Building Block for

Solid Waste Management

Dr. Shyamli Singh   Prof. Vinod K. Sharma

Handbook for Urban Local Bodies Officers

Author - Dr Shyamli Singh, Prof. Vinod K. Sharma

Co Author - Kanika Garg, Kanishka Sharma

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It is our social responsibility as citizens of India to help fulfil Gandhiji’s vision of Clean India, by his 150th birth anniversary

- Shri Narendra Modi

FOREWORD

The 74th Constitutional Amendment marks a landmark moment in India's realm of urban local self governance, creating urban local bodies (ULBs) constitutional entities with the authority to provide better governance and more effective delivery of civic services to communities. It is therefore important for the states to devolve greater responsibility, power, and resources to the ULBs through the devolution of finances and officials envisioned in the Twelfth Schedule to the Constitution.

Amidst unparalleled economic growth and a rapidly increasing population, India is faced with a series of difficult decisions regarding its future. With a 7.4 percent average annual growth rate during the previous decade, the country will become the world's fourth largest economy in approximately two decades. Indian Institute of Public Administration, New Delhi holds the cause of Namami Gange programme in high priority. We have developed a complete training programme under the project "Blended Capacity Building Programme for Stakeholders of River Ganga" The modules have been developed in a clear and easy-to-understand manner for the Urban Local Bodies. Though mostly based on missions of Namami Gange and state governing municipal administration, it lends itself to customization to meet the special needs of other states and river bodies.

This programme has been envisioned in a strategic step towards increasing the capacity of Urban Local Bodies. I am happy to note that the progress made in this direction will inspire masses to re-imagine the current scenario of the country and put together an integrated vision and process of Urban Planning.

S.N. Tripathi (IAS) R
Director General, IIPA

PREFACE

Solid waste has always been a major source of environmental pollution as it sweeps into surrounding water bodies such as the Ganga and its tributaries, either purposely by people or by heavy rains during the monsoon season. The problem is complicated, especially for water bodies, because biodegradable trash requires a lot of oxygen to degrade, causing illness and death in aquatic organisms. When non-biodegradable garbage is present, the free flow of water is obstructed, and dangerous compounds are suspended in the water.

In order to restore the pristine nature of Ganga and its tributaries, it becomes essential to get rid of the waste and effectively curtail future pollution through Solid Waste Management. Solid Waste Management (SWM) is costly and complex for local governments but is essential to the health of the environment and quality of life of the people. Climate change and the consequences of greenhouse gas emissions have elevated SWM to one of the most important global and local environmental issues. Poor trash collection and disposal contribute to local outbreaks of disease, regional water resource pollution, and global greenhouse gas emissions. In addition, there is a need to turn to trash for resource recovery.

In the hope to qualitatively advance the solid waste management in India, the module is prepared for Urban Local Bodies by IIPA under the NMCG sponsored project "Blended Capacity Building Programme for Stakeholders of River Ganga." The module discusses the challenges faced by ULBs in collecting and treating solid waste, as well as the overall management of waste as a resource, including recycling, environmental issues, disposal, and other elements of municipal garbage, with a focus on the Ganga basin states. It examines India's situation by laying out measures taken and implemented by local governments, as well as drawing on examples of best practices from around the world to establish long-term waste management solutions. It is our sincere hope that this will benefit ULBs and local stakeholders, motivating them to work towards the common goal of River Rejuvenation.

Prof. Vinod K. Sharma **Dr. Shyamli Singh**
Faculty, IIPA

Target Groups

District Collectors

Urban Local Bodies

Panchayati Raj Institutions

Academia

Introduction

Rapid population growth and development activities in India have exacerbated resource depletion and environmental deterioration. This development has resulted in rural-urban migration, urban impoverishment, and unsustainable resource consumption, as well as increasing greenhouse gas emissions and other pollution from Municipal Solid Waste (MSW).

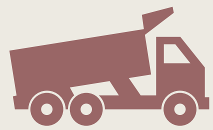
According to India's National Commission on Population (NCP), roughly 38.6% of Indians (600 million) will live in urban areas in the coming years (i.e., by 2036). India's urban population would nearly double between 2018 and 2050, from 461 million to 877 million, according to the UN. According to the CPCB statistics for 2014-2015, India generates about 1,43,449 metric tonnes of municipal solid waste (MSW) every day. To compound the matter, the country's total number of towns (statutory and census) climbed from 5,161 in 2001 to 7,936 in 2011, resulting in a 2,775 rise in municipal garbage generation in a decade. It is anticipated that if garbage is not disposed of in a more systematic manner, the country will require more than 1,400 km of land, similar to the size of the city of Delhi, by the year 2047 for its disposal.

