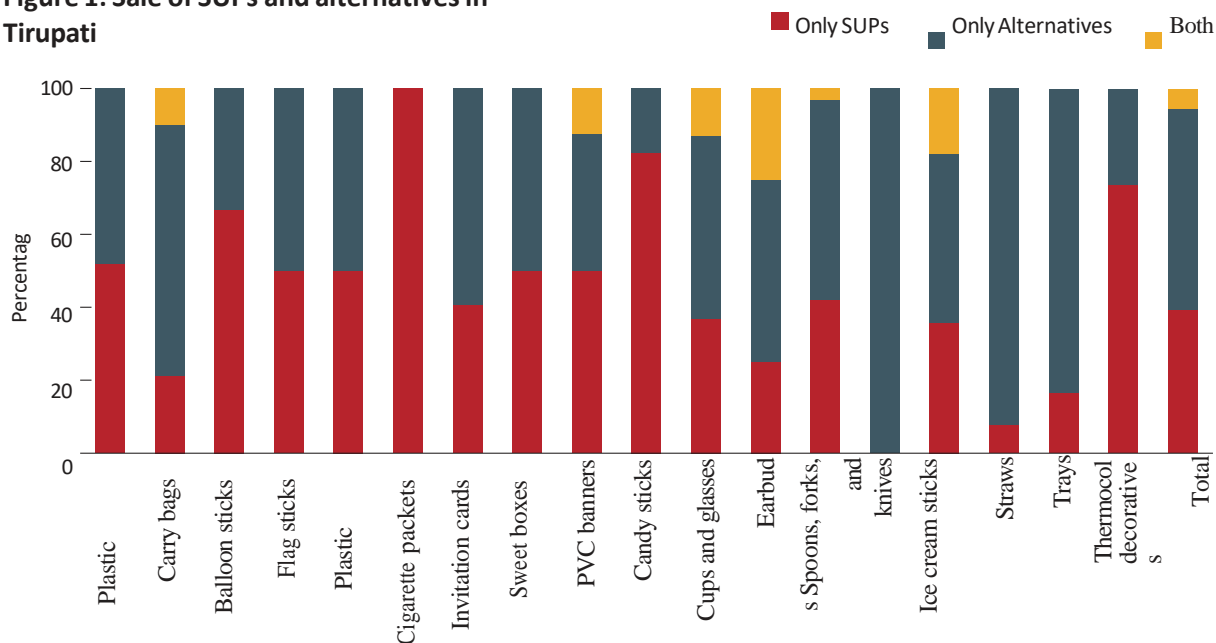


Table 3: Types of alternatives to SUPs in Tirupati

Banned SUP items	No. of alternatives available	Type 1	Type 2	Type 3
Plastic sheets	2	Silver Foil	Paper sheets	
Plastic carry bags (<75 μ)	3	Paper bags	Jute carry bags	Cloth bags
Plastic balloon sticks	1	Thread		
Plastic flag sticks	1	Paper stick		
Plastic flags	2	Cloth flags	Paper flags	
Plastic films on cigarette packets	0			
Plastic films on invitation cards	1	Paper card without films		
Plastic films on sweet boxes	1	Cardboard boxes		
PVC banners (<100 μ)	2	230 GSM	Cloth banners	
Plastic candy sticks	1	Paper sticks		
Plastic cups and glasses	2	Steel glasses	Paper glasses	
Plastic earbuds	1	Wooden earbuds		
Plastic spoons, forks and knives	2	Steel cutlery	Wooden spoons, forks and knives	
Plastic ice-cream sticks	1	Wooden sticks		
Plastic plates	3	Steel Plates	Reusable plastic plates	Paper plates
Plastic straws	1	Paper straws		
Plastic trays	2	Cardboard box/ trays	Aluminium trays	
Thermocol decorative items	2	Paper décor	Inflatable balloon décor	



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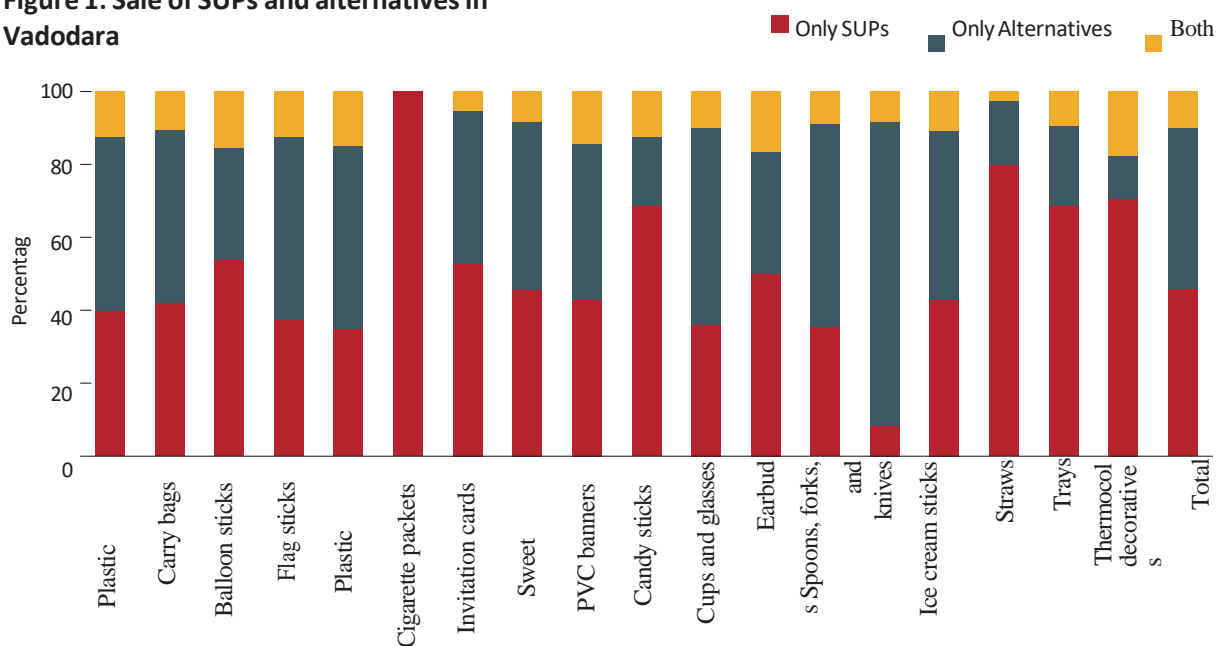
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Figure 1: Sale of SUPs and alternatives in Vadodara**Table 3: Types of alternatives to SUPs in Vadodara**

Banned SUP items	No. of alternatives available	Type 1	Type 2	Type 3	Type 4
Plastic sheets	2	Paper/ butter paper	Aluminium foil		
SUP carry bags (below 75 μ) available	4	Paper bag	Cloth Bag	>75 microns	Biodegradable bags
Plastic balloon sticks	1	thread			
Plastic flag sticks	1	Wooden stick			
Plastic flags	2	paper	Cloth		
Wrapping/films on cigarette packets	0				
Plastic wrapping/films on invitation cards	1	Paper cards without any wrapping			
Wrapping/films on sweet boxes	2	Paper	Butter paper		
PVC banners below 100 μ	1	Cloth banners			
SUP candy sticks	1	Wooden stick			
Cups and glassess	4	Glasses made of glass	Paper	Steel Glass	Ceramic
Earbuds	1	Wooden stick			
Spoons forks knives	2	Steel spoon, fork, knives	Wooden fork, spoon and knives		
Ice cream sticks	1	Wooden stick			
Plates	4	Steel plates	Paper plates	Ceramic	Aluminium foil
Straws	1	Paper straws			
SUP trays	2	Wooden	Reusable tray		
Thermocol decorative	1	paper			



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ANNEXURE IV

reporting is on the basis of wet weight, that is, the weight of materials immediately after sorting.

9.2.2 The mass fraction of component *i*, *mf_i*, is defined and computed as follows:

$$mf_i = \frac{w_i}{\sum_{i=1}^j w_i} \quad (2)$$

where:

w_i = weight of component *i* and

j = number of waste components.

In those cases in which a container is used to store and weigh the materials,

$$w_i = \text{gross weight} - \text{tare weight of container} \quad (3)$$

9.2.3 The percent of component *i*, *P_i*, is defined and computed as follows:

$$P_i = mf_i \times 100 \quad (4)$$

9.2.4 For the data analysis to be correct, the denominator of (Eq 2) must be unity, and

$$\sum_{i=1}^j P_i = 100 \quad (5)$$

9.3 The mean component composition for the one-week period is calculated using the component composition results from each of the analysis samples. The mean mass fraction of component *i*, \bar{mf}_i , is calculated as follows:

$$\bar{mf}_i = \frac{1}{n} \sum_{k=1}^n (mf)_k \quad (6)$$

and the mean percent of component *i*, *P_i*, is calculated as follows:

$$\bar{P}_i = \frac{1}{n} \sum_{k=1}^n (P)_k \quad (7)$$

where:

n = number of samples.

10. Precision and Bias

10.1 A precision and bias statement cannot be made for this test method at this time. However, the committee is interested in conducting an interlaboratory test program and encourages interested parties to contact ASTM Headquarters.²

11. Keywords

11.1 composition; municipal solid waste; waste characterization

² ASTM Headquarters, 1916 Race Street, Philadelphia, PA 19103.

APPENDIX

(Nonmandatory Information)

X1. EXAMPLE CALCULATION OF THE NUMBER OF SAMPLES FOR ANALYSIS

X1.1 Example Assumptions:

X1.1.1 Corrugated is selected as the governing component.

X1.1.2 A 90 % confidence level is selected.

X1.1.3 A precision of 10 % is desired.

X1.1.4 Therefore:

$$\begin{aligned} s &= 0.06 \text{ (from Table 3),} \\ x^- &= 0.14 \text{ (from Table 3),} \\ e &= 0.10, \text{ and} \\ t^*(n=\infty) &= 1.645 \text{ (from Table 4).} \end{aligned}$$

Using (Eq 1):

$$\begin{aligned} n &= [t^* \cdot s / (e \cdot x^-)]^2 \\ &= \frac{1.645 (0.06)}{0.1 (0.14)} \bigg|^2 \end{aligned}$$

$$\begin{aligned} &= 50 \\ &= n_o \end{aligned} \quad (X1.1)$$

Referring again to Table 4, for *n* = 50,

$$t^*_{90}(n = 50) = 1.677 \quad (X1.2)$$

and,

$$\begin{aligned} n &= \frac{1.677 (0.06)}{0.1 (0.14)} \bigg|^2 \\ &= 52 \\ &= n_8 \end{aligned} \quad (X1.3)$$

Since 52 (that is, *n₈*) is within 10 % of 50 (that is, *n_o*), 52 samples should be selected for analysis.



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ANNEXURE V

Determination of Sorting Sample size, number of vehicle loads, Vehicle load size and no. of days for sampling

The first step in characterization of the waste is to fix the sorting sample size, vehicle load size, number of vehicle loads to be sampled (n) duration of sampling (k). As per ASTM D 5231-92 (hereafter referred to as Standard) , sorting samples size should be in the range of 91-136 kg. Weekly sampling period (k) has been specified in the range of 5-7 days in the Standard. Further, vehicle load size should be at least four times the desired weight of the sorting sample size.

Further as per the ASTM standard (Section 9)

$$n=(t*s/(e*x))^2$$

Where,

- s : Estimated standard deviation = 0.03 for Plastic (Table 3 of the Standard)
- x : Estimated mean= 0.09 for Plastic (Table 3 of the Standard)
- e : Desired level of precision (If desired level of Precision is 10% then e=0.1)
- t : Student t statistic corresponding to the desired level of confidence is calculated as per Table 4 of the ASTM standards

“n” is calculated using iteration method as per the Standard. An example illustrating the same is given below

$$s = 0.03$$

$$e = 0.10$$

$$x = 0.09$$

t (For $n=\infty$ and Confidence level = 90% = 1.645 (from Table 4 of the Standard)

$$n'=(t*s/(e*x))^2=30$$

For $n' = 30$; $t' = 1.699$ (for Confidence level= 0.9) (from Table 4 of the Standard)

$$n = ((1.645 * 0.03) / (0.1 * 0.09))^2 = 32$$

Hence, number of vehicle load should vary between 30-32 as determined by the aforementioned calculations. However, the volume of waste generated in a city is subject to variations influenced by factors such as population density, geographic location, the sampling and analysis capabilities of the local governing body, and others. The computation of the number of vehicle loads is adjusted based on the need for a higher confidence level and lower precision level, especially in the case of larger cities.

ANNEXURE VI

Example 1: Distribution of Sample Location (Refer Section 2.2)

In a city (XYZ) with a population of approx. from 5,01,500 a dynamic urban landscape unfolds where the majority of residents belong to the middle-income group. Apart from residential areas there are few slum areas within the city, one old temple working as tourist spot for the city and some market hubs including wholesale and retail shops. To efficiently manage the generated waste, Nagar Nigam has signed an MOU with waste management agency. All generated waste is collected by Nagar nigam from various dhalauns and localized waste collection points and being transported to MRF facility installed by Waste Management Agency. Recyclable material are manually separated and remaining is being sent to the only available disposal site of the city.

Key points of above description:

- Population between 100000 to 999999
- Majority of the people are middle income group and no high income groups
- All the waste generated in the city is being transported to the one disposal site
- One Material recover facility are installed
- There are multiple dhalaun and collection points near by the various wards to collect waste.

Step one: Determination of parameter for waste Characterization

As per Table 1 of SOP following parameter can be determining

- No. of Vehicle to be sampled (n): 45
- Duration of sampling (No of Days) (k): 6
- Vehicle load size: 480 kg
- Sorting Sample size: 120 kg

Step Two: Distribution of the sampling locations

City area is divided into four zones East, West, North & South and subsequently various wards in the zone are divided into Middle-income residential wards, Economically Weaker Section (EWS) residential wards/slums and Commercial

wards (Market Area) and others. In addition, one disposal point is also identified in each Zone. Location distribution is given below:

Table 1: Sample location distribution

Day	Zone 1					Zone 2					Zone 3					Zone 4					Total
	M I	EW S	C W	M X	D S	M I	EW S	C W	M X	D S	M I	EW S	C W	M X	D S	M I	EW S	C W	M X	D S	
1	1	0	0	0	1	0	1	0	0	1	0	0	1	0	1	0	0	0	1	1	8
2	0	1	0	0	1	0	0	1	0	1	0	0		1	1	1	0	0	0	1	8
3	0	0	1	0	1	0	0	0	1	1	0	1	0	0	1	0	1	0	0	1	8
4	0	0	0	1	1	1	0	0	0	1	1	0	0	0	1	0	0	1	0	1	8
5	0	0	0	0	1	0	1	0	0	1	0	0	1	0	1	0	0	0	1	1	7
6	0	1	0	0	1	0	0	0	0	1	0	0		0	1	1	0	0	0	1	6
Total	1	2	1	1	6	1	2	1	1	6	1	1	2	1	6	2	1	1	2	6	
																					45

Middle-income residential wards: MI

Economically Weaker Section (EWS) residential wards/slums: EWS

Commercial wards (Market Area): CW

Mixed commercial and residential wards: Mx

Disposal Point: DS

The sample is required to be collected at waste generation points excluding the one to be collected at the Disposal point.

Note: In the absence of predefined economic distinctions in a town, the allocation of wards was determined by the predominant socio-economic nature of the areas. For instance, if a ward has more than 50% high-income residences, it is designated as a high-income ward. Conversely, if a ward has over 50% low-income residents, it is categorized as a low-income ward, and so forth. Vehicles from these identified categories may be selected.

Step 3: Sample collection and Sample preparation

Sample collection: Vehicles collecting waste from each socio-economic strata of each zone to be identified. Every day, select vehicles randomly from each socio-economic strata of each zone. Make sure that the waste collectors are not removing valuable plastics/ dry wastes beforehand.

Sample preparation: The entire vehicle load of waste i.e 480 Kgs should be discharged in a designated area. Use the Quartering and coning method to reduce the size of the shorting sample to 120 kg.

Waste characterisation:

First waste should be characterise into two categories Plastic waste and others Subsequently The total plastic waste be sorted and weighed into 4 categories, as per the EPR guidelines. Each sub-category should be weighed and registered in the data sheet as given below:

**Table 2A: Plastic Waste characterization (Plastic Packaging category wise) :
Generation points**

Vehicle Load No. (1)	Sorting Sample Size (Kg) (2)	Total PW(Kg) (3)	Category 1 PW (kg) (4)	Category 2 PW (kg)(5)	Category 3 PW (kg) (6)	Category 4 PW (kg) (7)
1	120	10	2	4	2.5	0
2	120	8	1.5	2	2	0.05
3	120	9	1.5	3	1	0.02
4	120	10	1.7	2.5	1.5	0.01
5	120	9	1.5	3	1	0
6	120	7	1	2	1	0.03
7	120	8.5	2	2	1.5	0
8	120	9	1	3	2	0.005
9	120	8	1.5	2	1.5	0
10	120	7	1	2	1.5	0.02
11	120	6.5	1	2	0.8	0
12	120	10	3	2	1	0.02
13	120	9	1.5	4	1	0.02

Vehicle Load No. (1)	Sorting Sample Size (Kg) (2)	Total PW(Kg) (3)	Category 1 PW (kg) (4)	Category 2 PW (kg)(5)	Category 3 PW (kg) (6)	Category 4 PW (kg) (7)
14	120	10	1.7	4	1.5	0.01
15	120	9.5	1.5	3	1	0
16	120	8.5	1	2	1	0.03
17	120	10	2	2	2	0
18	120	9	1	3	2	0.005
19	120	11	2.5	3	2	0
20	120	7	1	2	1.5	0.02
21	120	8	1	2	1.5	0
	2520	184	31.9	54.5	30.8	0.24

Table 2B: **Plastic Waste characterization (Plastic Packaging category wise) :**
Disposal points

Vehicle Load No. (1)	Sorting Sample Size (Kg) (2)	Total PW(Kg) (3)	Category 1 PW (kg) (4)	Category 2 PW (kg)(5)	Category 3 PW (kg) (6)	Category 4 PW (kg) (7)
1	120	6	0.5	2	2	0.01
2	120	7	0.25	3	1	0
3	120	6.5	0.7	1	1	0
4	120	7	1	0.5	1	0.001
5	120	7.1	0.5	1	0.5	0
6	120	6.8	0.75	1.5	0.5	0
7	120	6	0.5	2	2	0.01
8	120	7	0.25	3	1	0
9	120	6.5	0.7	1	1	0
10	120	7	1	0.5	1	0.001
11	120	7.1	0.5	1	0.5	0

Vehicle Load No. (1)	Sorting Sample Size (Kg) (2)	Total PW(Kg) (3)	Category 1 PW (kg) (4)	Category 2 PW (kg)(5)	Category 3 PW (kg) (6)	Category 4 PW (kg) (7)
12	120	6.8	0.75	1.5	0.5	0
13	120	6	0.5	2	2	0.01
14	120	7	0.25	3	1	0
15	120	6.5	0.7	1	1	0
16	120	7	1	0.5	1	0.001
17	120	7.1	0.5	1	0.5	0
18	120	6.8	0.75	1.5	0.5	0
19	120	6	0.5	2	2	0.01
20	120	7	0.25	3	1	0
21	120	6.5	0.7	1	1	0
22	120	7	1	0.5	1	0.001
23	120	7.1	0.5	1	0.5	0
24	120	6.8	0.75	1.5	0.5	0
	2880	161.6	14.8	36	24	0.044

Banned SUPs waste sorting

The total plastic waste also to be sorted into all the 20 banned SUP products and should be weighed and registered in the data sheet as given below:

Table 3A : **Plastic waste characterization (Single Use Plastic) – Generation point**

	Vehicle Load No. 1(kg)	Vehicle Load No 2(kg)	VL3	...VL21	Total	Average Kg/Kg of waste
Sorting Sample Size (kg)	120	120	120	120	2520	

	Vehicle Load No. 1(kg)	Vehicle Load No 2(kg)	VL3	...VL21	Total	Average Kg/Kg of waste
Plastic Waste (kg)	10	8	9	8	184	0.07302
SUPs					0	0.00000
Earbuds(kg)	0.0001	0.0002	0	0.0001	0.00185	0.00000
Balloons(kg)	0.001	0	0	0.001	0.006	0.00000
Candy(kg)	0.01	0	0	0.01	0.061	0.00002
Ice-cream(kg)	0.02	0.01	0	0.02	0.17	0.00007
Straws(kg)	0.15	0.14	0.1	0.15	2.65	0.00105
Plates(kg)	0.2	0.18	0.2	0.2	4	0.00159
Cups(kg)	0.21	0.15	0.1	0.21	3.31	0.00131
Glass(kg)	0.17	0.15	0.2	0.17	3.42	0.00136
Forks(kg)	0.1	0.05	0.1	0.1	1.45	0.00058
Spoons(kg)	0.08	0.07	0.1	0.08	1.23	0.00049
Knives(kg)	0.05	0.03	0	0.05	0.6	0.00024
Trays(kg)	0.02	0.015	0	0.02	0.315	0.00013
Sweet box(kg)	0.001	0	0	0.001	0.01	0.00000
Invitation (kg) cards	0.0001	0	0	0.0001	0.0006	0.00000
Cigarette (kg) Packets	0.002	0.001	0	0.002	0.027	0.00001
<120 microns(kg)	1.5	1.2	1	1.5	25	0.00992

	Vehicle Load No. 1(kg)	Vehicle Load No 2(kg)	VL3	...VL21	Total	Average Kg/Kg of waste
<50 microns(kg)	1	0.8	1.1	1	21	0.00833
Plastic flags(kg)	0.0001	0.0002	0	0.0001	0.0016	0.00000
PVC banners < 100 µm,	0.001	0	0	0.001	0.006	0.00000
polystyrene for decoration(kg)	0.02	0.01	0	0	0.19	0.00008
	3.5353	2.80635	2.88	3.5153	63.44905	

Table 3B : Plastic waste characterization (Single Use Plastic) – Disposal point

	Vehicle Load No. 1(kg)	Vehicle Load No 2(kg)	VL 3	..VL24	Total	Average Kg/Kg of waste
Sorting Sample Size (kg)	120	120	120	120	2880	0.0561
Plastic Waste (kg)	6	7	6.5	6.8	161.6	0.0000
SUPs						
Earbuds(kg)	0.0001	0.0002	0	0.00012	0.00222	0.0000
Balloons(kg)	0.0002	0	0.001	0.0001	0.0078	0.0000
Candy(kg)	0.005	0	0.0001	0.001	0.0366	0.0001

	Vehicle Load No. 1(kg)	Vehicle Load No 2(kg)	VL 3	..VL24	Total	Average Kg/Kg of waste
Ice-cream(kg)	0.01	0.015	0	0.015	0.24	0.0010
Straws(kg)	0.15	0.14	0.1	0.09	2.88	0.0012
Plates(kg)	0.12	0.18	0.15	0.14	3.54	0.0013
Cups(kg)	0.18	0.15	0.12	0.15	3.6	0.0010
Glass(kg)	0.11	0.14	0.15	0.1	3	0.0005
Forks(kg)	0.05	0.05	0.05	0.07	1.32	0.0005
Spoons(kg)	0.08	0.07	0.03	0.08	1.56	0.0003
Knives(kg)	0.05	0.03	0.01	0.05	0.84	0.0001
Trays(kg)	0.01	0.015	0.012	0.01	0.282	0.0000
Sweet box(kg)	0.001	0	0.0002	0.001	0.0132	0.0000
Invitation (kg) cards	0.0001	0	0	1E-04	0.0012	0.0000
Cigarette (kg) Packets	0.0001	0.0002	0.0001	1E-04	0.003	0.0095
<120 microns(kg)	1.2	1.1	1	1.25	27.3	0.0076
<50 microns(kg)	0.7	0.8	1.15	1	21.9	0.0000
Plastic flags(kg)	0.0001	0	0	1E-04	0.0012	0.0000
PVC banners < 100 µm,	0.0001	0	0	1E-04	0.0012	0.0000

	Vehicle Load No. 1(kg)	Vehicle Load No. 2(kg)	VL 3	..VL24	Total	Average Kg/Kg of waste
polystyrene for decoration(kg)	0.002	0.001	0.001	0	0.024	0.0231
	2.6687	2.69135	2.7744	2.95762	66.55242	0.0561

Step 4.: Assessment of Plastic Waste is given below:

1. Quantity of Plastic Waste Generation

Average quantity of plastic waste generated (kg of plastic waste/ kg of mixed waste) (data sheet at Table 2A & Table 3A)

$$Q1 = (\sum \text{Row 1b}) / (\sum \text{Row 1a})$$

OR

$$Q1 = (\sum \text{Column 3}) / (\sum \text{Column 2})$$

$$= (184/2520)$$

Considering Quantity of Mixed Waste generated in the town (TPA) (Q)

$$= 1,50,000 \text{ Tons per annum}$$

Quantity of Plastic Waste Generated (TPA) (Q_T)

$$= Q1 * Q = 1,50,000 \times (184/2520)$$

$$= 10,952.3 \text{ Ton per Annum}$$

2. Quantity of Plastic Packaging Waste Generation

- Average quantity of plastic packaging waste generated (kg of plastic packaging waste / kg of mixed waste)

$$(Q2) = (\sum (\text{Column 4}) + \sum (\text{Column 5}) + \sum (\text{Column 6}) + \sum (\text{Column 7})) / (\sum (\text{Column 2}))$$

(data sheet at Table 2A)

$$= (31.9 + 54.5 + 30 + 0.24) / 2520$$

$$= 116.64/2520$$

$$= 0.0462$$

- Quantity of Mixed Waste generated (TPA) = 1,50,000 Tons per annum
- Quantity of Plastic Packaging Waste Generated (Q_{pack})(TPA)
 - = 0.0419×150000
 - = 6942.8 Tons per Annum

3. Quantity of SUP Waste Generation

- Average quantity of SUP waste generated (SUP in kg / kg of mixed waste)
 - $(Q_3) = (\sum (\text{Row } 2a... 7c) / (\sum (\text{Row } 1a) (\text{data sheet Table } 3A))$
 - $Q_3 = 66.55/2520$
 - = 0.0264
- Quantity of Mixed Waste generated (TPA) = 1,50,000 tons per annum
- Quantity of Plastic Packaging Waste Generated (TPA) (Q_{SUP}) = $Q_3 \times Q$
 - = 3961.3 tons per annum

4. Quantity of Other (Non-packaging waste)

$$Q_{\text{other}} = Q_T - Q_{\text{pack}}$$

$$= 150,000 - 10,952.3$$

$$= 1,39,048 \text{ tons per annum}$$

5. Quantity of Plastic Waste Disposed

- Average quantity of plastic waste generated (kg of plastic waste/ kg of mixed waste)
 - $Q_{1d} = (\sum \text{Column } 3) / (\sum \text{Column } 2) - \text{refer Table } 2B$
 - OR
 - $Q_{1d} = (\sum \text{Row } 1b) / (\sum \text{Row } 1a) - \text{refer Table } 3B$
 - = (115/2880)
- Considering Quantity of Mixed Waste Disposed (TPA) (Q_D)= 50,000 Tons per annum
- Quantity of Plastic Waste Disposed (TPA) (Q_{TD}) = $Q_{1d} \times Q_D$
 - = $50,000 \times (184/2520)$
 - = 1996.5 Ton per Annum

6. Quantity of Plastic Packaging Waste Disposed

- Average quantity of plastic packaging waste Disposed (kg of plastic packaging waste / kg of mixed waste)

$$(Q_{2d}) = (\sum (\text{Column 4}) + \sum (\text{Column 5}) + \sum (\text{Column 6}) + \sum (\text{Column 7})) / (\sum (\text{Column 2})) \text{--- (refer Table 2B)}$$

$$= (14.8+36 + 24 +0.044)/ 2880$$

$$= 74.88/2880$$

$$= 0.0259$$

- Quantity of Mixed Waste Disposed (TPA) $Q_{D}= 50,000$
- Quantity of Plastic Packaging Waste Disposed ($Q_{\text{pack D}}$)(TPA) = $Q_{2d} * Q_{D}$
=1299.37 Tonnes per Annum

7. Quantity of SUP Waste at Disposal

- Average quantity of SUP waste at Disposal (SUP in kg / kg of mixed waste)

$$(Q_{3d}) = (\sum (\text{Row 2a... 7c}) / (\sum (\text{Row 1a})) \text{--- (refer Table 3B)}$$

$$= 66.552/2880$$

$$=0.0231$$

- Quantity of Mixed Waste Disposed (TPA) = 50, 000 Ton per Annum
- Quantity of SUP Waste Disposed (TPA) ($Q_{\text{SUP}D}$) = $Q_{3d} * Q_{D}$
=0.0231 x 50,000= 1155.41 Ton per Annum

8. Quantity of Other (Non-packaging waste) Disposed

$$Q_{\text{other D}} = Q_{TD} - Q_{\text{pack D}}$$

$$= 50,000 - 1996.5$$

$$=48844.5 \text{ tons per Annum}$$

9. Quantity of Plastic waste Utilised/Processed

$$Q_{\text{ utilised/processed}} = Q_{T} - Q_{TD}$$

$$= 10,952.3 - 1996.5$$

$$= 8955.5 \text{ Tons per Annum}$$

ANNEXURE VII

Quick Verification Test to distinguish Compostable Plastics from Conventional Plastics

S No	Experiment	Observation	Inference
1	Take Dichloromethane (DCM) in test tube. Dissolve 2x2 cm film sample or few granules in Dichloromethane (DCM)	Dissolution of samples*	Confirm the presence of PLA and PBAT. PE and PP will not undergo dissolution.
2	Dissolve 2x2 cm film sample or few granules in boiled xylene	Dissolution of samples.	Confirm the presence of PE and PP. PLA and PBAT will not undergo dissolution.
3	Immerse few granules of sample in distilled water at ambient temperature	Float/Sink	Samples made from PLA and PBAT will sink and samples made from PE and PP will float on water.

***Note:**



- Styrene based polymers undergo dissolution in DCM and may appear as compostable plastics. Dense black smoke with soot in air will be observed on burning of Styrene based samples. In addition to that, identification by FTIR & DSC shall be carried out for confirmation of Styrene based polymers.
- The film sample containing starch and other additives may not undergo complete dissolution in DCM.

ANNEXURE VIII









Plastic packaging and SUP References





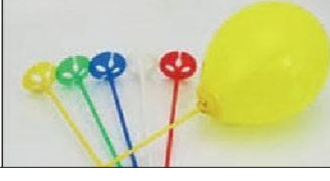



A. Plastic Packaging

Category	Plastic type	Description	Examples	Representative pictures
Category -1	Rigid	The packaging which are rigid in nature	Soft drink bottles. Water bottles (PET) & juice bottles Transportable & storage-able Food containers, Shampoo bottles Plastic containers for cooking oil, vinegar, sauces, pickles. Clamshell packaging for fruits, vegetable & etc.	
Category -2	Flexible	Flexible plastic packaging of single layer or multilayer (more than one layer with different types of plastic), plastic sheets or like and covers made of plastic sheet, carry bags, plastic sachet or pouches	Plastic Carry bag, Plastic sheet Plastic grocery bags, wrap/cling film, shrink film, Plastic packaging for toiletries (shampoo sachets, lotion pouches), rozen foods (freezer bags, plastic film on frozen food trays) Plastic packaging for medical supplies (sterile pouches, medication blister packs) Plastic packaging for electronic devices (bubble wrap, anti-static bags) Plastic packaging for clothing (garment bags, polyethylene garment covers) Plastic packaging for pharmaceuticals (pill packets, blister packs) Plastic packaging for toys (toy packaging, bubble wrap) Plastic packaging for stationery items (pencil case, document pouches)	

<p>Category -3</p>	<p>Multi layer</p>	<p>Multilayered plastic packaging (at least one layer of plastic and at least one layer of material other than plastic)</p>	<p>Milk products & juice storage boxes such as fruiti Packets of biscuit, namkeen mixture, chips, kurkure etc. & other multilayer packaging.</p>	
<p>Category -4</p>	<p>Compostable</p>	<p>Plastic sheet or like used for packaging as well as carry bags made of compostable plastics</p>	<p>Compostable shopping bags, food packaging, sheets and others</p>	

B. Single-Use Plastic

Product	
1. Plastic Earbuds	
2. Plastic sheets below 50 microns	
3. Carry bags below 120 microns	
4. Plastic cutlery (spoons, forks)	
5. Straws	
6. Plastic plates, cups, glasses	
7. SUP knives (mostly used for cake cutting)	
8. SUP Trays	

Product	
9. Wrappings on Invitation cards	
10. Thermocol decorative items	
11. Wrapping on sweet boxes (Plasticsheet wrapped on sweet boxes/fruit baskets)	
12. Wrapping/Films on cigarette packets	
13. Plastic Balloon sticks	
14. Plastic stirrers	
15. Plastic Flags	
16. Plastic Candy sticks	



केन्द्रीय प्रदूषण नियंत्रण बोर्ड
CENTRAL POLLUTION CONTROL BOARD
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार
MINISTRY OF ENVIRONMENT, FOREST & CLIMATE CHANGE, GOVT. OF INDIA

File No. CP-20/117/2021-UPC-II-HO-CPCB-HO-Part(7)

Date: ०५-07-2024

To,

The Chairman
All SPCBs/PCCs

Sub: - Direction under Section 5 of the EPA, 1986 regarding Characterization & Assessment of Plastic Waste by Local Bodies, District Panchayats, SPCBs & PCCs as per methodology developed by CPCB

Whereas, the Ministry of Environment, Forest & Climate Change (MoEF&CC) notified the PWM Rules, 2016, in exercise of the powers conferred under section 3,6, & 25 of the Environmental (Protection) Act, 1986 Vide Notification No. G.S.R. 320 (E) dated March 27, 2016; and

Whereas, MoEF&CC, vide Notification dated August 12, 2021 banned identified SUP items and prescribed minimum thickness of carry bag with effect from July 01, 2022; and

Whereas, as per Rule 4(2) of PWM Rules, 2016 (as amended), *"The manufacture, import, **stocking, distribution, sale and use** of following single use plastic (SUP), including polystyrene and expanded polystyrene, commodities shall be prohibited with effect from the 1st July, 2022:*

- (a) *Ear buds with plastic sticks, plastic sticks for balloons, plastic flags, candy sticks, ice-cream sticks, polystyrene [Thermocol] for decoration.*
- (b) *Plates, cups, glasses, cutlery such as forks, spoons, knives, straw, trays, wrapping or packing films around sweet boxes, invitation cards, and cigarette packets, plastic or PVC banners less than 100 micron, stirrers; and*

Whereas, as per Rules 4(1)(c) of PWM Rules, 2016 (as amended), *"Carry bag made of virgin or recycled plastic, shall not be less seventy-five microns in thickness with effect from the 30th September, 2021 and one hundred and twenty (120) microns in thickness with effect from 31st December, 2022"; and*

Whereas, as per Rule 4(1)(d) of the PWM Rules, *"plastic sheet or like, which is not an integral part of multi-layered packaging and cover made of plastic sheet used for packaging, wrapping the commodity shall not be less than fifty microns in thickness except where the thickness of such plastic sheets impairs the functionality of the product"; and*

‘परिवेश भवन’ पूर्वी अर्जुन नगर, दिल्ली-110032

Parivesh Bhawan, East Arjun Nagar, New Delhi - 110032

दूरभाष/Tel: 43102030, 22305792, वेबसाइट/Website : www.cpcb.nic.in

Whereas, Guidelines on Extended Producer Responsibility for Plastic Packaging and commodities made from compostable plastics or biodegradable plastics were notified by MoEF&CC on February 16, 2022 in Schedule – II of 4th amendment of Plastic Waste Management Rules, 2018 (as amended); and

Whereas, as per Provision 5.1 of the Schedule-II of PWM Rules (as amended), "The following plastic packaging categories are covered under Extended Producer Responsibility:

- i. Category I: Rigid plastic packaging;
- ii. Category II: Flexible plastic packaging of single layer or multilayer (more than one layer with different types of plastic), plastic sheets or like and covers made of plastic sheet, carry bags, plastic sachet or pouches;
- iii. Category III: Multi-layered plastic packaging (at least one layer of plastic and at least one layer of material other than plastic);
- iv. Category IV: Plastic sheet or like used for packaging as well as carry bags & commodities made of compostable plastics;
- v. Category V: Plastic sheet or like used for packaging as well as carry bags and commodities made of biodegradable plastics"; and

Whereas, as per Rule 6(5) of PWM Rules, 2018 (as amended), "The local body shall undertake assessment of plastic waste generated, including plastic waste existing in dump sites, by the 30th June of every year and also estimate the quantity of plastic waste to be generated in following five-year period"; and

Whereas, as per Rule 6(8) of PWM Rules, 2018 (as amended), "The local body shall include in the annual report the following details on plastic waste management, namely: -

- i. Plastic waste generated, including plastic waste existing in dump sites, in a year;
- ii. Plastic waste management infrastructure available for collection, segregation, processing;
- iii. Projection of plastic waste to be generated;
- iv. Status on framing and implementation on byelaws;
- v. Actions taken action to prevent stocking, distribution, sale and usage of prohibited Single Use Plastic items"; and

Whereas, as per Rule 7A(1) of PWM Rules, 2018 (as amended), "The Panchayat at District level shall undertake assessment of plastic waste generated, including plastic waste existing at dump sites, by the 30th June of every year for rural areas of the district and also estimate the quantity of plastic waste to be generated in following five-year period"; and

Whereas, as per Rule 7A(3) of PWM Rules, 2018 (as amended), "The Panchayat at District Level shall include in the annual report the following details on plastic waste management, namely: -

- i. Plastic waste generated, including plastic waste existing at dump sites, in a year;

- ii. *Plastic waste management infrastructure available for collection, segregation, processing;*
- iii. *Projection of plastic waste to be generated;*
- iv. *Status on framing and implementation on byelaws;*
- v. *Actions taken action to prevent stocking, distribution, sale and usage of banned Single Use Plastic items"; and*

Whereas, as per Rule 17 (4) of PWM Rules, 2018 (as amended), "Every urban local body and Panchayat at District Level shall prepare and submit online an annual report in Form -V (A & B) to the Urban Development Department and to Rural Development Department, respectively, and also to the State Pollution Control Board or Pollution Control Committee concerned by the 30th June every year"; and

Whereas, as per Rule 17 (6) of PWM Rules, 2018 (as amended), "The State Pollution Control Board or Pollution Control Committee shall prepare and submit online an annual report in Form VI to the Central Pollution Control Board on the implementation of these rules by the 31st July of every year"; and

Whereas, as per the aforementioned formats for filing Annual Reports, Assessment & Characterization of plastic waste by the Local Bodies, District level Panchayats, SPCBs & PCCs, is to be carried out as per methodology developed by CPCB; and

Whereas, CPCB had prepared draft Standing Operating Procedure (SOP) for assessment of quantity of plastic waste generated and its characterization, with a focus on Single Use Plastic and Categories of Plastic Packaging as per the PWM Rules; and

Whereas, the draft Standard Operating Procedure (SOP) prepared by the Central Pollution Control Board (CPCB) was circulated during the period February 11, 2024 to March 12, 2024 for comments; and

Whereas, the SOP has been finalised incorporating the comments and suggestions from various stakeholders. The same is enclosed at **Annexure-I** and is also available at CPCB's website (https://cpcb.nic.in/uploads/plasticwaste/SOP_PWM_24062024.pdf); and

Now, therefore, in view of the above direction and in exercise of powers vested under Section 5 of Environment (Protection) Act, 1986 to the Chairman CPCB, following directions are issued for compliance:

1. To direct the Local Bodies and District Panchayats in your jurisdiction to carry out Assessment & Characterization of plastic waste for the purpose of reporting in the Annual Report, as per provision of PWM Rules, in accordance with the SOP for Assessment & Characterization of Plastic Waste developed by CPCB.