The rapid development and increased waste generation is demanding for a renewed attention to the increasing problem of municipal solid waste management. Although Solid Waste Management (SWM) is a state subject, it is the urban local bodies (ULBs) that are directly responsible for it. They are required to plan, design, operate and maintain the SWM in their respective cities/towns.

The current practices of the uncontrolled disposal/dumping of untreated waste on the outskirts of towns/cities have created serious environmental problems including unabated pollution of rivers, emission of methane etc. It thus becomes imperative to formulate a visionary solid waste management policy that is sustainable. This module will guide the local authorities in the state to implement waste management in compliance with the regulatory framework of India. This will further help them to manage the rivers within their stretch.

>1.5 lakh metric tonne of solid waste is generated in India everyday

80% of the total collected waste is dumped in landfills



Out of the total, only **20%** waste is processed

70% of plastic is turned into waste in a short span of time

1.5 million to 5 million waste pickers collect, clean & segregate our recyclable waste every day

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8 million tonne of flowers
are discarded everyday

50 kg of food
is thrown away per person year

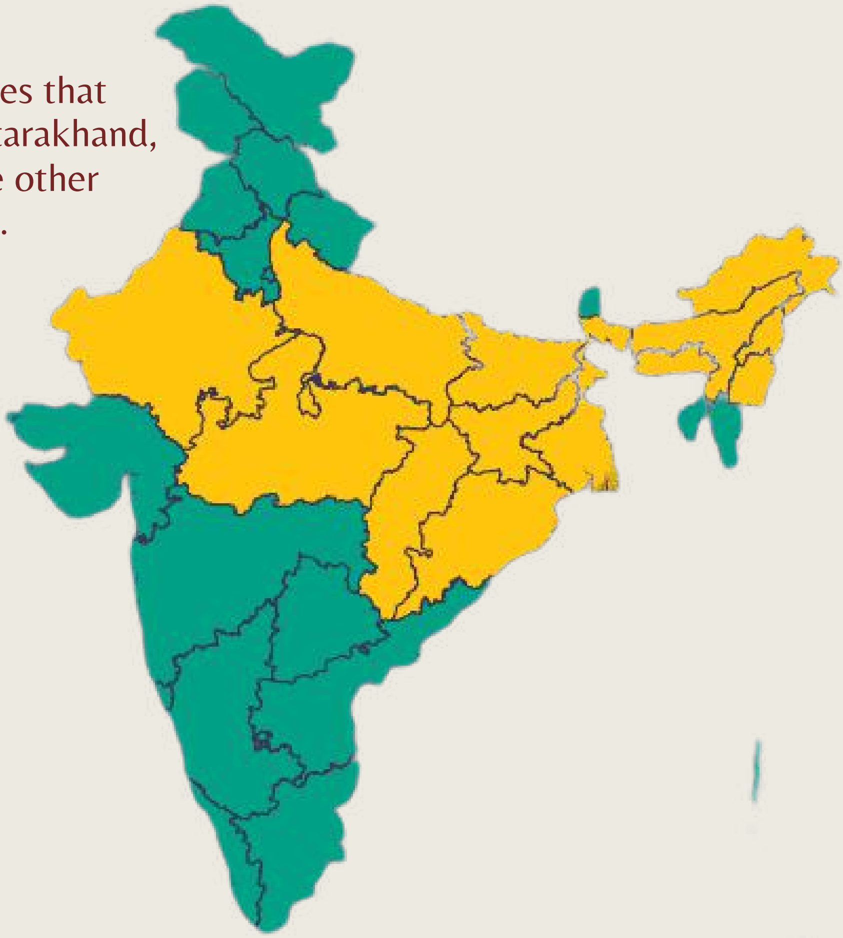
Pre-consumer textile waste
is the **3rd largest** contributor of solid waste

The waste management sector has the potential to create

12-15 million indirect jobs
3 million direct jobs

States & UTs performance on SDG India Index (2020-21)

The Ganga Basin states that are front runners (Uttarakhand, Haryana, Delhi) while other states are Performers.



Aspirant(0-49) Performer(50-64) Front Runner(65-99) Achiever(100)

Front Runner

Kerala
Himachal Pradesh
Tamil Nadu
Andhra Pradesh
Goa
Karnataka
Uttarakhand
Sikkim
Maharashtra
Gujarat
Telangana
Mizoram
Punjab
Haryana
Tripura
Chandigarh
Delhi
Lakshadweep
Puducherry
Andaman and Nicobar Islands
Jammu and Kashmir
Ladakh

Performer

Manipur
Madhya Pradesh
West Bengal
Chhattisgarh
Nagaland
Odisha
Arunachal Pradesh
Meghalaya
Rajasthan
Uttar Pradesh
Assam
Jharkhand
Bihar
Dadra and Nagar Haveli & Daman and Diu

Issues faced by ULBs

1 Process & Implementation

The lack of a systematic door-to-door collecting system, as well as the difficulties of expanding it to the entire city.