-4-

2. To provide necessary assistance & impart training to the Local Bodies and District Panchayats for implementation of Point (1) above.
3. To carry out assessment & characterization of plastic waste in at least two Local Bodies and District Panchayat in association with the concerned Authorities.
4. To monitor the implementation of this SOP by the concerned stakeholders in your jurisdiction.
5. To validate the data submitted by the Local Bodies and District Panchayats as per the methodology stipulated in the SOP.
6. To carry out Assessment & Characterization of plastic waste in your jurisdiction for the purpose of reporting in the Annual Report, as per provision of PWM Rules, in accordance with the methodology stipulated in the SOP.

You are hereby directed to take necessary action for compliance of aforesaid Directions and submit Action Taken Report to this office within 15 days of issuance of the Direction.

13/4/2
 ✓ (Tanmay Kumar)
 Chairman *Dy*

Copy to:

1. Shri Naresh Pal Gangwar : For kind information, please
 Additional Secretary,
 Ministry of Environment, Forest and
 Climate Change,
 Indira Paryavaran Bhawan,
 Jorbagh Road, New Delhi – 110 003
2. The Regional Director : For follow up with concerned
 All CPCB Regional Directorates SPCB/PCCs in your
 jurisdiction, please
3. DH-IT, CPCB : For uploading a copy of
 these directions on CPCB
 website, please

Dy
 ✓ Bharat Kumar Sharma
 Member Secretary

o/c

**Tamil Nadu Pollution Control Board**

From
Er. Y. Beulah, M. E.,
District Environmental Engineer(a/c),
Tamilnadu Pollution Control Board,
Coimbatore South,
Plot No. E-55A, SIDCO Industrial Estate,
Pollachi Main Road,
Kuvichi, Coimbatore - 641 021.

To
The Member Secretary,
Tamilnadu Pollution Control Board,
76, MountSalai,
Guindy,
Chennai - 32

Letter No.F. NGT(SZ)-OA.295-2024/DEE/TNPPCB/CBS/2025 Dated:24.01.2025

Respected Sir,

Sub : TNPC Board - O/o. DEE, Coimbatore South – The SUO-MOTU proceedings initiated by Hon'ble NGT (PB) in O.A NO.1186 OF 2024 based on the news published in "THE HINDU" dated 08.09.2024 titled: "lake developed under smart cities initiative in Coimbatore turn dumping grounds for plastic waste" -- additional details requested- report submitted – Reg;

- Ref :** 1. NGT (PB) O.A.No.1186 OF 2024.
2. NGT (PB) O.A.No.1186 OF 2024 renumbered as NGT (SZ) O.A. No. 295 of 2024.
3. Inspection of Lake developed under Smart Cities Initiative in Coimbatore by the officials of TNPCB, CBS on 20.11.2024
4. CPCB Lr. F. No. Tech/02/Legal (TN)/RDC/2024-25/792 dated: 03.12.2024
5. Lr. No. F. NGT(SZ) -OA.295-2024/DEE/TNPPCB/CBS/2024-1 Dated:04.12.2024
6. Email received from the CPCB dated: 22.01.2025

I submit to state that, vide reference 1st cited above the Hon'ble NGT (PB) has initiated a Suo Motu proceedings based on the News published in "The Hindu" dated 08.09.2024 titled: "Lake developed under Smart Cities Initiative in Coimbatore turn dumping grounds for plastic waste" which is related to the grim situation of lakes in Coimbatore that were developed as part of the Smart Cities initiative that have unfortunately become dumping grounds for plastic waste. As per the news item, this includes items like packaged drinking water bottles, snack wrappers, disposable cutlery, trays, and plastic bags.

In this regard, the Hon'ble NGT (PB) has impleaded the following as respondents in the matter vide order dt. 26.09.2024:

1. Commissioner-Coimbatore City Municipal Corporation,
2. The Member Secretary, Tamil Nadu Pollution Control Board (TNPCB),
3. Central Pollution Control Board (CPCB), Through its Member Secretary,
4. District Magistrate (DM), Coimbatore.

In this regard, an action taken report was requested by the CPCB vide reference 4th cited. An action taken report has been submitted to the Board vide this office letter dated 04.12.2024.

Whereas, additional details regarding the NGT (SZ) O.A. No. 295 of 2024 was requested by the CPCB vide reference 6th cited. In this connection the details of quantity of

plastic waste generated in Coimbatore (TPD), quantity of plastic waste processed (TPD), details of plastic waste processing facilities along with their capacity and details of action taken by the local body for enforcement of SUP ban vide annexure.

This is submitted for kind information and necessary action please.

Encl: Annexure.


24/11/23
District Environmental Engineer(a/c)
Tamilnadu Pollution Control Board
Coimbatore South


24/11/23

Annexure

1. Quantity of Plastic Waste generated in Coimbatore (TPD) - **90 Tons / Day**(As per 2023-24 Annual Report)
2. Quantity of Plastic Waste processed (TPD) - **60 Tons / Day** (As per 2023-24 Annual Report)
3. Details of Plastic Waste processing facilities along with their capacity

Sl. No	Name of the Unit	Whether the unit is in operation (Yes / No)	Processing Capacity (TPA)	Consent Validity	Has the unit obtained / applied for EPR
1	GLOBAL PLASTICS,1032/8 Part,Madukkarai Village, Madukkarai Taluk,Coimbatore 641042	Yes	365	RCO valid upto 31.03.2027	Yes
2	A.N.TRADERS,103,SIDCO Industrial Estate,Madukkarai Taluk,Coimbatore 641021	Yes	600	RCO Valid upto 31.03.2023	No
3	VELA INDUSTRIES,S.F No. 61/B Part,Kabilipalayam Village, Pollachi Taluk, ,Coimbatore - 642002	Yes	730	CTO Valid upto 31.03.2025	Yes
4	MUKESH PLASTICS,SF.No. 186/5A1, Kurichi Village,,Madukkarai Taluk,,Coimbatore - 641021	Yes	960	RCO Valid upto 31.03.2027	No
5	KABILA PLASTIC,SF.No.781/6, Madukkarai Village,,Madukkarai Taluk,Coimbatore - 641105	Yes	300	RCO Valid upto 31.03.2027	No
6	VIVIN PLASTICS,SF.No.781/2 & 796/5, Madukkarai Village,,Madukkarai Taluk,, Coimbatore - 641105	Yes	240	RCO Valid upto 31.03.2025	No

7	CHOUDHARY PLASTICS (old) SHREE AYEEJI I, S.F.No.151/1A, 151/1B & 151/1C,, Seerapalayam Village,Madukarai Taluk,,Coimbatore - 641050	Yes	3540	CTO Valid upto 31.03.202 5	Yes (Applied)
8	CHERAN PLASTIC INDUSTRIES, S.F No. 80/1A Part , 89/1A Part, ,Veerakeralam Village, Perur Taluk, ,Coimbatore - 641007	Yes	57	RCO Valid upto 31.03.203 6	No
9	SAFA PLASTIC INDUSTRIES,SF.No.869 /1 PART, Site No.111, Door.No.1,Kovai Automobile Nagar, Maracompany Road,Marapalam, Madukkarai Village, Madukkara	Yes	240	RCO Valid upto 31.03.202 6	No
10	SRI PON RAKKIYANNAN PLASTICS,SF.No.784/2 Part, Maracompany Medu, Mara,Madukkarai Village, Madukkarai Taluk,Coimbatore District-641105	Yes	240	RCO Valid upto 31.03.202 5	No
11	AADHAM PLASTICS,SF.No.802/1 A PART, Site No.182,MADUKARAI VILLAGE,MADUKKARAI TK,Coimbatore 641105	Yes	240	RCO Valid upto 31.03.202 5	No
12	M/s.JAYACHANDRAN PLASTICS LLP SF No. 321,322/2B & 325/1A1 Kunnathur Village Annur Taluk Sathy Main Road Coimbatore 641107	Yes	12	RCO Valid upto 31.03.203 0	Yes

4. Details of Action Taken by the Local body for enforcement of SUP ban from Jan 2019 to 31.12.2024

ULB	Type	All raids	All SUP Seized (MT)	All Fine (INR Lakhs)	All IEC
Coimbatore	Corporations	42,931	40.59	120.6655	21,989

Special Enforcement Raid conducted for 4 days every month (from October 2022 to December 2024)

Day Wise	No. of entities visited	No. of violations observed	No. of Challans issued	Qty. of plastic seized in Kg	Amount of fine in Rs.
Day 1	5,568	4,989	4,989	1,507.31	10,58,500
Day 2	879	203	203	1,418.06	97,150
Day 3	10	0	0	50.35	25,200
Day 4	3	0	0	0	0
Total	6,460	5,192	5,192	2,975.72	11,80,850

“Indicative Guidelines for Restoration of Water Bodies”

(in compliance to Hon’ble NGT Order dated 10.05.2019 in M.A.No. 26/2019 in OA.No. 325 of 2015)



Central Pollution Control Board

(Ministry of Environment, Forest and Climate Change, Govt. of India)

Parivesh Bhawan, East Arjun Nagar

DELHI-10 032

(www.cpcb.nic.in)

June 2019

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Indicative Guidelines for Restoration of Water Bodies (Polluted Lakes, Ponds and Rivers)

1 Introduction

Adequate availability of water of required quality is pre-requisite for survival and quality of human life. Surface water bodies like lakes, ponds, reservoirs, tanks and rivers were treated as community resource or asset over the centuries. In urban areas also such water bodies played an important role as a source of drinking water, absorption of flood water and a conduit for ground water recharge. They were being nurtured, protected, conserved and managed by the active participation of the local community without any code of conduct or rule. In turn, these water bodies have been catering the local human and livestock populations. The introduction of public water supply and ground water development through tube wells and hand pumps in the modern times, coupled with urbanization and industrialization induced pollution, a tectonic shift in the attitude of the people towards these water bodies has been witnessed. Both locals as well as the government have started neglecting this asset and have stopped caring, nurturing and conserving these community resources. Mushrooming urban, industrial and infrastructure development has further changed the status of these water bodies from community resources to a mere dumping ground or sink for solid wastes, construction debris, domestic sewage, industrial effluents, religious offering etc. resulting in severe degradation in the quality of such resources.

India has had abundant supply of water resources. However, from being a water abundant country India is gradually progressing towards water scarcity due to increasing population pressure, urbanization and uncontrolled growth. At present it is sustaining 18 per cent of world population with 4 per cent of global water

resources. Therefore, management of water resources has assumed great importance. Today availability of water resources is a major issue and is a big challenge facing our country.

In order to revive, restore and rehabilitate the traditional water bodies, the Government of India launched a Scheme for Repair, Renovation and Restoration (RRR) of water bodies which has multiple objectives like comprehensive improvement and restoration of water bodies thereby increasing tank storage capacity, ground water recharge, increased availability of drinking water, improvement in agriculture/horticulture productivity, improvement of catchment areas of tank commands, environmental benefits through improved water use efficiency by promotion of conjunctive use of surface and ground water, community participation and self-supporting system for sustainable management for each water body, capacity Building of communities in better water management and development of tourism, cultural activities, etc. by providing Central Grant to State Governments under a Pilot Scheme directly linked to agriculture during the remaining period of Xth Five Year Plan in January 2005. Keeping in view the benefits arising out of the implementation of the scheme, it was extended to XII Plan as well. Further, the Ministry of Environment, Forest and Climate Change is implementing a Centrally Sponsored Scheme of National Plan for Conservation of Aquatic Eco-systems (NPCA) since February, 2013 for conservation and management of identified lakes and wetlands in the 11 country in a holistic and integrated manner. Under the scheme financial assistance is provided to the concerned State Governments for undertaking various activities for conservation of wetlands and lakes, which also include a small component of lake front development and beautification, especially in urban lakes.

The National Water Policy (2012) formulated by MoWR, RD&GR advocates conservation, promotion and protection of water and highlights the need for augmenting the availability of water through rain water harvesting, direct use of

rainfall and other management measures. Further, the Standing Committee on Water Resources (2012-13) in their 16th Report on “Repair, Renovation and Restoration (RRR) of Water Bodies” also substantiated that *encroachment on water bodies is threatening the existence of a large number of water bodies and throwing consequent challenges of depleting ground water resources, occurrence of devastating floods in urban areas as well as water scarcity. Afore-said Committee suggested steps required to remove encroachment and to restore the water bodies.*

In recent years several metro cities such as Mumbai and Chennai have witnessed unprecedented flood. Encroachment of river bed is one of the reasons of flooding since it reduces the desired waterway of the river. Inadequacies of flood protection works, reduction in the water holding capacity of natural reservoirs in the basin due to progressive siltation, breaching of river banks, raising of river bed caused by deposition of silt are also the reasons. Encroachments happen due to number of local factors, thus issue is to be looked into by concerned State Government as per the prevailing rules and regulations of the respective State/UT.

As per MoWR, RD & GR, total number of water bodies have declined in the States which may be attributed to (i) increase in population and density of population per square kilometer; (ii) change in land use pattern; (iii) shift from paddy based agriculture to cash crop cultivation; (iv) depletion of ground water; (v) rapid Urbanization; (vi) unplanned urbanization and development activities; (vii) boom in construction activity; (viii) new water bodies have been developed to meet the additional requirement of water for drinking water and irrigation arising due to increase in population; (ix) some of the water bodies mainly, wells in southern group of islands were lost due to submergence of coastal area during tsunami in 2004.

NITI Aayog based on a study warning that India is facing its 'worst' water crisis in history and that demand for potable water will outstrip supply by 2030 if remedial steps are not taken. Nearly 600 million people faced high to extreme water stress. Also, made predictions that twenty-one cities, including Delhi, Bengaluru, Chennai and Hyderabad will run out of groundwater by 2020, affecting 100 million people. If matters are to continue, there will be a 6% loss in the country's Gross Domestic Product (GDP) by 2050. Moreover, critical groundwater resources, which accounted for 40% of India's water supply, are being depleted at "unsustainable" rates and up to 70% of India's water supply is "contaminated" 'Therefore, *water resource available to the country should be brought within the category of utilizable resources to the maximum possible extent.*

Therefore, existing scenario necessitates formulation of guidelines for restoration of water bodies keeping in view (i) to make pollution free water bodies and to meet the desired water quality criteria; (ii) to preserve excess water during monsoon, (iii) to restore and augment storage capacities of water bodies (iv) to serve and enhance ground water recharge; (v) increased availability of water for different intended purposes etc., These guidelines are only indicative guidelines and limited to restoration of ponds, lakes, polluted rivers or streams and divided into two parts i.e., stagnated surface water bodies such as ponds, lakes and rolling surface water bodies such as rivers or streams. However, concerned stakeholders are advised to conduct detailed gap analysis to enable to include related action plans for restoration of water bodies for ensuring compliance to Hon'ble NGT order dated 10.05.2019. For understanding aspects relating to restoration of water bodies, the documents already published or issued by Ministry of Water Resources, River Development and Ganga Rejuvenation (MoWR, RD & GR), Ministry of Housing and Urban Development also be referred as given at Sl. No. 7 References of these indicative guidelines.

This requires an understanding on the status of the water bodies, their suitable use, need for management and conservation so that they serve as a good

resource for future, potential strategies for long-term management especially in the urban areas, which are facing severe water shortage. It should include (i) Recognition Phase, (ii) Restoration Phase; (iii) Protection Phase; (iv) Improvement Phase and (v) Sustenance phase

2. Recognition Phase

Identification and recognition of the problem (inventory of existing and lost water bodies (due to encroachment, pollution, diversion etc.), analysis of cause of the problem and its effect and development of alternative solutions of problem as detailed below: -

2.1 Collection and maintenance of historical information relating to the water bodies

Based on the records available or remote sensing data or GIS maps, interaction with the public living in the vicinity of the water body, following information relating to the water bodies should be collected and records maintained by the concerned department in the State/UT: -

2.1.1 Stagnated water bodies such as ponds/lakes

A. Geographical details of the water body: - GPS Location and address of the water body, size or dimensions, area, elevation above mean sea level, ownership of the water body, boundaries with earmarking, map of water body (Digital map or remote sensing or satellite map over the years/National Wetland Atlas) with salient features

B. Hydrological description of the water body: - area, category of lake or pond (natural or man-made), average and maximum depth of stored water (during monsoon and non-monsoon period), total storage capacity, main source of water (rainfall/groundwater seepage/catchment

runoff/direct or indirect flow from any river or stream or creek), water permanence (permanent or intermittent), destination of excess water from pond or lake, purpose used to serve (like drinking water source, fisheries and agriculture or cultivation of aquatic food plants, recreational and aquatic sports, ground water recharge, act as a sink for sediments, habitat for noteworthy animal species, migratory birds or any other purpose), status of lakes or ponds in terms of % open water and aquatic vegetation.

C. *Catchment Description*

- Details on natural drains or flood channels and their flows contributing to water accumulation.
- Major Towns, total population living around the water body, any sewage contribution from the towns, total sewage generation, total no. of existing STPs and their treatment capacities, if any.
- Major industrial clusters or estates contributing to pollution in water body, total no. of industries (sector-wise), sector-wise total industrial effluent generation, existing industrial effluent treatment capacity [(both captive and Common Effluent Treatment Plants (CETPs)], if any.
- Total waste generation (waste like municipal solid waste, plastic waste, industrial hazardous waste, construction and demolition waste), existing provision for collection, transportation, treatment and disposal practices in the vicinity;
- Any other relevant information such as: - (i) Declared Wetland Ramsar sites, (ii) Bio-diversity details such as flora and fauna biodiversity (list of plant species, list of animal species, species of conservation significance (rare, endangered, threatened, endemic species), major plant invasive alien species and extent of invasion, major animal invasive alien species and extent of invasion.

2.1.2 River or streams

A. *Digital map of river under consideration with its tributaries showing salient features.*

B. *Geographical and Hydrological description of polluted river*

Origin of the river and confluence with any other water body, length of travel of the river before confluence with any other water body, velocity of flow (in m/sec), average cross-sectional area (in m²), average depth of flow (in m) during monsoon and non-mon-soon period, volume of flow or discharge (in m³/sec), tributaries of the river under consideration for restoration, GPS location details of all the tributaries and drains confluence with the river or stream; drains or channels contributing to river pollution;

C. *Catchment description*

- Purpose used to serve by the river or streams
- Major towns along the banks of the river, town-wise total population (with projection for the next 20 years), total water consumption (both supply by local or urban bodies and the ground water consumption), total sewage generation pattern, no. of STPs and the treatment capacity.
- Major industrial estates or clusters along the banks of the river, Industry-sector -wise no. of industries, total water consumption, total industrial effluent generation and existing mechanism for treatment of industrial effluent.
- GPS location details of STPs, CETPs and their capacities, if any
- Ground water status, its utilization and the quality.

- Agricultural practices and the control measures with respect to agricultural runoff.
- Flora and fauna including biodiversity etc.

Also, water being state subject, the State Government or Union Territory Administration should assign the task of maintaining historical records pertaining to each water body to concerned Department in the State/UT and also to designate one responsible Department to enable to take necessary remedial actions as and when situation demands.

2.2 Digital Mapping of all the collected information

All the collected information to be located on the map and such details to be periodically updated and maintained by the concerned department in the State/UT.

- 3. Restoration Phase** includes declaring the 'designated best use' in order to formulate strategies and to decide degree of treatment required for restoration of such water body, if required, selection of best solution to problems identified and application of the solution to the problems of the land which vary from case-to-case, to achieve the designated best use water goals as detailed below: -

3.1 Designation of water body for its use by the State/UT

The landscape of India is dotted with large number of lakes, reservoirs and wetlands. Historically, the water bodies such as ponds or lakes have met water demands of the population for centuries and a community management system had sustained them for a long period of time.

In a water body or its part, water is subjected to several types of uses. Depending on the types of uses and activities, water quality criteria have been specified to determine its suitability for a particular purpose. Among the various

types of users there is one use that demands highest level of water quality or purity and that is termed as “Designated Best Use” in that stretch of water body. Based on this, water quality requirements have been specified for different uses in terms of primary water quality criteria. The Primary Water Quality Criteria for bathing water already prescribed under Environment (Protection) Rules, 1986.

Every pond, lake, river or stream falling under the jurisdiction of the concerned Department of the State Government or UT Administration is required to declare for its ‘designated best use’ in order to formulate strategies and to decide degree of treatment required for restoration of such water body, if required. In the absence of such information, it would be difficult for the regulatory authorities to formulate the strategies to be prepared in case restoration of such water bodies is required.