2 Social and behavioural

The public's lack of understanding of source segregation. Another issue is a lack of IEC and knowledge distribution by ULBs and the government.

3 Infrastructure

This includes a shortage of land for SWM, poor infrastructure upkeep, and a lack of vehicles for waste collection and transportation.

4 Administrative issues

Major impediments include a lack of public accountability, a communication gap between several ULB departments, and a lack of suitable institutional framework.

5 Planning & Policy

Lack of long term waste management plans and management of wastes from religious premises, slaughterhouses, gardens.

6 Human Resources Management

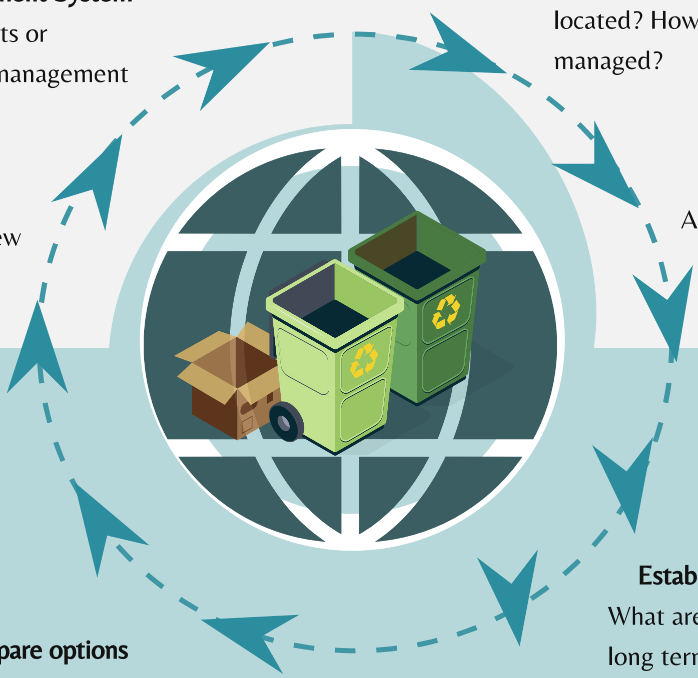
A lack of capacity building of ULB staff, inadequate training of existing workers, and a staffing shortfall.

Regulatory framework

Rules	Directives
MSW (Management and Handling) Rules 2000 and revised SWM, Rules 2016	▪ Municipal Solid Waste (Management & Handling) Rules, 2000 by MoEFCC ▪ Revised SWM Rules, 2016 circulated in the year 2016 by MoEFCC ▪ Designates Urban Local Bodies responsible for MSWM and lays down the mandatory functions to be performed by various stakeholders ▪ Separate rules for Construction and Demolition waste 2016
Revised Manual on Municipal Solid Waste Management, 2016	• Municipal Solid Waste Management Manual 2000 by MoUD and CPHEEO • Guidelines published by MoUD through CPHEEO in the year 2016 Provide implementation guidelines for all aspects of MSWM, including segregation, collection, transportation, treatment and disposal
Swachh Bharat Mission	• Swachh Bharat Mission guidelines published by the MoUD in 2014 • cover Household toilets, community and public toilets • solid waste management • with special focus on reorienting institutions as well as sensitizing citizens for developing citywide approach to sanitation including solid waste management through IEC and capacity building of the citizens and workers

National Urban Sanitation Policy (NUSP), 2008	• Policy prepared by the Ministry of Urban Development in 2008 z Broadly covers aspects of urban sanitation, with a specific focus to eliminate open defecation in cities • Focus on re-orienting institutions for developing city-wide approach to sanitation, covering all its aspects including Solid Waste Management
Rules for Special Waste	• Plastic Waste Management Rules, 2011 and revised in 2016 • Bio-medical Waste (Management and Handling) Rules, 1998 and amended 2003, 2011 and Bio-Medical Waste Management Rules, 2016 • E-Waste Management Rules, 2011 and revised in 2016 • Battery (Management and Handling Rules) 2001

THE APPROACH



Identify needs
What type of waste and in what quantities?

Review Existing Systems
Where are the uncontrolled dumps located? How is waste currently managed?

Review existing regulations
Are the existing laws adequate?

Organize Decision-Making process
Who will make the decisions?

Establish objectives
What are your short and long term goals?

Identify Potential Compoonents
Which waste management activities

Compare options
Which activities are the most cost-effective? Are they affordable in the long-run?