Water being the State subject, such list of water bodies with designated best use with all the relevant information collected by the concerned Department of the State/UT Administration is required to be submitted to the concerned State Pollution Control Board (SPCB)/Pollution Control Committee (PCC), Central Pollution Control Board (CPCB) as well as MoEF & CC, MoWR, RD & GR.

3.2 National Restoration Goals (Ponds, Lakes and Rivers)

‘Water quality criteria-designated best use’ water quality parameters as given at **Annexure-I** is required to be followed as ‘National Restoration Goals (for Ponds, Lakes or Rivers)’. However, this national restoration goals or criteria given at Annexure-I is only indicative and national restoration goals issued from time to time need to be followed for restoration of water bodies.

Monitored water quality of the water body (lakes and ponds) for relevant parameters (monitored at least 8 times in a year) (average mean value) is compared with the ‘National Restoration Goals’. In case of ponds or lakes, if the monitored water quality of the selected water body is complying at least i.e.,

6 out of 8 times to the designated best use water quality parameters, then such pond or lake is fit for the 'designated best use' and if not then requires remedial measures for its restoration. *This criterion is applicable only in case of ponds and lakes.*

*In case of rivers or streams, the criteria issued from time to time by CPCB for categorization of monitoring location need to be followed and accordingly, the strategies to be formulated for its restoration to achieve at least bathing water quality criteria. Criteria for categorization of river monitoring location is ~~are~~ given in **Annexure-II. This criterion is to screen the potential locations having pollution (w.r.t bathing water quality parameters i.e., BOD and Faecal Coliform only) and requires more comprehensive examination to identify all the possible sources of pollution.***

3.3 Steps to be followed for restoration of stagnated polluted ponds or lakes

Conservation and restoration requires a systematic and comprehensive plan to study selective and representative freshwater ecosystems. Details of the study should include the status of ponds or lakes or rivers, their suitable use, management and conservation so that they serve as a good resource for future use and formulation of strategies for long-term management especially in the urban areas.

3.3.1 World Lake Vision

The World Lake Vision has been developed by International Lake Environment Committee (ILEC), Japan (<https://www.ilec.or.jp/en/pubs/>), in collaboration with UNEP , aiming at illuminating the growing crisis in management of lake ecosystem, articulating principles to guide the transition towards managing lakes for their sustainable use and to provide a practical blueprint for ensuring long-term health of lakes and integrity of their survival and economic development. The Seven Principles of Sustainable Lake Management are:

- A harmonious relationship between humans and nature is essential for the sustainable use of lakes.
- A lake drainage basin is the logical starting point for planning and management actions for sustainable lake use.
- A long-term, preventive approach directed to preventing the causes of lake degradation is essential.
- Policy development and decision making for lake management should be based on sound science and best available information.
- The management of lakes for their sustainable use requires the resolution of conflicts among competing users of lake resources taking into account the needs of present and future generations and of nature.
- Citizens and other stakeholders should be encouraged to participate meaningfully in identifying and resolving critical lake problems.
- Good governance, based on fairness, transparency and empowerment of all stakeholders, is essential for sustainable lake use.

The restoration of any water body should be considered only based on the needs and its utilities. *General steps to be followed for restoration of water bodies includes following: -*

3.3.2 Assessment of water quality of the selected water body

Water quality of all the designated best use water bodies are required to be monitored for relevant parameters and as per frequency prescribed under 'guidelines for water quality monitoring 2017' by Ministry of Environment, Forest and Climate Change (MoEF & CC). *Wherever, frequency is not suggested, water bodies are required to be monitored following the standard protocols for collection of samples by the concerned department at least once in a month or but not less than 08 months in a year (covering pre and post-monsoon period)*

3.3.3 Need for restoration of water body

The monitored values of the water body is analyzed based on the criteria suggested under these guidelines or criteria issued from time to time by CPCB for identification of polluted lakes or ponds or rivers or streams and decision be taken for restoration of water body. The criteria suggested for river monitoring location is to use for initial screening and identification of potential hotspots on the river. A comprehensive examination of water quality is required for identifying sources.

3.3.4 Identification of sources of pollution, quantification and assessing detailed gap analysis

Following steps to be followed for identification of sources of pollution, its quantification and for carrying out detailed gap analysis

A. Desk Review and Reconnaissance Survey

Identification of various sources contributing to pollution in ponds or lakes—need to be carried out based on desk survey (available information or data/ google map/ historical records) and physical reconnaissance survey (based on physical visual observations, interactions with the local public etc.,) for identification and ascertaining the sources of pollution of ponds or lakes. All the possible sources of pollution should be identified which may be

- open channels or drainage channels contributing untreated sewage or untreated or partially treated effluent discharge from existing sewage treatment plant in the vicinity (or)
- any untreated industrial effluent discharges either from the individual industry or any common effluent treatment plant (CETP) located in the vicinity (or)

- improper disposal of solid waste (plastic waste/ municipal solid waste/industrial hazardous waste/sludges from septic tanks or sewage treatment plants (STPs) or hazardous waste disposal from common effluent treatment plants (CETPs) (or)
- Run off from nearby agricultural fields, if any.
- Social and cultural misuse of ponds or lakes by local communities especially for immersion of idols during festival seasons.
- Any open-defecation around the ponds or lakes by the people living in the vicinity due to lack of sanitary facilities in their dwellings or colonies and fencing all around such water body.
- Physical condition of weed growth and necessity for dredging- Aquatic plants growing in ponds and lakes are beneficial for fish and wildlife as they provide food, dissolved oxygen, and spawning and nesting habitat for fish and waterfowl. Aquatic plants can trap excessive nutrients and detoxify chemicals. However, dense growths (over 25% of the surface area) of algae and other water plants can cause (i) Fish kills; (ii) Fish flavor problems; (iii) Pond water odor problems; (iv) Drinking water taste problem and (v) Stunted fish growth.
- Silting or sediments in the ponds or lakes due to improper disposal of waste including construction and demolition waste or silt contribution from drainage channels which reduces storage capacity and accumulation of contaminated sludges.
- Status of aesthetic conditions around the water body
- Condition of the banks or bunds, spill over (provision to ensure smooth flow of excess floods on downstream especially during monsoon period) or flood channels including obstructions if any.

- Encroachment of waterbodies due to urbanization
- Condition of Eutrophication of lakes or ponds due to inadequate measures (due to indiscriminate discharge of Industrial effluents, runoff from agricultural fields, refuse and discharge of sewage, domestic wastes like food remnants, soaps, detergents cause depleted levels of dissolved oxygen in water lead to a situation where other aquatic life-forms cannot survive).
- Available In-situ available technological options for restoration of ponds or lakes (such as aeration, bio-remediation) in lakes or plants)

B. Detailed gap analysis

Detailed gap analysis to be made w.r.t municipal sewage, industrial effluent and waste management with a projection of at least 15 to 20 years, existing infrastructure for management of municipal sewage, industrial effluents and waste management in the catchment area of the water body under consideration for its restoration including volumetric flow details of all the channels or drains contributing to pollution in water body, as detailed below: -

- **Sewage management:** - Total population (with projected population at least for the next 20 years) living around the water body, total water consumption (taking into account both water supply by local/urban bodies as well as ground water consumption), total sewage generation (with projected generation quantities), total no. of existing STPs and their treatment capacities and the observed gap with regard to the sewage management (gap may be estimated in the catchment of waterbody).

- **Industrial effluent management:** - Industrial clusters or estates contributing to pollution in water bodies, total no. of industries, estimation of total water consumption by the industries, total industrial effluent generation, existing treatment capacity (both captive and common effluent treatment plants (CETPs), gap in industrial effluent management and the requirement for captive or common effluent treatment plants

- **Waste Management:** - waste-wise total waste generation, existing provisions for collection, transportation, treatment and disposal (in compliance to the concerned rules) with their capacities and waste-wise gap analysis and the requirements for their management

C. Identification of other associated issues which requires attention as a part of restoration of pond or lake

Apart from identification of all possible pollution sources, detailed gap analysis, additional measures required on case-to-case basis to be identified especially in case of ponds or lakes w.r.t the following aspects: -

- Buffer Zone development maintenance and the existing activities within the buffer zone.
- Feasibility for Bio-diversity park in case adequate land is available in the vicinity of ponds or lakes.
- Greenery development in the vicinity of the ponds or lakes.
- Introduction of recreation facilities such as paddle boats, building jetty.
- Machinery and the man power requirement for maintenance of

the restored water body.

- Existing provision for disposal of waste arising from the desiltation and de-weeding activity of a pond or lake.
- Awareness and training requirements.
- Any other related measures required also be analyzed for inclusion of such actions while making action plans for restoration of water body (E.g., aesthetic point of view, bins for rubbish management which may be generated due to visitors).

4. **Protection Phase** that takes care of the general health of the water body and ensures normal functioning. A long-term, preventive approach directed to preventing the causes of waterbody degradation is essential.

4.1 Preparation of action plans

Action plans to be prepared based on the historical information collected, desk review, reconnaissance survey conducted, detailed gap analysis for ensuring additional measures required for restoration of water body (vary from case-to-case) covering both direct and indirect measures with specific time targets and the organization responsible for implementation of action plans with budget estimates. Action plans should include covering following aspects: -

- A. **Sewage Management:** - for management of sewage inflow if any (which is causing eutrophication of lake or pond) by having adequate infrastructure for treatment of sewage through adequate capacity of sewage treatment plants (STPs) or combination of other low cost treatment technologies for ensuring discharge norms notified under Environment (Protection) Act, 1986 and same should be ensured by an individual generator of sewage as well as by the concerned local or urban body.

B. Industrial effluent management: - for management of industrial effluent inflow by having adequate infrastructure for treatment of industrial effluent in the form of captive industrial effluent treatment plants or through common effluent treatment plants by the respective industry contributing to the pollution of water bodies and same also should be ensured by the respective State Industrial Development Corporations or State Pollution Control Board (SPCB) or Pollution Control Committee (PCC). Adoption of state-of-the technologies for production processes and for ensuring treatment of generated industrial effluent (feasibility adoption of zero liquid discharge).

C. Management of waste

- Adequate infrastructure should be ensured for management of wastes (such as municipal solid waste, industrial hazardous waste, construction and demolition waste, plastic waste, e-waste) in accordance with the respective provisions notified under the Environment (Protection) Act, 1986, by all the concerned.
- Periodic physical removal of improperly disposed wastes (such as municipal solid waste, construction and demolition waste, plastic waste, industrial hazardous waste, human and animal night soils) by the concerned local or urban body.

D. De-siltation

- Periodic removal of nutrient enriched accumulated sludges in ponds and lakes helps in ground water recharge potential, removal of contaminated sediments as well as increases storage capacity of lakes or ponds.

- Sediments removed from the ponds or lakes should be stored in a designated area (till moisture is completely drained out) at a suitable distance away from ponds or lakes and such dried sediments should be removed immediately so that sediments will not become a part of ponds or lakes once again especially in the event of any rain fall. Depending on the characteristics, such sediments after draining may be used as manure (complying to the manure quality prescribed under Solid Waste Management Rules, 2016 as amended from time to time or disposed of in accordance with the relevant provisions notified under Environment (Protection) Act, 1986.

E. De-weeding

- **Periodic dredging** (once in three months) of 80 % of dense and thickly covered aquatic plants viz., floating plants such as algae, duckweed, watermeal, water hyacinth; submerged plants such as milfoil, hydrilla, water lettuce, curly-leaf pondweed, clasping-leaf pondweed, coontail, sago pondweed, water lily, water shield etc., bottom sediment, and associated nutrients should be carried out. De-weeding methods include: -
 - **Preventive measures**
 - such as proper design and construction of ponds or lakes including levelling and smoothing of banks
 - **Manual or physical control measures**
 - Manual or physical control measures such as non-chemical and non-motorized measures be taken for removal of weeds (manual harvesting) using hand pulling, rakes, cutters, benthic barriers, drawdown, aeration, shading and weed rollers as these measures are typically very low, however, such measures

are labor intensive and are therefore better suited to small, less established weed populations. Hand pulling and raking may result in turbid or murky water and may create plant fragments that can subsequently spread to new sites.

➤ **Mechanical control measures**

- Using motor-driven under water weed cutters or floating weeds, rotovators essentially large-scale underwater rototillers for tilling up lake or pond sediments as well as to chop and loosen plant roots, or draglines (in case of underwater pond or lake dredging) (or) dry-land excavation machinery such as bulldozers (in case of drained ponds or lakes) shall be used (or)
- Limiting the amount of sunlight available to aquatic plants by floating black plastic sheeting on the water surface (or) use of dark-colored and nontoxic water dyes (such as nigrosine, aniline and aqua-shade)

➤ **Biological controls** i.e., introducing aquatic animals and plants that eat or compete with waterweeds. Herbivorous animals (those that eat plants) include a wide variety of insects, snails, crayfish, tadpoles, turtles, fish (sterile, triploid grass carp), ducks, geese, and swans which can be stocked in ponds or lakes to consume aquatic plant.

➤ **Application of common aquatic herbicides for control of lake or pond weeds**

Use of herbicides is not recommended as it may kill fish in ponds or lakes. Herbicides should be used in a controlled and systematic way under the supervision of the expert and general herbicides that may be used for weed control are as given below-

- *For Algae (microscopic, filamentous, Chara) control- Herbicides such as copper sulfate, copper chelates, endothall,, simazine)*
- *Submerged Plants (coontail, watermilfoil, pondweeds such as sago, curlyleaf, leafy) control- Herbicides such as Endothall, Diquat, simazine, fluridone may be used*
- *Free-floating plants (duckweed, watermeal) control:- Herbicides such as Diquat, simazine may be used*
- *Rooted-floating plants such as (waterlilies, spanerdock) control- Herbicides such as Glyphosate and 2,4,-D may be used*
- *Emergent plants (cattails, perennial grasses, and broadleaves) control: - Herbicides such as Glyphosate may be used*

F. Prohibition of discharges or disposal of waste or washing activity and action against violators

- Ban on discharge of industrial effluent or sewage or waste (such as municipal solid waste or industrial hazardous waste or plastic waste or construction and demolition waste or sludges from septic tanks/ STPs/CETPs) into lakes or ponds or drainage channels connected with ponds or lakes or open defecation in the vicinity as well as washing of clothes or wading of cattle
- Stringent actions be taken against violating industry by the SPCB/PCC as per provisions under Water (Prevention and Control of Pollution) Act, 1974 as well as Environment (Protection) Act, 1986

- Levying of fine or Environmental Compensation on the violators for improper disposal of sewage or industrial effluent or wastes into lakes or ponds.

G. Stabilization of earthen bunds and the drainage channels as well as silt and soil erosion control measures

- Stabilization of earthen embankments, shore line protection with vegetative or rock riprap to avoid soil erosion and the inflow drainage channels with the stone revetment or pitching so as to avoid rapid seepage or leakages
- All the inflow drainage channels should be provided with suitable silt barriers or sediment traps or sediment detention basins at suitable intervals for control of silt especially during monsoon.
- Also, at all the outfalls of drainage channels, suitable strains or traps should be provided to control inflow of all the floating materials and periodic removal of floating materials should be ensured.

H. Protection drainage basin including preservation of drainage channels

A lake or pond drainage basin is the logical starting point for planning and management actions for sustainable lake or pond use. A long-term, preventive approach for preventing the causes of degradation is essential.

- Historically the drainage channels which used to carry natural runoff from the drainage basin and presently carrying either untreated municipal sewage or industrial effluent or both and contributing to pollution of water bodies eventually due to encroachment in view of urbanization. All such drainage channels need to be restored by interventions such as (i) stoppage of inflow of untreated municipal

sewage or industrial effluent. If required, interaction and diversion of untreated sewage or industrial effluent from such drainage channels by routing through properly designed dedicated sewerage network to ensure conveyance and for ensuring treatment and disposal through STPs/CETPs. Feasibility of in-situ treatment of treated sewage and industrial effluent within drainage channels and prior to the inflow into the water bodies also be explored by the concerned authorities.

- Major channels running from the larger watersheds should be identified based on the historical data and such drainage channels should be preserved and protected with suitable buffer land without any impervious cover. This aspect should be ensured by the State Local/ Urban Development/Town Planning authorities while planning or expansion of a locality.

I. Removal of encroachments and blockades

- The State Government or UT Administration should maintain records pertaining to the boundaries of each pond or lake in the respective State/UT and necessary steps should be taken and ensured removal of all encroachments in the water body spread area/water body boundary as and when required.
- Removal of encroachments in the drainage channels should be carried out periodically to facilitates enhancement in aeration naturally in the water body
- Refrain from granting any consent for establishment for large scale projects in the catchment areas.

- Pond or lake boundary should be provided with fence (permanent / temporary fencing) to avoid unauthorized entry.

J. Flood Control Measures

- Excess floods from drainage basin be controlled with a provision of properly designed 'spill way' with a provision of controlled gates for smooth flow of excess water or run off during monsoon.
- Remove all encroachments (lake bed, storm water drains) to prevent calamities related to floods and to facilitate inter connectivity of water bodies.
- Removal all blockades at inlet or outlets should be ensured to avoid stagnation or blockage of storm water.

5. Improvement phase that deals with overall improvement in the water body and its uses including resolution of conflicts among competing users of lake resources taking into account the needs of present and future generations and of nature.

5.1 Adoption of In-situ techniques for in-situ remediation of ponds or lakes

A. *Physical treatment approaches*

Aeration (using surface aerators or , submerged aerators or a combination of both may be used to increase the dissolved oxygen in the water body, which is used by microorganisms to degrade the pollutants. Aeration also aids in mixing the different thermal layers of the water body, resulting in de-stratification, exposing the lower-most layers to atmospheric air. The need and extent of aeration is calculated based on the water quality parameters, depth of water body, ambient temperatures, wind conditions

etc.). Apart from aeration, methods such as wastewater diversion, periodic de-weeding and sediment dredging, proper maintenance of drainage channels or feeder channels also helps in increase in dissolved oxygen)

B. Chemical treatment approaches

Flocculation using chemicals like alum and neutralizing chemicals especially during acidification (increase in pH level of the stagnated water body)

C. In-situ techniques

- *Using aquatic plants* (Macrophytes such as water hyacinth (*Eichhornia crassipes*) and water lettuce (*Pistia stratiotes*), Whorl-leaf watermilfoil (*Myriophyllum verticillatum*), pondweed (*Potamogeton* spp.), common reed (*Phragmites communis*), cattail (*Typha latifolia*), duckweed (*Lemna gibba*) and canna (*Canna indica*)
- *Using aquatic animals* such as clams, snails and other filter-feeding shellfish
- *Using biological techniques* may be used to decompose, transform and absorb water pollutants. However, concentration and frequency of dosing of the microbial cultures is decided based on the volume of the water body, water quality parameters, ambient temperatures and extent of algal growth [as per literature (i) an enzyme namely Phycoplus and the nutrients are mixed thoroughly and sprayed into the pond within 2-3 weeks' time significance difference may be seen; (ii) treatment method based on hydroponics technique that cleans the lake by absorbing nutrients dissolved in the water and thereby supporting living species inside the lake; (iii) floating

treatment wetlands (FTW) which are artificial islands made of chemically inert materials, gravel having floating characteristics with plants that stay afloat on the lake or ponds such as wetland plants, water hyacinth, mosquito repellents and ornamental plants like cattails, bulrush, citronella, canna, hibiscus, fountain grass, flowering herbs, tulsi and ashwagandha) which helps in cleaning the lake or pond through hydroponics system, (iv) Introduction of mixture of nutrients to grow algae formed by diatoms (the most basic, single-cell life form found in water bodies) which helps in release of oxygen into water and in turn aerobic bacteria present in water body helps to break down the organic matter and convert the pollutants to base constituents and also reduces odors from the lakes or ponds. The diatoms are eaten by zooplanktons that are, in turn, consumed by fish].