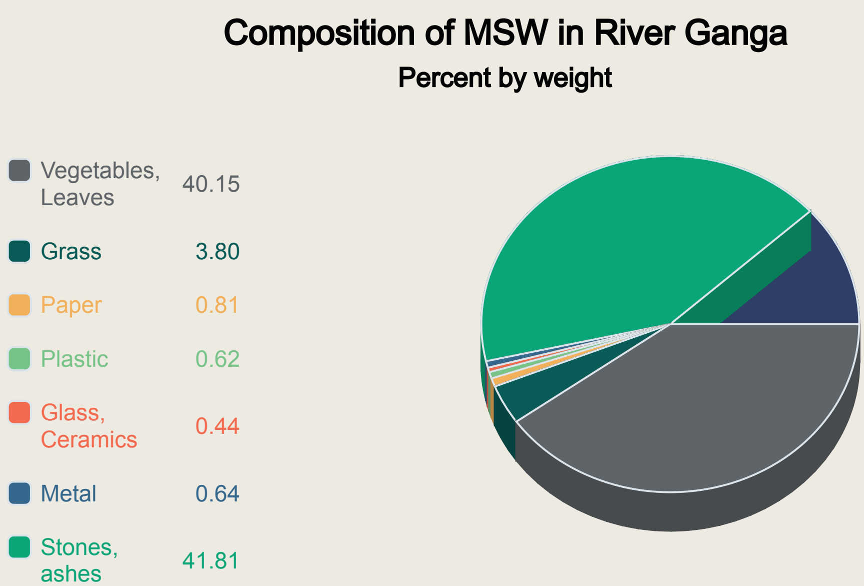
Develop the Integrated Solid Waste Management Plan
How will you finance building of facilities, obtain equipment, and hire & train workers?

Implement the Plan
When will you begin to conduct new or additional solid waste management activities?

Evaluate the Waste Management System
How can you make adjustments or improve/ expand solid waste management services?

Municipal Solid Waste

Household waste, construction and demolition debris (C&D), sanitation residue, and trash from streets, all of which are mostly created by residential and business complexes, fall into this group. According to the Ministry of the Environment, it includes solid or semi-solid commercial and residential trash generated in municipal or notified districts, excluding industrial hazardous wastes but containing treated bio-medical wastes.



Source:: Mishra N K, ASSESSMENT OF SOLID WASTE MANAGEMENT IN GANGA BASIN - VARANASI: A CASE STUDY. J Community Health Manag 2015;2(1):22 - 28

Approximately 40% of MSW is not collected at all, resulting in it being spread throughout the city/town and into local drains and water bodies, choking and polluting surface water. As a result of unsorted waste collection and transportation, open dumping occurs, resulting in leachate and gaseous emissions as well as a nuisance in the local environment. Nature, as indicated in the table, breaks down waste, but it does so at its own time, necessitating the management of piled-up garbage.

Degeneration time for biodegradable and non-biodegradable waste

Category	Type of waste	Approximate time taken to degenerate
Biodegradable	Organic waste such as vegetable and fruit peels, leftover foodstuff, etc	A week or two
	Paper	10-30 days
	Cotton cloth	2-5 months
	Woollen items	1 year
	Wood	10-15 years
Non-biodegradable	Tin, aluminum, and other metal items	100-500 years
	Plastic bags	One million years
	Glass bottles	Undetermined

Municipal Solid Waste Management Planning

7-STEP APPROACH

STEP 1

POLICIES, PROGRAMMES AND LEGAL FRAMEWORK

- Identify National & State Policies/ Strategies and their goals
- State Level/ Regional/ District SWM Strategies/Policies
- Identify Overall Goals for ULBs
- Role of Central/State and Local Government
- Institutions & Stakeholders involved in MSWM Planning

STEP 2

ASSESSMENT OF CURRENT SITUATION AND GAP ANALYSIS

- Legal & Policy Framework
- Institutional & Financial Setup
- Technical Aspects
- Community Participation
- MSW Generation, Collection & Transportation
- Availability & Suitability of Land for Processing &Disposal
- MSW Processing, Treatment and Disposal
- Current Status of Dump Sites
- Environmental Concerns

STEP 3

STAKEHOLDER CONSULTATION FOR MUNICIPAL SOLID WASTE MANAGEMENT PLANNING

STEP 4

PREPARATION OF DRAFT MSWM PLANNING

- Future Projections
- Rules, Regulations & Municipal Bye-laws
- Institutional & Financial Structuring
- Storage, Collection, Transportation
- Best Available Site & Technology for processing & Disposal

Future Projection: Estimating future waste generation quantities and composition is critical for developing MSW Management plan. Planning horizons for MSW processing, treatment, or disposal projects typically extend to 20–30 years, depending on the nature of the facility. Forecasting future MSW generation is dependent on various factors, such as

- future population forecasts;
- anticipated lifestyle changes;
- change in socio-economic profile of the ULB