5.2 Drainage basin management

- Drainage basin management includes control of non-point sources, structural and land treatment measures (regular monitoring of structures and systems and carrying out necessary rehabilitation and modernization programmes), interception and diversion of nutrients, sediments control (terracing, contour farming, grassed water ways, prior to reaching stagnated water body.
- Crop management, crop residue management and creation of shelter belts, good Irrigation practices, run off control provisions from agriculture runoff laden with excess fertilizers and pesticides

5.3 Green or Buffer Zone

- Buffer Zone around a lake or pond (at least 50 to 100 m periphery) should be maintained as green belt zone or no activity zone and no activity is allowed within the buffer zone by the concerned Departments in the State/UT. In case, any activity presently existing within the buffer zone (50 to 100 m), such as residential or commercial or industrial activity should take necessary measures to prevent discharge of any wastes into the water body.
- Within the buffer zone, no impervious cover is allowed and mainly plantation with a dense population of deeply rooted plants, trees, shrubs and grasses should be created so as to absorb nutrients (which promotes aquatic plant growth and a shift in the water quality) that comes directly from the anthropogenic activities.

5.4 Creation of biodiversity environment

In case the water body happens to be a site for the visit by migratory birds the number and type of trees by the side of the water body and water channels have also to be monitored to ensure adequate shelter as well as suitable environment for egg laying and propagation of bird species.

5.5 Monitoring of Implementation of action plans for restoration of ponds or lakes

The action plans are to be prepared and submitted to CPCB for seeking approval. The action-plan should include activity-wise action points, specific time lines, organization responsible for implementation, budget estimates as well as Program Evaluation and Review Technique (**PERT**) chart for implementation of action plans within the specified timelines, Upon approval of action plans for restoration

of ponds or lakes, thereafter, execution of action plans to begin and to be mentioned on monthly basis by the Monitoring Committee to be constituted under the Chairmanship of Principal Secretary (Environment) of the respective State Government or Union Territory Administration. The monitoring committee should review the progress on implementation of the action plans at least once in three months and apprise the Chief Secretary of the State/UT periodically.

A model lake restoration technique is given at **Figure 1** and a model flow chart for restoration of Ponds or Lakes is given in **Figure 2**.

LAKE OR POND RESTORATION TECHNIQUES

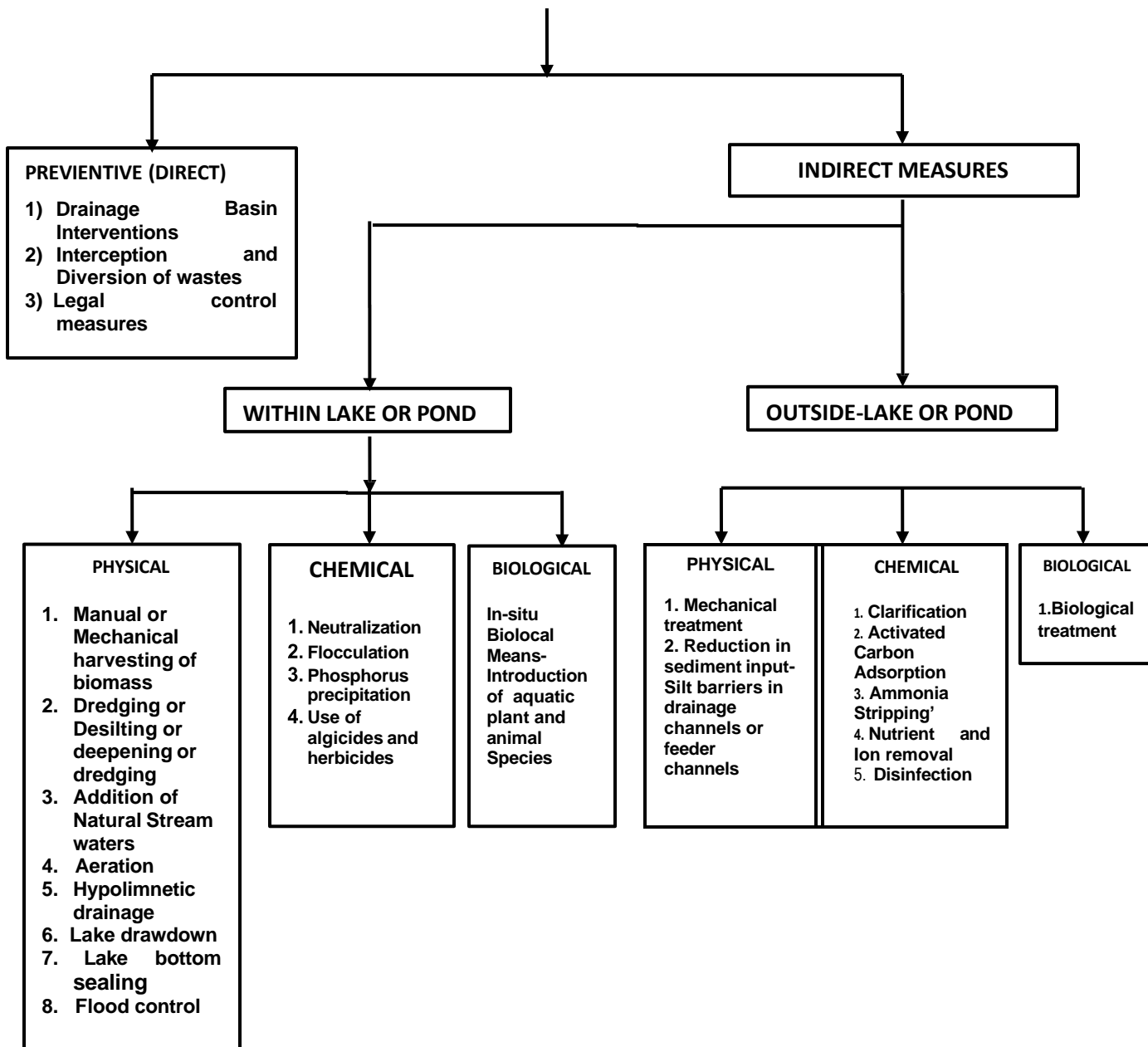


Figure 1. A Model Lake or Pond Restoration Technique

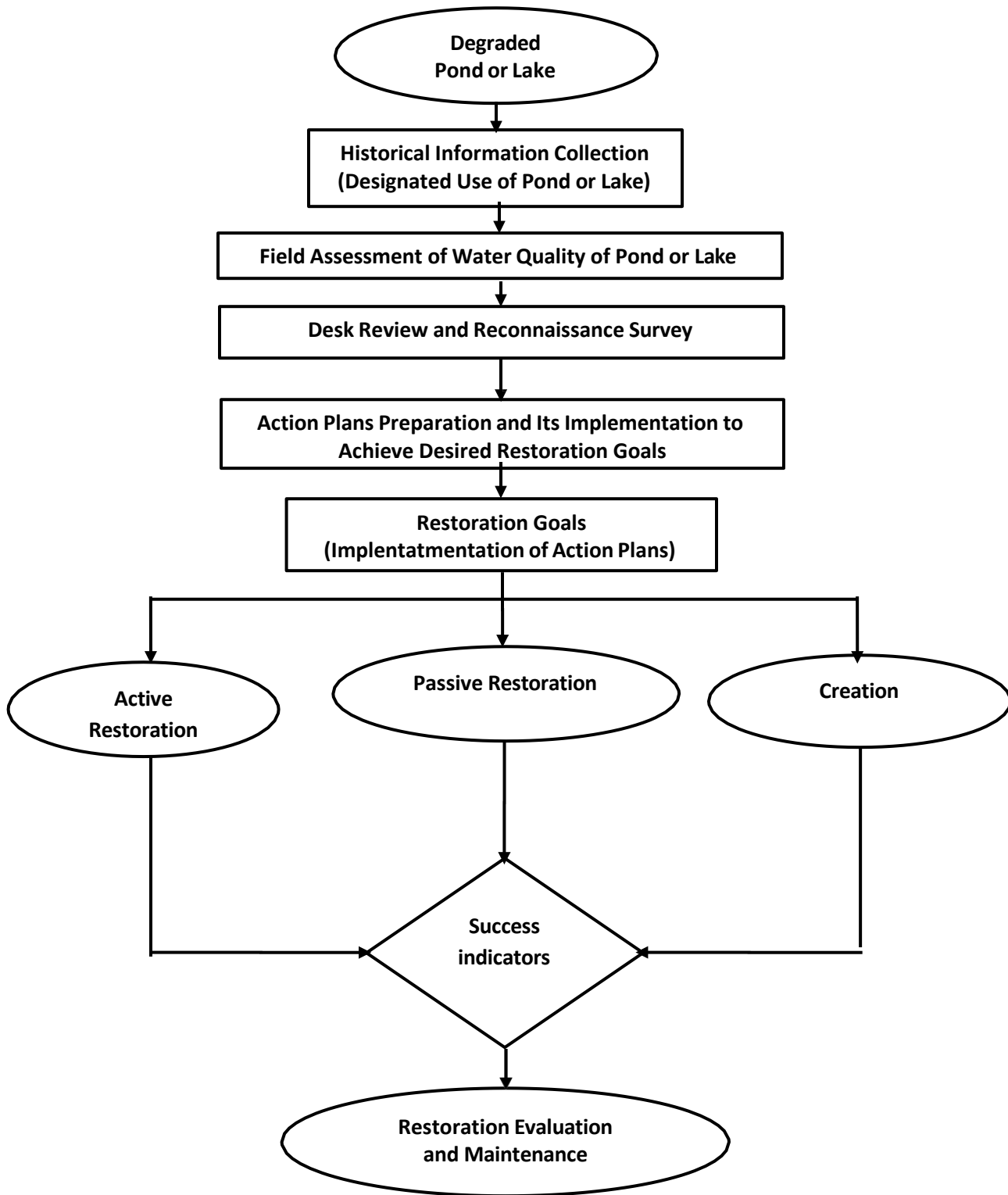


Figure 2. Model Flow Chart for Restoration of Pond or Lake

5.6 Steps involved in preparation of Action Plan for rejuvenation of polluted river stretches

A. Background Information (Refer to Sl. No. 2.1.2)

- (i) Digital map of identified polluted river with its tributaries
- (ii) Geographical and hydrological description of polluted river
- (iii) Catchment description- uses of river, towns, cities and villages, industries (sector-wise no. of industries), ground water status and its utilisation, agricultural practices, flora and fauna etc.

B. Water Quality of River and Its Tributaries

- (i) Water quality of river and its tributaries (at least for five years)
- (ii) Quality assigned as per modified Water Quality Criteria (**Annexure-I**)

C. Identification of Causes of Pollution in Catchment Area of the River

➤ Industrial Pollution

- (i) List of water polluting industries, industry sector-wise: water consumption, effluent generation and quantity of industrial effluent discharged into river
- (ii) Status on granting of Consent under Water (Prevention and Control of Pollution) Act, 1974
- (iii) Status on granting of authorization under the Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016 as amended (as applicable)
- (iv) Compliance status and action taken (Placing in public domain)
- (v) Final disposal mode of treated industrial effluents (i.e., disposal on land or drain or ZLD or drain connected to CETP etc.,)
- (vi) Performance status of captive Effluent Treatment Plants (if applicable)
- (vii) Existing Common Effluent Treatment Plants (CETPs) and their performance status.
- (viii) Regulation of small scale industries/tiny units'/service units discharging effluents/sludge disposal into drains/landfill or any other mode of disposal

➤ Ground water management

- (i) Status of ground water level-reserves in the catchment area of river under consideration
- (ii) Blocks identified as over exploited, critical, semi-critical and safe (as per Central Ground Water Board (CGWB) if any)

- (iii) Status of permissions granted by Central Ground Water Board (CGWB) to the industries and other Development projects in the catchment area of river.
- (i) Compliance of conditions stipulated by CGWB and subsequently by SPCB.
- (ii) Ground water sources (Hand -pumps, Wells, Tube Wells) identified in the catchment area of the river and the characteristics (at least for the period of two years);
- (iii) Ground water sources (Hand -pumps, Wells, Tube Wells) identified as non-potable for human consumption in river stretch with Geo-genic/or polluted due to industries.
- (iv) Compliance on ground water charging imposed by Rain Water Harvesting Mechanism.
- (v) Existing mechanism for supply of potable water to the human population in the affected areas.
- (vi) Health deformities /clinical reports in polluted river stretch areas in view of ground water contamination.

➤ **Sewage treatment and disposal: -**

- (i) Cities, towns and villages located on the bank of river stretches discharging sewage effluents through drains into the river.
- (ii) Quantification and pollution load of sewage generated by a city/town/village.
- (iv) Status of septage management.
- (v) Listing of drains carrying sewage and trade effluents joining river and determining flow and characteristics with details of catchment contributing sources (drainage maps from major /minor irrigation development of State/or local body).
- (vi) Existing sewage treatment capacities and performance of Sewage Treatment Plants and their compliance Status
- (vii) Final mode of disposal of treated sewage as well as sludge management

➤ **Waste management in the catchment area of river: -**

- (i) Area-wise Hazardous waste generation, treatment and final mode of disposal and the existing infrastructure.
- (ii) Area-wise Status on municipal solid waste generation, treatment and final mode of disposal and the existing infrastructure
- (iii) Area-wise Status on bio-medical waste generation, treatment and final mode of disposal and the existing infrastructure
- (iv) Any other waste generation, treatment and final mode of disposal and the existing infrastructure

➤ **River catchment information**

- (i) Regulation of Flood Plain Zone
- (ii) Encroachment in Flood Plain Zone
- (iii) Plantation status
- (iv) Flow data of river/tributary

➤ **Gap Analysis and Identification of the problems in the identified polluted river catchment: -**

- (i) Sewage generation, existing infrastructure with treatment capacities and the observed gaps w.r.to infrastructure for sewage management
- (ii) Industrial effluent generation, existing infrastructure with treatment capacities and the observed gaps w.r.to infrastructure for industrial effluent management
- (iii) Waste generation, existing infrastructure with treatment capacities, designed life of the treatment and disposal facilities as applicable and the observed gaps w.r.to infrastructure for waste management
- (iv) Any other relevant issues

(Note: - All the details such as river and its tributaries, area-wise population, sources and water consumption quantities, sewage generation, existing infrastructure for sewage management and the gaps observed, area-wise industries (industry sector-wise no. of industries), sources of water and water consumption quantities (industry-sector-wise), industrial effluent generation, existing infrastructure for treatment (like Captive ETPs, CETPs), final mode of disposal of industrial effluents, waste generation and its management with existing infrastructure, characteristics of river and its tributaries, identified contaminated ground water resource areas has to be detailed in the map preferably a digital map)

D. The River Rejuvenation Action Plan:-

After having complete based information as detailed under earlier paras A to D above, Action Plans on each Activity with time-lines can be framed. The key components of action plan may follow the suggested points as given the Table below:

S. No	Key Activity and Components		Agency to perform the task	Proposed Specific Time Frame for implementation of action plan
1	Industrial Pollution Control			
	(a)	Inventorisation of water polluting industries	SPCB	
	(b)	Grant of consents	SPCB	
	(c)	Compliance verification	SPCB/ District Magistrate (DM)	
	(d)	Planning for CETP (as applicable)	SPCB+ State Industries Department or of Industries	
	(e)	Insisting on ZLD measures, recycling/reuse of treated industrial effluents	SPCB	
	(f)	Prohibition of disposal of effluents into drains except during rainy season subject to complying to effluent discharge norms for disposal in surface water.	SPCB + DM	
	(g)	Covering small and tiny units and not allowing discharge of effluents either individually or combined	SPCB+ Local Body/ Urban Body	
	(h)	Publishing list of defaulting industries in local newspapers and involving public in reporting deliberate discharges (without entering in the premises-backyard water and reporting running of industry against the closure orders.	SPCB + DM	
	(i)	Hazardous or Non Hazardous Waste Management Plan and no dumps anywhere except at identified locations	SPCB + DM	
	(j)	Reporting Non-Compliance of CGWB	SPCB +	

		conditions and closure of Non complying units.	CGWB	
	(k)	Levying compensation or fines for non-compliances as empowered to UPPCB under the Hon'ble NGT Order Dtd. 13/07/2017 in Ganga Matter in case of Tanneries.	SPCB	
	(l)	Other Action as relevant	SPCB + Concerned Agency of State	
2	Ground Water Protection			
	(a)	Declaration of Polluted Blocks	CGWB	
	(b)	Embargo on Water pollution /over-abstraction of industries as per block status	CGWB	
	(c)	Rain water harvesting	Local Body + DM	
	(d)	Identification of Geo-genic contamination (as applicable)	CGWB	
	(e)	Identification of industries discharging industrial effluent illegally and levying fine on such industries including closure of such industries	SPCB + CGWB	
	(f)	Remediation of contaminated ground water (due to discharge of industrial /sewage) with the recovered funds from the default industry	SPCB + CGWB	
	(g)	Capping of contaminated tube wells and Potable water supply through alternate measures in the affected areas of groundwater	Water Supply Department	
3	Sewage Management			
	(a)	Identification of cities, towns and villages discharging sewage into river/tributary	State Local and Urban Development and Executing Agencies	
	(b)	Identifying drains joining river and their quantification and characterizations of pollution load		
	(c)	Preparation of Detailed Project Report (DPR) for interception and diversion (I & D) of drains to sewage treatment plant (STP) for which suitable site to be identified and plan for utilization of treated sewage.		

	(d)	Execution of STP works and necessary infrastructure and ensuring household sewer connection for full utilization of STP		
	(e)	Regular cleaning of drains and prohibiting disposal of garbage/plastic and filthy material into drains including dairy waste		
	(f)	Restoration of natural drains for carrying only storm water (but not sewage)	Local and Urban Bodies + State Water Resources + State Irrigation Department + SPCB	
	(g)	Ensuring utilization of treated sewage for beneficial use such as agriculture, construction activity, washing/flushing/cleaning, industrial cooling etc.,	Local and Urban Bodies + State Irrigation Department + SPCB	
	(h)	Interception and Diversion of sewage from Drains and connectivity to STPs	Local and Urban Bodies	
4	Flood Plain Zone (FPZ) Protection			
	(a)	Demarcation of FPZ and not permitting encroachments	State Irrigation Department	
	(b)	Adopting good irrigation practices to conserve water	State Irrigation Department /DFO	
	(c)	Plantation and bio-diversity parks in FPZ	State Forest Department	
5	E-Flow			
	(a)	E-Flow determination/gauging	State Irrigation Department	
	(b)	Regulation of flow from barrages	State Irrigation Department	
6	Health Impact Assessment Reports-Treatment Services			

	(a)	Epidemiological survey in the catchment to find out water-born diseases/ health issues	State Health Department	
	(b)	Providing treatment services to the diseased persons in the catchment area		
7	Education and Awareness			
	(a)	Regular involvement of educational institutions for creating awareness and conservation programmes	State Education Department with concerned Departments	
8	Funding for execution of Action Plans			
	(a)	Pooling of financial resources of state and central assistance	State Finance Commission/ MoUD and MoWR, RD & GR	

E. Monitoring of Implementation of Action Plans for Rejuvenation of Polluted River Stretches:-

- (i) In compliance with Hon'ble NGT Order dated 20/09/2018 (OA No. 673 of 2018), State/UT Level 'River Rejuvenation Committee (RRC)' constituted firstly has to ensure timely preparation of action plans (before 20/11/2018).
- (ii) Prepared actions plans need to be submitted to CPCB for random scrutiny as well as for approvals.
- (iii) Thereafter, execution of action plans to begin and to be mentioned on monthly basis by the 'RRC' under overall supervision of the Principal Secretary (Environment) of the respective State Government or Union Territory Administration.