STEP 5

SCHEDULE FOR IMPLEMENTATION

- Timeline
- Manpower requirement
- Financial

STEP 6

STAKEHOLDER CONSULTATION FOR MSWM PLAN VALIDATION

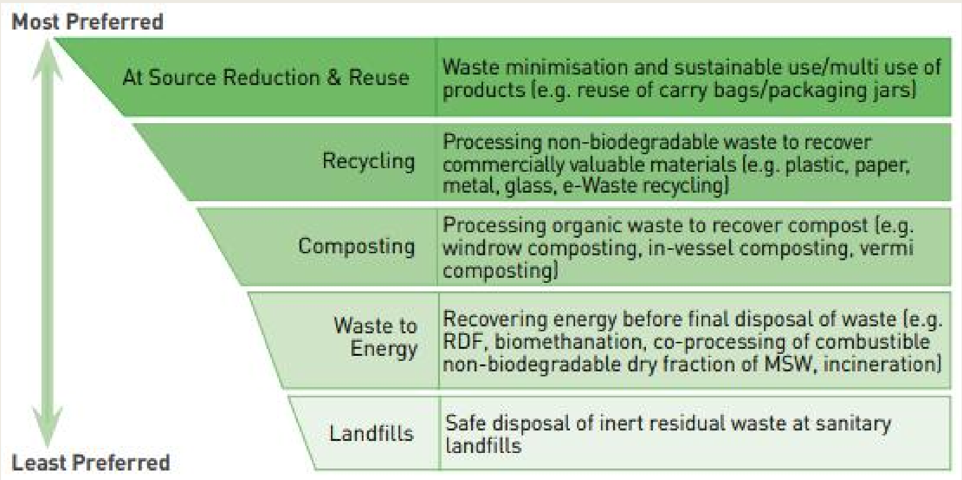
STEP 7

MUNICIPAL COUNCIL APPROVAL FOR MSWM PLAN AND PLAN IMPLEMENTATION INCLUDING PPP

Integrated Solid Waste Management Plan

The Integrated Solid Waste Management (ISWM) hierarchy provides a waste management hierarchy with the goal of reducing waste disposal while increasing resource conservation and efficiency. The ISWM must be incorporated into their city's or town's overall municipal solid waste management strategy.

Integrated Solid Waste Management System Hierarchy



Source:: MUNICIPAL SOLID WASTE MANAGEMENT MANUAL Central Public Health and Environmental Engineering Organisation (CPHEEO)

The following are two approaches for operationalizing a municipal solid waste management plan that have been suggested:

1. Centralised Method

Door to door collection

Handover to collection team

Collected waste discarded in the landfill

2. Decentralised Method

Ward-wise collection of Waste → Segregation at source into biodegradable & non-biodegradable

↓

Biodegradable waste is composted, non-biodegradable waste is further segregated → Further collected by recyclers for upcycling or downcycling

Waste Minimization, Segregation, Collection and Transportation

The most preferred waste management option, according to the ISWM hierarchy, is to eliminate the formation of garbage at various stages, such as during product design, manufacture, packing, usage, and reuse. Waste prevention lowers the cost of waste processing, treatment, and disposal, as well as the environmental consequences of leachate, air pollutants, and greenhouse gas emissions (GHG). The most popular waste prevention measures include reducing waste generation at the source and reusing things.

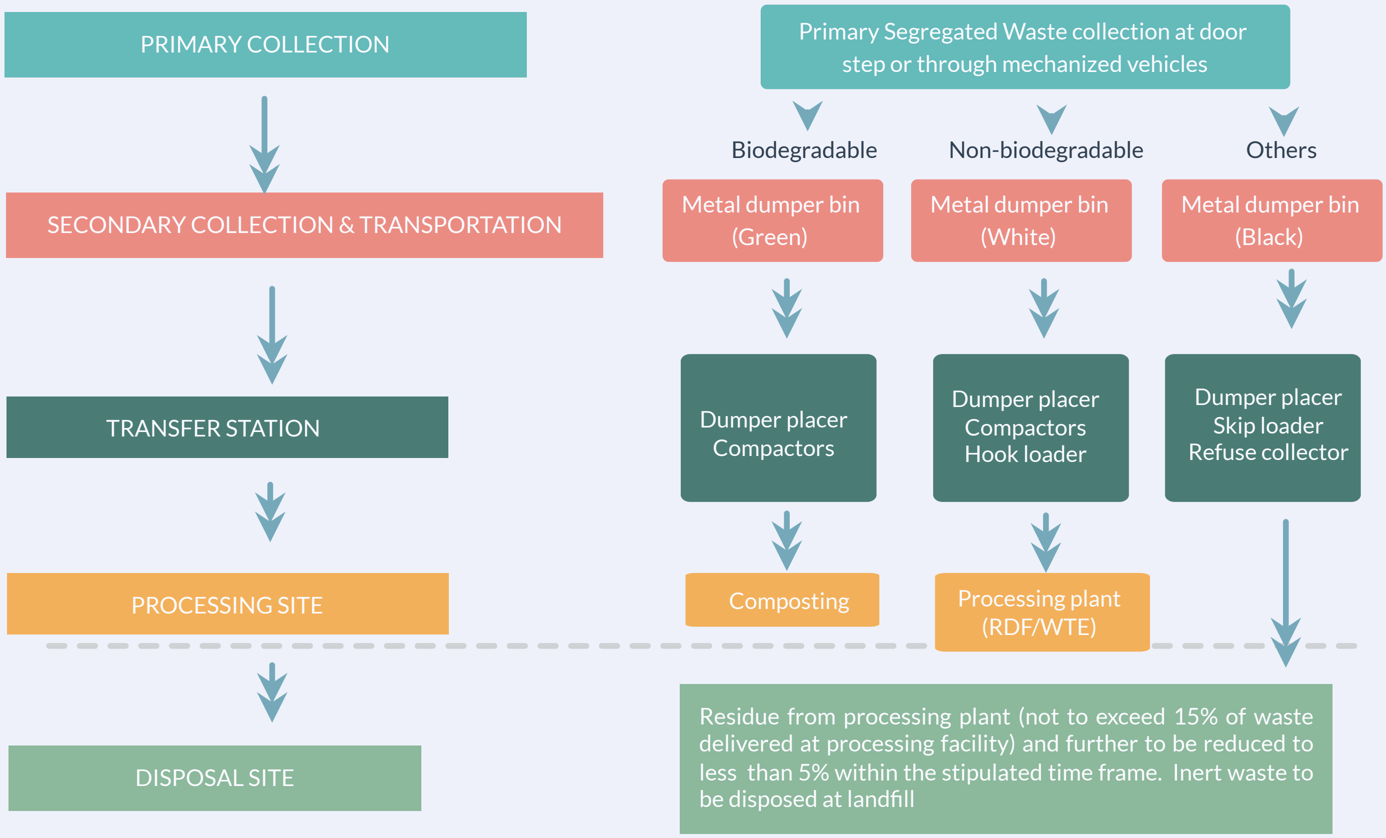
The SWM Rules, 2016 define segregation as the sorting and storage of various components of solid waste, such as biodegradable wastes such as agriculture and dairy wastes, non-biodegradable wastes such as recyclable waste, non-recyclable combustible waste, sanitary waste, and non-recyclable inert waste, domestic hazardous wastes, and construction and demolition wastes. If waste is separated at the source, it can be collected and transported for further processing. There is a significant proportion of segregated material that can be reused or recycled as a result of waste separation, resulting in lower virgin material consumption. Biodegradable waste bins must be painted green, recyclable waste bins blue, and other waste bins black. While household garbage is collected on a daily basis, garbage from markets, businesses, and institutions may be collected twice a day. The type of vehicle utilised to collect garbage at the curb is determined by the volume of rubbish produced and collected. Separate containers are necessary for the collection of diverse fractions (wet, dry, and home hazardous garbage); at a minimum, ULBs must collect wet and dry trash separately.

Figure: Waste collectors at River Banks of Ganga

Basic Segregation					
Wet Waste	Dry Waste with further sub segregation				Domestic Hazardous
Food wastes of all kinds, cooked and uncooked, including eggshells and bones, flower, fruit and waste including juice, vegetable peels and household garden/plant wastes. Soiled tissues, food wrappers, paper towels; fish and meat	Paper cardboard and cartons	Containers & packaging of all kinds excluding those containing hazardous materials Compound packaging (tetrapak, blisters etc.) Plastics	Rags Rubber Wood Discarded clothing Furniture	Metals Glass (all kinds) Inerts House sweepings and inerts (not garden, yard or street sweepings)	E-waste* Hazardous wastes** Household medical waste*** Batteries from flashlights and button cells. Lights bulbs, tube lights and Compact Fluorescent Lamps (CFL) Car batteries, oil filters and car care products and consumables

* E-waste includes printers and printer cartridges, as well as electronic parts and equipment. * Hazardous wastes: Chemicals and solvents, as well as their empty containers, paints, oil, lubricants, glues, thinners, insecticides, pesticides, and herbicides, as well as their empty containers, photographic chemicals, bleaches, and household kitchen and drain cleaning agents *** Household Medical Waste: Thermometers and other mercury-containing products, as well as their empty containers

Collection, Transportation and Disposal of waste



The 2016 SWM Rules require ULBs to conduct an information, education, and communication (IEC) campaign to raise public knowledge regarding MSWM operations. Ensuring active community engagement strengthens communities and encourages the informal sector, non-governmental organisations (NGOs), and community-based organisations (CBOs) to provide recyclable materials to environmentally friendly recycling facilities. A campaign should be started to decrease the use of non-recyclable, non-reusable, or toxic materials. Individuals should also be taught how to sort waste on their own property into biodegradable, dry, and special waste and hand it over to waste collectors. Regular meetings between ULB employees and representatives of RWAs, market organisations, NGOs, SHGs, and other stakeholders should be organised to promote successful uptake of such programmes. The community should be involved in the design of the primary collection system, including the selection of garbage collection systems and schedules.