A model flow chart for rejuvenation of polluted river is given in **Figure 3**

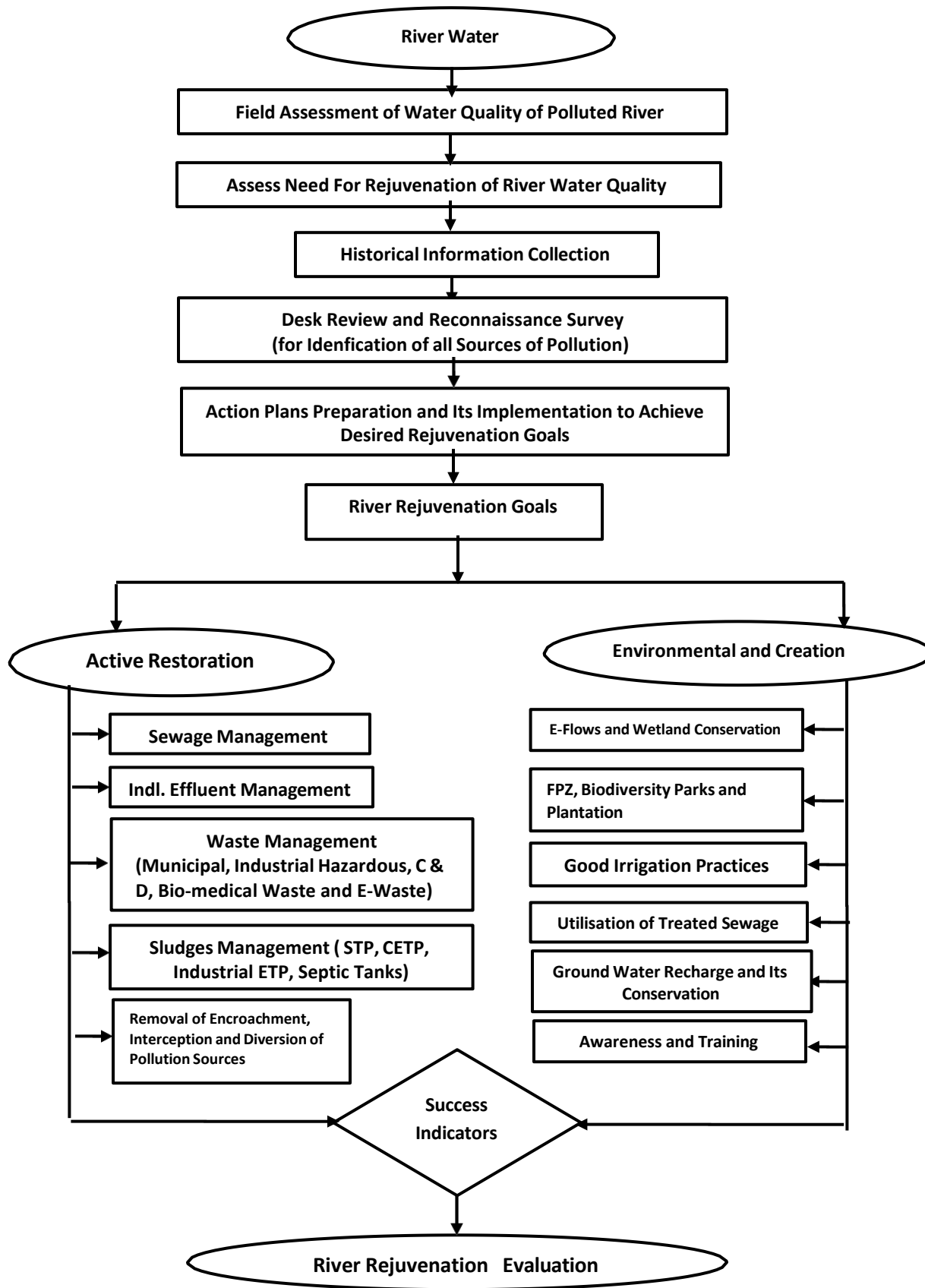


Figure 3. Model Flow Chart for Rejuvenation of Polluted Rivers

6. Sustenance Phase

Good governance, based on fairness, transparency and empowerment of all stakeholders, is essential to sustain the restoration efforts. Also, ownership of each waterbody should be decided, as most of them face indefinite sustenance due to multiplicity of administrative control and/or lack of specific action by singular authority. The in charge authority should treat the water body as 'natural resources', to act as the potential catalysts to better civic health, provide recreation, improve tourism, possibly meet water-needs of local people, etc. Such gains shall be attained only after the water bodies are treated on eco system based approach.

6.1 Awareness

Awareness for citizen's groups, resident welfare associations, local organizations, activist groups, green organizations, political organizations, educational institutions and government agencies in protection of the water bodies should be organized periodically by the concerned authorities through campaigns, electronic media in vernacular languages also be ensured by the concerned authorities

6.2 Training

Organizing periodic trainings through identified and reputed institutions for all the concerned on aspects relating to maintenance during post- restoration phase of the water body.

6.3 Promoting Public Participation

Promoting active public participation (with the help of schools, colleges and universities, NGOs) for identifying and resolving critical lake or pond problems as

well as periodic maintenance and restoration of water body from aesthetic and restoration point of view should be organized.

6.4 Dissemination of Information

Water quality of the pond or lake should be displayed at the main entrance of the pond or lake boundary and such water quality data also connected to the servers of concerned custodian State Department (s) as well as State Environment Department, respective State Pollution Control Board (SPCB)/Pollution Control Committee (PCC). Display boards also should be provided at all the salient points on '**Do's and Don'ts**' for the public.

6.5 Recreational Centre

Creation of pond or lakes can be converted into recreational centers with boating activities, walkways and benches for visitors on charge basis so as to generate revenue for operation and maintenance of the lake or pond areas

7. References

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[https://www.indiawaterportal.org/sites/indiawaterportal.org/files/Repair%2C%20Renovation%20and%20Restoration Water%20Bodies %20External%20Assistance MoWR 2009.pdf](https://www.indiawaterportal.org/sites/indiawaterportal.org/files/Repair%2C%20Renovation%20and%20Restoration%20Water%20Bodies%20External%20Assistance%20MoWR%202009.pdf)
- Advisory on Conservation and Restoration of Water Bodies in Urban Areas published by Central Public Health and Environmental Engineering Organization (CPHEEO), Ministry of Urban Development (August 2013)
<http://mohua.gov.in/upload/uploadfiles/files/Advisory%20on%20Urban%20Water%20Bodies.pdf>
- OA No. 200 of 2014 Titled M.C. Mehta Vs Union of India -(River Ganga) Order of HON'BLE NGT Dated 10/12/2015; and 13/07/2017.
- OA No. 231 of 214 Titled Doaba Paryavaran Samiti Vs State of UP & Ors. (on river Hindon) Order of HON'BLE NGT Dated 08/08/2018
- OA No. 673 of 2018 Titled News item published in "The Hindu" authored by Shri Jacob Koshy titled "More river stretches are now critically polluted: CPCB" Order of HON'BLE NGT Dated 20.09.2018, 19.12.2018 and 08.04.2019

-- OO --

Water Quality Criteria-Designated Best Use

Designated-Best-Use	Class of Water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	Total Coliforms Organism in MPN/100ml shall be 50 or less pH between 6.5 and 8.5 Dissolved Oxygen 6mg/l or more Biochemical Oxygen Demand 5 days 20C 2mg/l or less
Outdoor bathing (Organised)	B*	Faecal Coliform in MPN/100ml: 500 (desirable) and 2500 (Maximum Permissible) Faecal streptococci in MPN/100 ml: 100 (desirable) and 500 (maximum Permissible) pH between 6.5 to 8.5 Dissolved Oxygen: 5mg/l or more Biochemical Oxygen Demand 3 Day BOD, 27 ° C: 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	Total Coliforms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4mg/l or more Biochemical Oxygen Demand 5 days 20C 3mg/l or less
Propagation of Wild life and Fisheries	D	pH between 6.5 to 8.5 Dissolved Oxygen 4mg/l or more Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling	E	pH between 6.0 to 8.5 Electrical Conductivity at 25 °C micro mhos/cm Max.2250 Sodium Absorption Ratio Max. 26 Boron Max. 2mg/l

* ***Class B as per Primary Water Quality Criteria for Bathing Water (Water Used for Organised Outdoor Bathing) as per Environment (Protection) Rules, 1986***

CRITERIA FOR CATEGORISATION OF RIVER MONITORING LOCATION

1. Introduction

Water Quality monitoring is an essential component to maintain and restore the wholesomeness of resources by way of prevention and control of pollution as prescribed under the Water (Prevention and Control of Pollution) Act, 1974. However, the Water (Prevention and Control of Pollution), Act, 1976 does not define the level of wholesomeness to be maintained or restored in different water bodies of the country. In view of the said reason, the Central Pollution Control Board (CPCB) has tried to define the wholesomeness of water in terms of safe human uses, and thus, taken human uses of water as base for identification of water quality objectives for different water bodies in the Country. It is considered ambitious to maintain or restore all natural water body at pristine level which is possible only by taking proper control measures. The level and degree of treatment required can be decided depending on the categorization of the polluted river locations/stretch, as per the criteria detailed below:-

2. Categorization of River Monitoring Location

The water quality data is required to be analyzed and primarily mean or average values of Biochemical Oxygen Demand (BOD) and Faecal Coliform (FC) need to be estimated. Then, based on the total score estimated for the parameters BOD (weightage- 70 %) and FC (Weightage- 30 %), based on the criteria, the monitoring location is categorized as 'polluted' location. The polluted monitoring locations in a continuous sequence are defined as 'polluted river stretch'. However, actual self-purification distance need to be estimated based on the requisite input parameters which depend on the case-to-case and the local conditions.

The monitoring locations may be categorized in five classes from Category I to Category -VI. i.e., critically polluted to Good or Fit for Bathing i.e., Category -I indicates 'critically polluted'; Category-II indicates 'severely polluted'; Category-III indicates 'moderately polluted', Category -IV indicates 'less polluted', Category -V indicates 'Good' or Fit for Bathing'

Above suggested criteria is intended only for categorization of the river monitoring locations. However, if any State/UT desires to identify any other water body such as lakes, tanks may also apply these criteria depending on the need and the requisite achievable goals for rejuvenation of such water bodies.

Table 1 to Table 3 gives the mean or average BOD/Faecal Coliform values or range and the corresponding scores as well as categorization of the monitoring location

Table 1. Observed Mean or Average BOD Value in mg/l and corresponding BOD Score

S. No	Mean or Average BOD (Weightage-70 %)	
	Mean or Average BOD (in mg/l)	BOD Score (X)
1	> 48	100
2	24-48	80
3	12-24	60
4	6-12	40
5	≤ 6	20

Table 2. Observed Mean or Average Faecal Coliform (in MPN/100 ml) and corresponding FC Score

S. No	Mean or Average Faecal Coliform (Weightage -30 %)	
	Mean or Average Faecal Coliform (in MPN/100 ml)	FC Score (Y)
(1)	> 5,00,000	100
(2)	5000 to 5,00,000	80
(3)	5000 to 50,000	60
(4)	500 to 5000	40
(5)	≤500	20

Table 3. Total Score and corresponding Category of River Monitoring Location

S. No	Total Score* (Z')	Category Priority Class of the Monitoring location	Category of Monitoring location
(1)	81-100	Category -I	Critically Polluted
(2)	61-80	Category--II	Severely Polluted
(3)	41-60	Category -III	Moderately Polluted
(4)	21-40	Category -IV	Less Polluted
(5)	≤ 20	Category -V	Good or Fit For Bathing

Note:

- (i) Above criteria must be considered only for the river locations having monitored at least for 2 years and 8 observations in each year covering at least pre-monsoon and post-monsoon period;

- (ii) *Above criteria is a preliminary screening criteria for categorizing monitoring locations. However, comprehensive assessment needs to be done by States/UTs to arrive at the extent of contamination;*
- (iii) *Please refer to the procedure for estimation of Total Score given in S.No 3.;*

- 2.1 Criteria for Category- I – Critically Polluted:** - If the Total score is 81-100, then the monitoring location is categorized as '**Critically Polluted**'.
- 2.2 Criteria for Category- II – Severely Polluted:** - If the Total score is 61-80, then the monitoring location is categorized as '**Severely Polluted**'
- 2.3 Criteria for Category- III-Moderately Polluted:** - If the Total score is 41-60, then the monitoring location is categorized as '**Moderately Polluted**'
- 2.4 Criteria for Category-IV –Less Polluted:** - If the Total score is 21-40, then the monitoring location is categorized as '**Less Polluted**'.
- 2.5 Criteria for Category -V-Good or Fit for Bathing:**-If the Total score is ≤ 20 , then the monitoring location is categorized as '**Good or Fit for Bathing**'.

*For easy understanding, flow chart given in **Figure 4** and steps for calculating the total score may also be referred in the subsequent paras:-*

- 3. Steps for calculating total score and categorizing of monitoring location : -**
 - (i) *Depending on the average BOD measured value, assign the BOD score (X) as given in **Table 1**.*
 - (ii) *Similarly depending on the average FC measured value, assign the FC Score (Y) as given in **Table 2**.*
 - (iii) *Total score (**Z**) is estimated as: BOD Score (**X**) \times (Weightage of BOD i.e., 70 %) + FC Score (**Y**) \times (Weightage for FC i.e., 30 %). and*
 - (iv) *Now compare calculated Total Score (Z) with the **Z'** Value given in the **Table 3** and the monitoring location is categorized suitably.*

For easy understanding following examples may be referred in the subsequent paras.

E.g. (1): At a particular monitoring location, the average values of BOD and the FC values are observed as 6 mg/l and 9000 MPN/100 ml respectively. Then, the total score is calculated as

- X is the BOD Score corresponding to the mean BOD value of 6 mg/l as per **Table 1** = 20
- Y is the FC Score corresponding to the average FC value of 9000 MPN/100 ml as per **Table 2** = 60
- Calculated Total Score (**Z**) = X X **Weightage of BOD** + Y X **Weightage of FC** i.e., $20 \times 0.7 + 60 \times 0.3 = 14 + 18 = 32$.
- Compare 39 value with the **Z'** values given in **Table 3** to decide on the *Priority* Category of the Monitoring Location. In this case, monitoring location is Category-IV i.e., 'Less Polluted',

E.g.(2): At a particular monitoring location, the average value of BOD and the FC values are observed as 2 mg/l and 45 MPN/100 ml respectively. Then, the total score is calculated as

- X is the BOD Score corresponding to the average BOD value of 2 mg/l as per **Table 1** = 20
- Y is the FC Score corresponding to the average FC value of 45 MPN/100 ml as per **Table 2** = 20
- Calculated Total Score (**Z**) is calculated as = X X **Weightage of BOD** + Y X **Weightage of FC** i.e., $20 \times 0.7 + 20 \times 0.3 = 20$
- Compare 20 value with the **Z'** values given in **Table 3** to decide on the Category of the Monitoring Location. In this case, monitoring location is Category-V i.e., 'Good' or Fit for Bathing

E.g. (3): At a particular monitoring location, the average value of BOD and the FC values are observed as 2 mg/l and 550000 MPN/100 ml respectively. Then, the total score is calculated as

- X is the BOD Score corresponding to the average BOD value of 2 mg/l as per **Table 1** = 20

- *Y is the FC Score corresponding to the average FC value of 550000 MPN/100 ml as per **Table 2** = 100*
- *Calculated Total Score (**Z**) = **X** X **Weightage of BOD** + **Y** X **Weightage of FC** i.e., $20 \times 0.7 + 100 \times 0.3 = 44$.*
- *Compare 100 value with the **Z'** values given in **Table 3** to decide on the Category of the Monitoring Location. In this case, monitoring location is Category-III i.e., 'Moderately Polluted'*

E.g.(4): *At a particular monitoring location, the average value of BOD and the FC values are observed as 45 mg/l and 400 MPN/100 ml respectively. Then, the total score is calculated as*

- *X is the BOD Score corresponding to the average BOD value of 45 mg/l as per **Table 1** = 80*
- *Y is the FC Score corresponding to the average FC value of 400 MPN/100 ml as per **Table 2** = 20*
- *Calculated Total Score (**Z**) = **X** X **Weightage of BOD** + **Y** X **Weightage of FC** i.e., $80 \times 0.7 + 20 \times 0.3 = 62$.*
- *Compare 100 value with the **Z'** values given in **Table 3** to decide on the Category of the Monitoring Location. In this case, monitoring location is 'Category-II i.e., Severely Polluted'*

E.g (5): *At a particular monitoring location, the average values of BOD and the FC values are observed as 24 mg/l and 200000 MPN/100 ml respectively. Then, the total score is calculated as*

- *X is the BOD Score corresponding to the mean BOD value of 24 mg/l as per **Table 1** = 60*
- *Y is the FC Score corresponding to the average FC value of 200000 MPN/100 ml as per **Table 2** = 80*
- *Calculated Total Score (**Z**) = **X** X **Weightage of BOD** (70 %) + **Y** X **Weightage of FC** (30 %) i.e., $60 \times 0.7 + 80 \times 0.3 = 42 + 24 = 66$.*
- *Compare 90 value with the **Z'** values given in **Table 3** to decide on the Category of the Monitoring Location. In this case, monitoring location is Category-II i.e., 'Severely Polluted',*

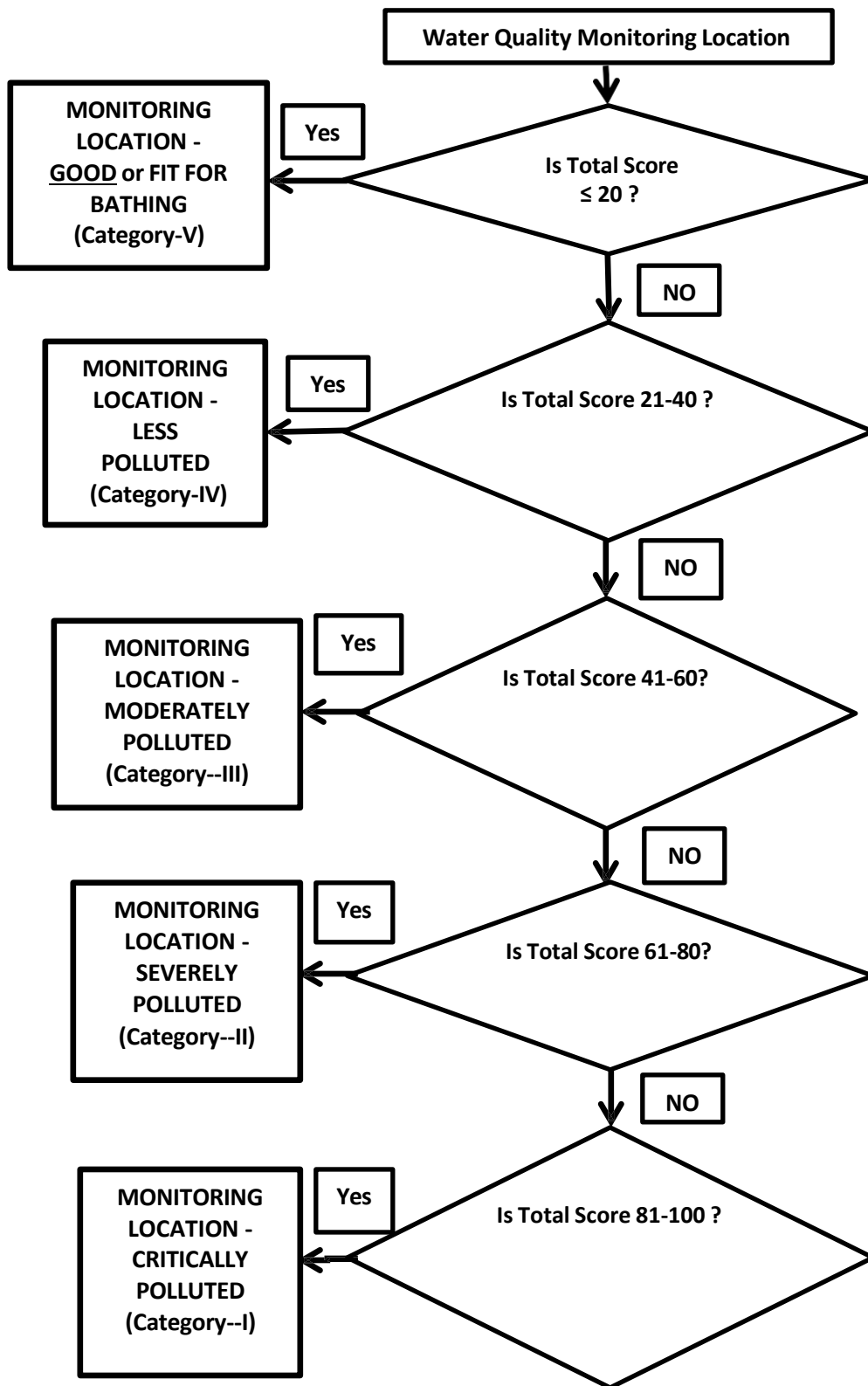


Figure 4. Flow Chart Showing Criteria for Categorization of River Monitoring Location

**Action Taken Report for National Green Tribunal case No 325/2015
in the State of Tamil Nadu**

Based on the suggestions & directions of National Green Tribunal, Government of Tamil Nadu has taken following action.