Treatment and disposal options for Solid Waste

When it comes to treatment technology, the ULBs must make well-informed decisions and deal with commercial partners on a tipping fee basis. According to the SWM Rules, 2016, all Class I cities in the state must have both compost facilities and landfill sites, whereas other cities or towns with populations under 1 lakh must only have suitably designed landfill sites.

The following concepts underpin the various technologies for municipal solid waste management treatment and disposal:

1.**Thermal treatment**: Incineration is the process of converting waste into carbon dioxide, water vapour, and ash by burning it in the presence of oxygen. It is a way of recovering energy from waste that is also known as the Waste to Energy (WtE) method. Its benefits include reduced trash volume, lower transportation costs, and lower greenhouse gas emissions. When waste is burned, however, toxins like mercury, lead, and dioxins are discharged into the atmosphere, posing a health risk.

2. **Pyrolysis and gasification**: This approach involves heat processing in the absence of oxygen or with a little amount of oxygen.

3. **Biological treatment methods**: Microorganisms are used to degrade waste's biodegradable components. The two types of processes are as follows: Windrow composting, aerated static pile composting, in-vessel composting, vermiculture, and other aerobic composting methods require the presence of oxygen. Anaerobic digestion occurs when there is no oxygen present.

4. **Landfills and open dumping**: Sanitary landfills are the controlled disposal of trash on land in such a way that waste-to-environment interaction is minimised and waste is concentrated in a well-defined region. Dumps are open sites where garbage is dumped and exposed to the elements, stray animals, and birds. Because there is no monitoring and no leachate collecting mechanism in place, both land and water resources are contaminated.

Choosing Appropriate Technology

The ISWM hierarchy should be used to guide the technology selection for SWM processing, treatment, and disposal in a ULB.

The collection of segregated waste improves the efficiency of garbage processing and treatment facilities. Recycling should always take precedence over segregation of recyclables for later use or recycling. To safeguard human health and the environment, it is vital to have access to adequate recycling enterprises.

Organic waste can be composted aerobically or utilised in energy-generating anaerobic decomposition processes.

Material with a high calorific value should be segregated further and used in cement factories for co-processing or as a fuel in properly designed and controlled industrial boilers.

Varied waste to energy options are available for different levels of trash generation. Based on the characteristics and volumes of waste created by each ULB, the technologies should be extensively assessed and selected.

Only in ULBs where a minimum of 1000 TPD of mixed garbage can be supplied daily to the plant should incinerator designs be considered, and only after higher-order technologies in the ISWM Hierarchy have been implemented.

For these plants to operate in an environmentally friendly manner, process and environmental controls, as well as system monitoring, are essential. Technologies that are still in development, such as pyrolysis, gasification, and bioreactor landfills, should not be implemented until their commercial feasibility has been proved in India. 15 percent of the mixed waste stream is expected to be rejected in an integrated composting and RDF facility. The proportion of rejections from mixed waste is determined by the presence of non-biodegradable items, which are eliminated during the pre-sorting stage.

Plastic Waste Management

The Plastic Waste Management Rules, 2016, govern the disposal of plastic waste. The responsibilities of urban local bodies (ULBs) for controlling plastic waste are outlined in these rules. The majority of discarded plastics end up in municipal trash streams. Reuse and recycling of plastic waste are the preferable strategies for managing plastic wastes following reduction, according to the integrated solid waste management (ISWM) hierarchy. Plastics, on the other hand, cannot be recycled indefinitely; each recycling cycle lowers the plastic's strength and utility. Plastic garbage clogs up the drainage system, resulting in flooding in many areas. It is necessary to take immediate action on waste management (with a focus on minimization) and disposal.

In cement kilns, plastic waste is allowed as fuel; residence times and temperatures are sufficient to prevent the development of dioxins and furans. Plastic waste incineration for energy recovery could be considered under carefully controlled and monitored settings. In India, reusing plastic trash to create polymer blended bitumen roadways is a common way to dispose of plastics. Plastics should not be disposed of in landfills.

BAD FOR THE RIVER. BAD FOR US.

We use tons of plastic, massive amounts of which ends up in the water bodies. It contains toxins, which further impacts marine life.

Out of 120 marine mammal species on the threatened list have been observed entangled or ingesting plastic.