Si.No	Activity Proposed	Organization Responsible
1.	Identification and Geo-Tagging of ponds or lakes in the country	The Geo-Tagging of 14341 PWD tanks have been under taken & completed by Institute of Water Studies, PWD.
2.	Assessment of Water Quality of Ponds or Lakes	Government of Tamil Nadu has taken initiation on this . Already a study on the Water Quality of Tanks has been taken up as per Government order GO(MS) No 124/PW/W2/dt 27/08/2019. This assessment work in progress.
3.	Priorization of ponds or lakes for restoration in consultation with the respective SPCB (Annexure2)	Priorization of ponds and lakes have already been taken up WRD wing and Environmental Wing of PWD. Both wings have investigated on this and the total number of prioritization comes to 229 tanks.
4.	Preparation and submission of Action Plans for restoration of prioritized ponds and lakes to CPCB for random scrutiny of proposed Action Plans. (Annexure1)	The Public works department is having 14341 numbers of irrigation tanks across 31 districts. Out Of 14341 numbers of water bodies, 4718 water bodies have been restored at an estimated cost of Rs. 1308.50 crore under various schemes such as Repair, Renovation and restoration (RRR), Tamil Nadu Irrigation Agriculture Modernization Project (TNIAMP) Phase I, Kudimaramath, De-silting of water bodies for city water supply, De-silting of reservoirs, De-silting by NGO, traditional water bodies and National Bank For Agriculture & Rural Development (NABARD) aided schemes. For 1717 tanks, restoration works are under progress at an estimated cost of Rs. 445.3 crore. More over 29440 numbers of encroachments evicted in water bodies so far. Further the Public works

		<p>Department planned to restore/renovate 906 tanks at an estimated cost of Rs. 649.55 crore under TNIAMP (phase II), 89 tanks at an estimated cost of Rs. 49.31 crore under RRR , 3 tanks at an estimated cost of Rs. 12 crore Under Environmental Protection and Renewable Energy Development Fund and 1 tank at an estimated cost of Rs. 9.86 crore under the Tamilnadu Investment Programme (TNIPP Phase-II).</p> <p>Supplying Clay, Silt, Savudu & Gravel available in Tanks, Reservoirs and other water bodies to the Public, Farmers and Potters and thereby increasing the capacity of Tanks .The Amendment to Rule 12(2) and 12 (2-A) (a) of the Tamil Nadu Minor Minerals Concession Rules, 1959 on 27.04.2017 made by Industries Department allows potters, public and farmers of Tamil Nadu (except Chennai, Kancheepuram and Thiruvallur Districts) to take clay, silt, savudu and gravel from beds of tanks, channels and reservoirs at free of cost, for pottery, domestic and agricultural purposes. According to this, clay, silt, savudu and gravel can be taken from the water bodies, such as tank beds, channels and reservoirs, notified in District Gazette in their Villages or adjoining Villages for the above purposes after obtaining prior permission from the concerned District Administration. By this, original capacity of the water bodies is being restored.</p>
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Annexure I

**DETAILS OF RESTORATION OF
TANKS UNDER TAKEN BY WRD
WING OF PWD**

1. Kudimaramath Scheme

The Government of Tamil Nadu revived the traditional Kudimaramath works from the year 2016-2017 to restore the Water bodies through user communities. These works include maintenance in supply channels, canals, tanks, shutters, strengthening and reconstruction of surplus weirs, sluices, etc. In Kudimaramath, works are entrusted to Farmers' Organizations / Council / Ayacudars / Group of Ayacudars on nomination basis for execution; 10% of the estimate cost is borne by the Farmers' Organizations / Council / Ayacudars / Group of Ayacudars in the form of labour or material or cash. To overcome the difficulties in mobilising funds required to commence the works 50 and make some significant initial progress, the Government have accorded approval to make an advance payment of 15% of the contract value to the Farmers' Organisations or Farmers' Councils or Ayacudars or group of Ayacudars, who have been nominated to carry out the works under Kudimaramath. The advance will be recovered from the first three bills.

1,387 Kudimaramath works at an estimated cost of Rs.500.00 crore are to be taken up in the year 2020-2021.

Year	G.O No.	No of Works	Estimate Amount (Rs. in crore)	No of Works completed	No of Works in progress	No of tanks rehabilitated	Expr in (Rs. in Crore) up to 19.07.19
2016-2017	G.O.Ms.No.54 Public Works (W1) Dept dated 10.03.2017.	1519	100.00	1513	---	767	92.51
2017-2018	G.O.Ms.No.142 PW(W2) dated 25.05.2018.	1511	328.95	1466		787	265.32
2019-2020	G.O.Ms.No.58 PW(W2) dated 13.06.2019.	1829	499.68	1563	233	941	-
2020-2021	.	1387	498.5185	Works just commenced	-		-

2. Repair, Renovation and Restoration (RRR) of water bodies directly linked to agriculture under Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)

Repair, Renovation and Restoration (RRR) is a Centre-State shared scheme under PMKSY. As per new guidelines of PMKSY, the funding pattern between Centre and State is 60:40 for drought prone areas and for non-drought prone areas the funding pattern is 25:75.

This scheme involves the following components:

- Standardisation of tank bund to standards
- Desilting the tank bed to restore the storage capacity
- Reconstruction / Improvements to sluices and surplus arrangements
- Desilting and strengthening of feeder channel to ensure supply to tanks

Phase I and II (2014-15)

- 104 tanks renovated at a cost of Rs.54.32 crore.
In Ramanathapuram, Vellore and Sivagangai Districts.
- Gol grant released - Rs. 9.23 crore.
- As the total expenditure has already been incurred by the State, there is no provision of reimbursement of expenditure in the above scheme. Hence the balance Gol grant of Rs.25.50 crore cannot be released.
-

Phase III (2017-18)

- 49 tanks sanctioned at an estimated cost of Rs.23.43 crore in Dharmapuri, Tiruvannamalai, Vellore and Virudhunagar Districts.
- Works are completed in 49 tanks
- Gol grant released - Rs.7.03 crore.
Expenditure incurred upto June'2019 : Rs.19.52 crore

Phase IV (2019-20)

- 89 tanks to be renovated at a cost of Rs.49.31 crore in Sivagangai, Ramanathapuram, Virudhunagar, Krishnagiri, Dharmapuri, Coimbatore and Tiruppur Districts.

Phase V

10 tanks to be renovated at a cost of Rs.35.86 crore in Dindigul and Vellore Districts. Proposal is under the consideration of Government of India.

ABSTRACT

Sl.No	Region	Name of the District	Number of Tanks	Estimate Amount (Rs. in Lakhs)	Ayacut (in Ha)	Present stage
PHASE I (2014-15)						
1	Chennai	Vellore	16	734.73	1885.52	All works completed
2	DRCS	Vellore	8	326.79	421.42	
3	Madurai	Ramanadhapuram	24	1640.48	1911.63	
TOTAL			48	2702.00	4218.57	
PHASE II (2014-15)						
1	Chennai	Vellore	20	731.60	1341.11	All works completed
2	DRCS	Vellore	8	279.59	459.93	
3	Madurai	Ramanadhapuram	9	958.89	1670.36	
		Sivagangai	19	760.30	1076.54	
TOTAL			56	2730.38	4547.94	
PHASE III (2017-18)						
1	Chennai	Dharmapuri	7	276.25	387.27	All Works completed
		Tiruvannamalai	3	110.95	198.25	
		Vellore	12	529.15	870.48	
2	DRCS	Tiruvannamalai	5	138.32	290.32	
3	Madurai	Virudhunagar	22	1287.96	2042.58	
TOTAL			49	2342.63	3788.90	
PHASE IV (2019-20)						
1	Chennai	Dharmapuri	15	828.27	1543.18	G.O already issued
		Krishnagiri	5	260.45	259.57	
2	Madurai	Ramanadhapuram	23	1217.07	1469.58	
		Sivagangai	24	1028.93	977.40	
		Virudhunagar	10	1189.84	1364.74	
3	Coimbatore	Coimbatore	6	264.42	602.81	
		Tiruppur	6	142.21	204.20	
TOTAL			89	4931.19	6421.48	
PHASE V						
1	Chennai	Vellore	1	3168.30	511.47	Proposal sent to MoWR for approval.
2	Madurai	Dindigul	9	417.37	754.90	
TOTAL			10	3585.67	1266.37	
GRAND TOTAL			252	16291.87	20243.26	

3. Supplying Clay, Silt, Savudu & Gravel available in Tanks, Reservoirs and other water bodies to the Public, Farmers and Potters

The Amendment to Rule 12(2) and 12 (2-A) (a) of the Tamil Nadu Minor Minerals Concession Rules, 1959 on 27.04.2017 made by Industries Department allows potters, public and farmers of Tamil Nadu (except Chennai, Kancheepuram and Thiruvallur Districts) to take clay, silt, savudu and gravel from beds of tanks, channels and reservoirs at free of cost, for pottery, domestic and agricultural purposes. According to this, clay, silt, savudu and gravel can be taken from the water bodies, such as tank beds, channels and reservoirs, notified in District Gazette in their Villages or adjoining Villages for the above purposes after obtaining prior permission from the concerned District Administration. By this, original capacity of the water bodies can be restored. The quantity of silt and clay proposed to be removed for agricultural purpose shall not exceed 75 cubic metre per acre (185 cubic metre per hectare) for wet lands and 90 cubic metre per acre (222 cubic metre per hectare) for dry lands, once in two years. The quantity of earth, savudu and gravel for domestic purposes shall not exceed 30 cubic metre. The quantity of clay proposed to be removed for pottery shall not exceed 60 cubic meter.

72.867 M.Cum of vandal earth has been issued to 6,49,059 beneficiaries throughout Tamil Nadu. Out of this, 16.272 M.Cum of vandal earth has been issued to 1,18,215 beneficiaries through Water Resources Department.

4. Desilting of Dams / Water bodies

To restore the water bodies to its original capacities desilting is very essential. Desilting of Water bodies are to be carried out by considering various aspects such as hydraulics of the water bodies, study of silt / sediment and its properties, Calculation of Quantum of silt, suitable process for removal of Silt, access to the water bodies for removal of silt, demand for silt / sediment etc., Desilting of major water bodies is a new attempt in Tamil Nadu and it has been decided to undertake the preliminary process for desilting of Vaigai Reservoir, Pechipparai Reservoir, Mettur Reservoir, Amaravathy Reservoir and Srivaikundam Anicut on pilot basis.

Sl. No.	Name of Reservoir / Water Body	Capacity in Mcft.	Quantum of silt deposited in Mcft.	Quantum of silt proposed to be desilted at present in Mcft.	Time required for desilting in years	Estimate Amount (Rs. Crore)	Expected Revenue (Rs.in Crore)
Work in Progress							
1	Veeranam	1465	148	148	3 ½	40	-
2	Cholavaram	1081	134	134	4	5.43	47.96
3	Redhills	3300	511	511	8	9.9	182.18
4	Chembarambakkam	3645	536	536	8	4.03	191.27
5	Poondi	3231	723	723	8	10.98	257.94
Estimate under Prepration							
1	Mettur	95659	21590	486	2	Estimate under Preparation	
Estimate under consideration of Government							
1	Amaravathy	4138	823	291	9	7.3	172.81
2	Parappalar	197.95	22	20.62	4	1.192	7.849
3	Vaigai	6879	1182	400	3	9	211.76
4	Pechipparai	5307	1595	145	3	5.12	95.60
Work temporarily stopped on the orders of Green Tribunal							
1	Srivaikundam Anicut	300 .00	225	35.315	1	5.93	9.31
Total		125203	27489	3429.395	---	98.882	1176.70

5. Tamil Nadu Irrigated Agriculture Modernization Project (TN IAMP)

Tamil Nadu Irrigated Agriculture Modernisation Project was planned for implementation in 66 sub basins to benefit an extent of 5.43 lakh hectare over a period of 7 years starting from 2017 with an outlay of Rs.2,962 crore. This is the follow on project of the successfully completed Irrigated Agriculture Modernisation and Water Bodies Restoration and Management Project. The Project is implemented by Water Resources Department and 6 line Departments in coordination with Tamil Nadu Agriculture University, Tamil Nadu Veterinary and Animal Sciences University and Tamil Nadu Fisheries University. Under this Project, it is proposed to take up rehabilitation of 4,778 tanks, Construction Recharge wells in water spread area of tanks .The works are proposed to be taken up in four phases.

Under Rehabilitation of Flood Affected Tanks and Irrigation Channels scheme 59 tanks have been rehabilitated.

Phase I Works

Rehabilitation of 1,325 tanks, construction of 39 artificial recharge wells in the water spread area of tanks have been completed.

Phase -II Works

Administrative sanction has been accorded for the Rehabilitation of 906 tanks and construction of 37 Artificial Recharge wells, grouped into 57 packages in 16 sub-basins at an estimated cost of Rs.649.55 crore. Agency settled for all the works except a few.

Phase-III Works

Preparation of Detailed Project Reports for selected 10 Sub basins have been initiated.

6. ECO-RESTORATION OF WATER BODIES

Environmental preservation would encompass conservation of ground water, rivers, other water bodies, conservation of the zoological and botanical diversity, protection of soil and other natural formation etc. Eco-restoration activities are carried out by Water Resources Department from the year 2014-2015. Projects are sanctioned by Environmental Management Agency of Tamil Nadu under Environmental Protection and Renewable Energy Development Fund.

Eco - Restoration of Sarkarperiapalayam Eri in Avinashi Taluk of Tiruppur District, Korattur, Ambattur and Madhavaram Tank in Thiruvallur District and Paruthipattu Lake in Avadi near Greater Chennai at an estimated cost of Rs.93.75 crore were completed. Administrative Sanction has been accorded for Revival of Chitlapakkam Tank in Tambaram Taluk of Chengalpattu District for an amount of Rs.25.00 crore, Eco-Restoration of Odathurai Tank in Bhavani Taluk of Erode District for an amount of Rs.3.20 crore and Eco-Restoration of Adambakkam, Perumbakkam and Vengaiwasal tanks in Chengalpattu District for an amount of Rs.12.00 crore. Works will commence early.

As per the G.O.Ms.No.(4D)No.4 PW(T2)D dated.14.05.2018 the Government as allotted Rs.9.81 Crores for the work of Eco-Restoration and Protection of Peerkankaranai Tank in Tambaram Taluk of Kanchipuram District under the Tamilnadu Investment Programme (TNIPP Phase-II) . Hence, the estimate for the above work is prepared and Technically Sanctioned by this department and this work is commenced and is in progress. At present 52% of the works has been completed so far

Eco Restoration works of tanks are under progress

Si.No	Name of Work	Cost (Rs.in Cr)
1.	Eco Restoration of Adambakkam Tank in Alandur Taluk of Kancheepuram District	3.4825
2.	Eco Restoration of Perumbakkam Tank in Sholinganallur Taluk of Kancheepuram District	4.8755
3.	Eco Restoration of Vengai Vasal Tank in Tambaram Taluk of Kancheepuram District	3.5820
4.	Eco-Restoration and Protection of Peerkankaranai Tank in Tambaram Taluk of Kanchipuram District	9.81

GOVERNMENT OF TAMILNADU
WATER RESOURCES DEPARTMENT
PUBLIC WORKS DEPARTMENT

From
Er. S. Suresh Kumar, B.E.,
Member Secretary,
Technical Sub Committee for RRC&
Joint Chief Engineer, WRD,
State Ground & Surface Water
Resources Data Centre
Public Works Department
Tharamani, Chennai - 600 113.

To
The Principal Secretary,
Municipal Administration
and Water supply department,
Secretariat,
Chennai – 09.

Lr. No: / RRC / AGC /2020 Dated: 28 .05.2020

Sir,

Sub: Hon'ble National Green Tribunal order dated 10.05.2019 in OA No.325/2015, "**Restoration of water bodies**" – Action Plan, District wise details of renovation of tanks and report on **Nadanthai Vaazhi Cauvery** - Submission – Regarding.

Ref: Email letter received from Central Pollution Control Board (CPCB), dated 19.05.2020 Addressed to The Member Secretary, State Pollution Control Board (SPCB) / Pollution Control Committee and forwarded to this office.

It is kindly submitted that the following in respect of OA No. 325/2015 "**Restoration of Water bodies**" are herewith submitted.

1. Action Plan for National Green Tribunal case No 325/2015 in the State of Tamil Nadu.
2. **Annexure- I** Details of Restoration of Tanks under taken by WRD wing of PWD.
3. **Annexure- II** District wise details of restored water bodies in the prescribed format (1 to 4).
4. **Annexure – III** Data volume containing Polluted Tanks list.

-SD-

Chief Engineer, WRD,PWD,
SG & SWRDC, Tharamani,
Chennai-113.

Encl:

- ✓ **Booklet I** containing the Action Plan in respect of Restoration of Water bodies & District wise details of restored water bodies in the prescribed format (1 to 4).

- ✓ **Booklet II** Annexure- I Details of Restoration of Tanks under taken by WRD wing of PWD.
- ✓ **Booklet III** Annexure- III Data volume containing Polluted Tanks list.
- ✓ **CD** Containing all the Data in soft copy.

1. Copy presented to the Principal Secretary, to Government, PWD, Fort. st. George, Chennai- 9.
2. Copy to Engineer-in-Chief, WRD & Chief Engineer (General), Chepauk, Chennai.

dec *28/5/2020*
For Member Secretary,
Technical Sub Committee for RRC

FORMAT - 1		
Sl.No	Name of District	No. of waterbodies available in various Departments
		PWD
1	Ariyalur	93
2	Chennai	2
3	Coimbatore	28
4	Cuddalore	227
5	Dharmapuri	131
6	Dindugal	180
7	Erode	22
8	Kancheepuram	949
9	Karur	18
10	Krishnagiri	190
11	Madurai	1342
12	Nagapattinam	7
13	Kanyakumari	2037
14	Namakkal	79
15	Perambalur	73
16	Pudukottai	1132
17	Ramanathapuram	642
18	Salem	109
19	Sivagangai	1464
20	Thanjavur	639
21	Theni	167
22	Tiruvallur	605
23	Thiruvarur	32
24	Thoothukudi	236
25	Tiruchirappalli	174
26	Tirunelveli	1319
27	Tiruppur	44
28	Thiruvanamalai	703
29	Nilgiris	-
30	Vellore	513
31	Villupuram	842
32	Virudhunagar	342
	TOTAL	14341

Districtwise Polluted Tanks as reported by		
Sl.No.	Tank_Name	District
1	Arasanilayathan eri	Ariyalur
2	Kulumoor Peria eri	
3	Velacheri tank	Chennai
4	Irugur tank	Coimbatore
5	Kannampalayam ta	
6	Kurichi tank	
7	Neelambur	
8	Odderpalyam tank	
9	Sulur Big tank	
10	Sulur small tank	
11	Kurinjpadi Periya Eri	Cuddalore
12	Serakuppam Iyaneri	
13	Ramakkal Tank	Dharmapuri
14	Aranmanai odaikulam	Dindigul
15	Kumaranaickenula	
16	Nagasamudram	
17	Oomaiservaikaran	
18	Rengasamudram	
19	Sirunaicken kula	
20	Vaiyapurikulam	
21	Veerakulam	
22	Adambakkam Tank	Kancheepuram
23	Chengalpattu Kolvoy Tank	
24	Chitlapakkam Tank	
25	Guduvanchery Tank	
26	Irumbuliyur Tank	
27	Jallampettai Tank	
28	Tambaram Kadapperi Tank	
29	Kaliyanur Peria Eri	
30	Kattankolathur Tank	
31	Kovilambakkam Tank	
32	Madipakkam tank	
33	Medavakkam Kalleri	
34	Moovarasampattu Peria Eri	
35	Nanmagnalam Tank	
36	Nathapettai Tank	
37	Nemelicheri Tank	
38	Ninnakarai Tank	
39	Pallavaram Tank	
40	Pallikkaranaï Narayanaapur	
41	Peerkankaranai Eri	
42	Perungalathur Big Tank	
43	Perungalathur Chitheri	
44	Perungudi Tank	
45	Potheri Tank	

46	Rajakeelpakkam Tank	
47	S.Kolathur Tank	
48	Selaiyur Tank	
49	Sembakkam Tank	
50	Semmanjeri Pudu Tank	
51	Semmenjeri Rettakuttai Th	Kancheepuram
52	Sholinganallur Rettaikeni T	
53	Sholinganallur Thamraikeni	
54	Tambaram Peria Eri	
55	Tambaram Pudu Thangal	
56	Thiruneermalai Tank	
57	Vaiyavur Tank	
58	Silloor kulam	Kanyakumari
59	Subbaiyar Kulam	
60	Thathiyar kulam	
61	Umamanganeri kulam	
62	Vandaneri kulam	
63	Chandirambigai Tank	Krishnagiri
64	Devasamudhiram Tank	
65	Gollappatti Tank	
66	Kareem Shaib Tank	
67	Thally Big Tank	
68	Anaiyur Tank	Madurai
69	Ayavettan	
70	Ayenpappakudi	
71	Chinthamani tank	
72	Kanakkan kulam	
73	Kannanendal tank	
74	Kurunthankulam tank	
75	Parasuramanpatti tank	
76	Pudukkulam	
77	Puliyankulam	
78	Puliyur	
79	Rettaikulam	
80	Samanatham	
81	Siruthur Chinna Tank	
82	Thirupalai	
83	Thuliapatti	
84	Usilampatti kanmoi	
85	Vadakarai Kanmoi	
86	Vandiyur Tank	
87	Akkaraipatti Tank	Namakkal
88	Mamundi Agraharam Tank	
89	Minnakkal Tank	
90	Semur Large Tank	
91	Keela eri	
92	Keelapuliyur tank	

93	Kurumbalur tank	Perambalur
94	Poolambady chitheri	
95	Thoramangalam Big tank	
96	Keelavettivayal kanmoi	Pudukottai
97	Keeranur Periyakulam	
98	Ottakkulam	
99	Pakkudi kanmoi	
100	Urvani kanmio	
101	Nenmeni	Ramanathapuram
102	Sellur	
103	Urapuli	
104	Vendhoni	
105	Biroji Tank	Salem
106	Deviyakurichi Tank	
107	Idappadi Large Tank	
108	Manivilanthan Palaya Tank	
109	Neikkarapatti Tank	
110	Sarvoy Big Tank	
111	Sentharapatti Tank	
112	Eluvani Tank	Sivagangai
113	Enapuram	
114	Kaluvangulam	
115	Keelakariskulam	
116	Melakariskulam	
117	Vanthavasi	
118	Vellani	
119	Athikudy Tank	Thanjavur
120	Kalichamman Eri	
121	Karimuthu Eri	
122	Kasira Eri	
123	Mudalikulam	
124	Oddappankarikulam	
125	Periya Eri	
126	Pikathiyar Odai	
127	Samudram Eri	
128	Thaligaikulam Eri	
129	Urachi Eri	
130	Karuvelankulam	Theni
131	Maithalamannadi kulam	
132	Mandhaikulam	
133	Meerusamudram	
134	Ottukulam	
135	Udayakulam	
136	Veerappanai kenkulam	
137	Agoor Chitteri	
138	Ambathur	
139	Amirthapuram Tank	

140	Ammaneri Tank	Thiruvallur
141	Arapatheri	
142	Ayanambakkam	
143	Boodur Tank	
144	Chellathur Tank	
145	Kakkalur Tank & Channel	
146	Koilpathagai	
147	Kolathur	
148	Korattur	
149	Madhavaram Rettai Eri	
150	Nadukuthagai	
151	Nallattur Tank	
152	Padiyanallur Tank	
153	Pakkam Large tank	
154	PalayaGummudipoondi Tha	
155	Paleripattu	
156	Panderavedu Tank	
157	Paruthipattu	Thiruvallur
158	Perungavoor Tank	
159	Porur	
160	Pullarambakkam Tank	
161	Pudhur Tank	
162	Rajanagaram Tank	
163	Chembrambakkam Tank	
164	Sirungavur Tank	
165	Sothupakkam Tank	
166	Srivilasapuram Tank	
167	Thandurai	
168	Thannirkulam Tank	
169	Thirunindravur	
170	Tiruttani Big Tank	
171	Vanganoor Tank	
172	Varadharajapuram& Chitte	
173	Veeramangalam Tank	
174	Venkathur Tank	
175	Villinjiambakkam	
176	Irumbedu Tank	Thiruvannamalai
177	Kannanur Big Tank	
178	Nochimalai Tank	
179	Paiyur tank	
180	Thirumalai samudiram tank	
181	Venkikal Tank	
182	Alanganeri	
183	Chatrampudukulam	
184	Ilандаikulam	
185	Kandiaperikulam	
186	Karaiyiruppu kulam	

187	Keela kulam	Tirunelveli
188	Mullikulam	
189	Nainarkulam	
190	Pattiyuthu kulam	
191	Pettai kulam	
192	Puliyoor Periya kulam	
193	Salaperikulam (Jegaveerara	
194	Seevalaperikulam	
195	Shencottaikulam	
196	Thanjavoorkulam	
197	Thattanpathukulam	
198	Thottiyankulam	
199	Udayarpattikulam	
200	Andipalayam	Tiruppur
201	Mannarai	
202	Mudalipalayam	
203	Samalapuram	
204	Sarkar periyapalayam	Trichy
205	Kollankulam tank	
206	Koothakudi eri	
207	Krishnasamutharam tank	
208	Kulathur Periyakulam	
209	Mavadi Kulam	Trichy
210	Navali Kulam	
211	Nawab kulam	
212	Sevanthan kulam	
213	Valavandhankottai	
214	Arakonam big tank	Vellore
215	Dharapadavedu tank	
216	Kavanoor tank	
217	Thirupathur Big Tank	
218	Chinnasalem Tank	Villuppuram
219	Emapair Eri	
220	Gidangal Tank	
221	Kallakurichi Small Eri	
222	Kaveripakkam tank	
223	Thenkeeranur Small Tank	
224	V.Marudhur Tank	
225	Aruppukottai Big Tank	Virudhunagar
226	Kondaneri tank	
227	Subramaniapuram.A	
228	Thiruthankal periyakulam	
229	Vagaikulam Tank	

Districtwise Polluted Tanks as reported by WRD Divisions		
Sl.No.	Name of Tank	District
1	Velacheri tank	Chennai
2	Kumaranaickenula	Dindigul
3	Nagasamudram	
4	Oomaiservaikaran	
5	Sirunaicken kula	
6	Vaiyapurikulam	
7	Veerakulam	
8	Adambakkam Tank		Kancheepuram
9	Chengalpattu Kolvoy Tank	
10	Chitlapakkam Tank	
11	Guduvanchery Tank	
12	Irumbuliyur Tank	
13	Jallampettai Tank	
14	Kadapperi Tank	
15	Kaliyanur Peria Eri	
16	Kattankolathur Tank	
17	Kovilambakkam Tank	
18	Madipakkam tank	
19	Medavakkam Kalleri	
20	Moovarasampattu Peria Eri	
21	Nanmagnalam Tank	
22	Nathapettai Tank	
23	Nemelicheri Tank	
24	Ninnakarai Tank	
25	Pallavaram Tank	
26	Pallikkaranaï Narayanaapuram Tank	
27	Peerkankaranai Eri	
28	Perungalathur Big Tank	
29	Perungalathur Chitheri	
30	Perungudi Tank	
31	Potheri Tank	
32	Rajakeelpakkam Tank	
33	S.Kolathur Tank	
34	Selaiyur Tank	
35	Sembakkam Tank	
36	Semmanjeri Pudu Tank	
37	Semmenjeri Rettakuttai Thangal	
38	Sholinganallur Rettaïkeni Tank	
39	Sholinganallur Thamraïkeni Thangal	
40	Tambaram Peria Eri	
41	Tambaram Pudu Thangal	
42	Thiruneermalai Tank	
43	Vaiyavur Tank	
44	Ayavettan	
45	Ayenpappakudi	

46	Chinthamani tank	Madurai
47	Kannanendal tank	
48	Naganakulam	
49	Parasuramanpatti tank	
50	Puliyankulam	
51	S. Alangulam	Madurai
52	Samanatham	
53	Semandankulam	
54	sirudhur Tank	
55	Thuliapatti	
56	Usilampatti kanmoi	
57	Vandiyur Tank	
58	Athalai Tank	Sivagangai
59	Karaikudi Tank	
60	Kovilur-koneri Tank	
61	Agoor Chitteri	Thiruvallur
62	Ambathur	
63	Amirthapuram Tank	
64	Ammaneri Tank	
65	Arapatheri	
66	Ayanambakkam	
67	Boodur Tank	
68	Chellathur Tank	
69	Kakkalur Tank & Channel	
70	Koilpathagai	
71	Kolathur	
72	Korattur	
73	Madhavaram Rettai Eri	
74	Nadukuthagai	
75	Nallattur Tank	
76	Padiyanallur Tank	
77	Pakkam Large tank	
78	PalayaGummudipoondi Thamarai	
79	Paleripattu	
80	Panderavedu Tank	
81	Paruthipattu	
82	Perungavoor Tank	
83	Porur	
84	Pullarambakkam Tank	
85	Putlure Tank	
86	Rajanagaram Tank	
87	Senrambakkam Tank	
88	Sirungavur Tank	
89	Sothupakkam Tank	
90	Srivilasapuram Tank	
91	Thandurai	
92	Thannirkulam Tank	

93	Thinnaur	
94	Tiruttani Big Tank	
95	Vanganoor Tank	
96	Varadharajapuram& Chitteri	
97	Veeramangalam Tank	
98	Venkathur Tank	
99	Villinjiambakkam	
100	Kannanur Big Tank	Thiruvannamalai
101	Nochimalai Tank	
102	Paiyur tank	Thiruvannamalai
103	Chatrampudukulam	
104	Ilandaikulam	
105	Kandiaperikulam	
106	Karaiyiruppu kulam	
107	Keela kulam	
108	Mullikulam	
109	Nainarkulam	
110	Salaperikulam (Jegaveeraramaperikualm)	Tirunelveli
111	Seevalaperikulam	
112	Shencottaikulam	
113	Thamaraikulam	
114	Thanjavoorkulam	
115	Thattanpathukulam	
116	Udayarpattikulam	
117	Gidangal Tank	Villuppuram
118	V.Marudhur Tank	
119	Kondaneri tank	
120	Rajakularamaperi Tank	Virudhunagar
121	Sengulam	

Districtwise Polluted Tanks as reported by Environmental Divisions		
Sl.No.	Tank_Name	District
1	Arasanilayathan eri	Ariyalur
2	Kulumoor Peria eri	
3	Irugur tank	Coimbatore
4	Kannampalayam ta	
5	Kurichi tank	
6	Neelambur	
7	Odderpalyam tank	
8	Sulur Big tank	
9	Sulur small tank	
10	Kurinjipadi Periya Eri	Cuddalore
11	Serakuppam Iyaneri	
12	Ramakkal Tank	Dharmapuri
13	Aranmanai odaikulam	Dindigul
14	Nagasamudram	
15	Rengasamudram	
16	Sirunaicken kula	
17	Vaiyapurikulam	
18	Guduvanchery Tank	Kancheepuram
19	Silloor kulam	Kanyakumari
20	Subbaiyar Kulam	
21	Thathiyar kulam	
22	Umamanganeri kulam	
23	Vandaneri kulam	
24	Chandirambigai Tank	Krishnagiri
25	Devasamudhiram Tank	
26	Gollappatti Tank	
27	Kareem Shaib Tank	
28	Thally Big Tank	Madurai
29	Anaiyur Tank	
30	Ayavettan	
31	Ayenpappakudi	
32	Chinthamani tank	
33	Kanakkan kulam	
34	Kannanendal tank	
35	Kurunthankulam tank	
36	Parasuramanpatti tank	
37	Pudukkulam	
38	Puliyankulam	
39	Puliyur	
40	Rettaikulam	
41	Samanatham	
42	Siruthur Chinna Tank	
43	Thirupalai	
44	Vadakarai Kanmoi	

45	Vandiyur Tank	
46	Akkaraiyatti Tank	Namakkal
47	Mamundi Agraharam Tank	
48	Minnakkal Tank	
49	Semur Large Tank	
50	Keela eri	
51	Keelapuliyur tank	Perambalur
52	Kurumbalur tank	
53	Poolambady chitheri	
54	Thoramangalam Big tank	
55	Keelavettivayal kanmoi	Pudukottai
56	Keeranur Periyakulam	
57	Ottakkulam	
58	Pakkudi kanmoi	
59	Urvani kanmio	
60	Nenmeni	Ramanathapuram
61	Sellur	
62	Urapuli	
63	Vendhoni	
64	Biroji Tank	Salem
65	Deviyakurichi Tank	
66	Idappadi Large Tank	
67	Manivilanthan Palaya Tank	
68	Neikkarapatti Tank	
69	Sarvay Big Tank	
70	Sentharapatti Tank	
71	Eluvani Tank	Sivagangai
72	Enapuram	
73	Kaluvangulam	
74	Keelakaraisalkulam	
75	Melakaraisalkulam	
76	Vanthavasi	
77	Vellani	
78	Athikudy Tank	Thanjavur
79	Kalichamman Eri	
80	Karimuthu Eri	
81	Kasira Eri	
82	Mudalikulam	
83	Oddappankarikulam	
84	Periya Eri	
85	Pikathiyar Odai	
86	Samudram Eri	
87	Thaligaikulam Eri	
88	Urachi Eri	
89	Karuvelankulam	Theni
90	Maithalamannadi kulam	
91	Mandhaikulam	

92	Meerusamudram	
93	Ottukulam	
94	Udayakulam	Theni
95	Veerappanai kenkulam	
96	Kakkalur Tank & Channel	Thiruvallur
97	Pakkam Large tank	
98	Putlure Tank	
99	Thannirkulam Tank	
100	Venkathur Tank	
101	Irumbedu Tank	Thiruvannamalai
102	Kannanur Big Tank	
103	Nochimalai Tank	
104	Paiyur tank	
105	Thirumalai samudiram tank	
106	Venkikal Tank	Tirunelveli
107	Alanganeri	
108	Chatrampudukulam	
109	Ilandaikulam	
110	Keela kulam	
111	Mullikulam	
112	Nainarkulam	
113	Pattiyuthu kulam	
114	Pettai kulam	
115	Puliyoor Periya kulam	
116	Seevalaperikulam	
117	Thottiyam kulam	Tiruppur
118	Andipalayam	
119	Mannarai	
120	Mudalipalayam	
121	Samalapuram	
122	Sarkar periyapalayam	Trichy
123	Kollankulam tank	
124	Koothakudi eri	
125	Krishnasamutharam tank	
126	Kulathur Periyakulam	
127	Mavadi Kulam	
128	Navali Kulam	
129	Nawab kulam	
130	Sevanthan kulam	
131	Valavandhankottai		Vellore
132	Arakonam big tank	
133	Dharapadavedu tank	
134	Kavanoor tank	
135	Thirupathur Big Tank	
136	Chinnasalem Tank	
137	Emapair Eri	
138	Gidangal Tank	

139	Kallakurichi Small Eri	villuppuram
140	Kaveripakkam tank	
141	Thenkeeranur Small Tank	
142	V.Marudhur Tank	Villuppuram
143	Aruppukottai Big Tank	Virudhunagar
144	Kondaneri tank	Virudhunagar
145	Subramaniyapuram.A	
146	Thiruthankal periyakulam	
147	Vagaikulam Tank	

FORMAT - 2

Sl.No	Name of District	No. of waterbodies restored in past 5 years	
		PWD	
		Nos	Amount incurred
1	Ariyalur	40	14.0901
2	Chennai	4	79.18
3	Coimbatore	8	1.235
4	Cuddalore	114	74.2959
5	Dharmapuri	64	22.584
6	Dindugal	160	40.39
7	Erode	21	6.241
8	Kancheepuram	384	152.67
9	Karur	7	1.49
10	Krishnagiri	76	29.009
11	Madurai	502	98.83
12	Nagapattinam	5	11.7474
13	Kanyakumari	356	2.86
14	Namakkal	30	5.47
15	Perambalur	45	7.5907
16	Pudukottai	188	26.435
17	Ramanathapuram	263	114.29
18	Salem	74	28.81
19	Sivagangai	201	54.48
20	Thanjavur	108	18.787
21	Theni	93	26.69
22	Tiruvallur	161	97.69
23	Thiruvarur	28	11.3958
24	Thoothukudi	176	43.88
25	Tiruchirappalli	44	15.50
26	Tirunelveli	747	118.96
27	Tiruppur	15	12.137
28	Thiruvanamalai	101	23.7316
29	Nilgiris	-	-
30	Vellore	197	46.5738
31	Villupuram	282	62.5331
32	Virudhunagar	224	58.92
	TOTAL	4718	1308.4964

Sl.No.	District	No. of waterbodies in which restoration works are under progress	
		PWD	
		Nos	Amount incurred
1	Ariyalur	35	6.5802
2	Chennai	2	8.36
3	Coimbatore	2	0.556
4	Cuddalore	41	0.1121
5	Dharmapuri	24	12.40
6	Dindugal	37	9.372
7	Erode	0	0
8	Kancheepuram	72	71.21
9	Karur	0	0
10	Krishnagiri	16	10.11
11	Madurai	342	60.86
12	Nagapattinam	0	0
13	Kanyakumari	35	0.30
14	Namakkal	0	0
15	Perambalur	14	3.58
16	Pudukottai	117	8.6582
17	Ramanathapuram	77	13.41
18	Salem	0	0
19	Sivagangai	200	76.60
20	Thanjavur	102	17.3959
21	Theni	14	4.23
22	Tiruvallur	72	27.82
23	Thiruvarur	0	0
24	Thoothukudi	29	6.10
25	Tiruchirappalli	67	20.277
26	Tirunelveli	242	11.78
27	Tiruppur	10	2.507
28	Thiruvanamalai	60	29.312
29	Nilgiris	-	-
30	Vellore	42	15.3324
31	Villupuram	16	0
32	Virudhunagar	49	28.41
	TOTAL	1717	445.2728

Sl.No	Name of District	No. of Encroachments identified in various departments	No. of Encroachments removed in last 5 years in various departments
		PWD	PWD
1	2	3	12
1	Ariyalur	340	122
2	Chennai	11739	691
3	Coimbatore	1074	824
4	Cuddalore	887	887
5	Dharmapuri	2849	2460
6	Dindugal	217	36
7	Erode	401	57
8	Kancheepuram	3370	798
9	Karur	12	10
10	Krishnagiri	4986	4800
11	Madurai	874	332
12	Nagapattinam	0	0
13	Kanyakumari	4121	1639
14	Namakkal	100	0
15	Perambalur	618	618
16	Pudukottai	4923	4771
17	Ramanathapuram	1673	778
18	Salem	449	63
19	Sivagangai	589	426
20	Thanjavur	617	67
21	Theni	912	260
22	Tiruvallur	6476	967
23	Thiruvavarur	476	242
24	Thoothukudi	41	34
25	Tiruchirappalli	95	95
26	Tirunelveli	232	227
27	Tiruppur	1060	211
28	Thiruvanamalai	5878	1010
29	Nilgiris	-	-
30	Vellore	2879	2496
31	Villupuram	5442	4190
32	Virudhunagar	402	329
	TOTAL	63732	29440

**BEFORE THE NATIONAL GREEN
TRIBUNAL (SOUTHERN ZONE)
CHENNAI**

Original Application No. 295 of 2024 (SZ)

IN THE MATTER OF:

Suo Motu matter in respect of news item appearing in The Hindu dated 08.09.2024 titled "Lakes developed under Smart Cities Initiative in Coimbatore turn dumping grounds for plastic waste.

...Applicant(s)

Vs

Coimbatore City Municipal Corporation,
Through its Commissioner,
Coimbatore and Ors.

...Respondent(s)

**REPLY AFFIDAVIT FILED ON
BEHALF OF THE CENTRAL
POLLUTION CONTROL BOARD
(CPCB), RESPONDENT NO. 3**

Advocate D.S. Ekambaram

COUNSEL FOR CPCB