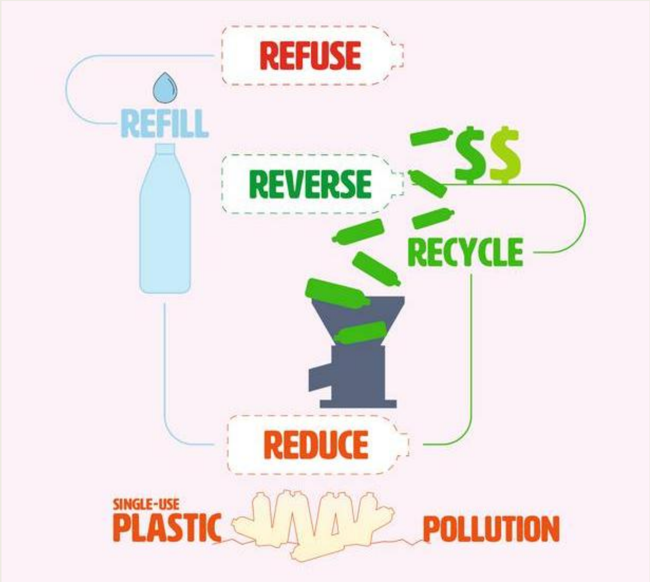
Chemicals used in plastics like phthalates and flame retardants have been found in fish, sea mammals, and other marine life.

Aviral-Reducing Plastic Waste in the Ganga

Aviral - Reducing Plastic Trash in the Ganga is a project supported by the Alliance to End Plastic Waste (AEPW) and implemented by the German development agency GIZ with the goal of reducing plastic waste into the ecosystem. Through capacity-building efforts at the local level, the pilot project is creating techniques for sustainable and resilient plastic waste management solutions and exhibiting best practise examples. The effort builds on the National Mission for Clean Ganga (Namami Gange) and the Clean India Mission's existing flagship programmes (Swachh Bharat Mission).

Aviral collaborates with local stakeholders from Haridwar and Rishikesh Municipal Corporations, as well as the private sector, informal waste workers, schools, and local NGOs, to pilot an approach based on four key axes of capacity enhancement, value chain, innovation & engagement, and awareness, while embedded in the broader plastic waste management ecosystem. Enhance municipal capacity and knowledge to adopt a more strategic approach to plastic waste management. To improve infrastructure throughout the value chain while increasing technical resources, with a particular focus on waste segregation. To support local businesses and start-ups in developing cutting-edge solutions to minimise waste and encourage recycling. Engaging and educating through public awareness campaigns and clean-ups, as it is believed that people and visitors will be more likely to practise sustainable plastic waste management. Aviral, which means "continuous" in Hindi, emphasises the goal of creating a circular system for plastics and regenerating natural environments.

Plastic pollution and garbage are becoming more prevalent, posing a threat to human health, animals, and biodiversity around the world. Cities, in particular, have the issue of managing rising plastic waste creation and expanding landfills, often without fully utilising the benefits and resources available. Aviral aims to promote a new approach to plastics and prevent riverine and marine litter by assisting places like Haridwar and Rishikesh in developing sustainable plastic waste management methods, maintaining the Ganga's uninterrupted flow.



Source: The Hindu. 2020. Plastic disposal in India - The long road ahead.

Construction and Demolition Waste Management

The Government of India has deemed it appropriate to formulate a separate regulation for construction and demolition waste, namely the Construction and Demolition Waste Rules, 2016, which describes the roles and responsibilities of the various stakeholders as well as the compliance criteria for the management of construction and demolition waste. Construction and demolition waste is defined as “waste consisting of building materials, debris, and rubble originating from the construction, modification, repair, or demolition of any civil structure,” according to the guidelines. Bricks, tiles, stone, dirt, rubble, plaster, drywall or gypsum board, wood, plumbing fixtures, non-hazardous insulating material, plastics, wall paper, glass, metal (e.g., steel, aluminium), asphalt, and other construction and demolition trash are examples of C&D waste. Hazardous waste, as defined by the Hazardous and Other Wastes Act, is not included in C&D trash (Management and Trans boundary Movement).

Large generators must be rewarded for establishing in-situ processing facilities. For large facilities, such as those serving cities with populations of a million or more, processing should be done using technology that minimises process residues for landfilling, such as the "wet" process, which can recover sand grade material (4.75 mm to 75 mm) from soil and other fine inert material. Schedule II allows for the continued use of processed C&D materials in sanitary landfill operations. While processed C&D trash will be disposed of in the city or region's sanitary landfill for MSW, residues from the C&D waste processing or recycling industry will be disposed of in the sanitary landfill for MSW.

Sanitary Landfills

Sanitary landfills, in accordance with the Solid Waste Management (SWM) Rules of 2016, use the following strategies to reduce the adverse impact of solid waste on the environment:
a) leachate collection and treatment to reduce groundwater pollution;
b) runoff control to control surface water contamination

The following waste types are eligible for sanitary landfills:
Non-biodegradable and inert trash, either naturally or through pretreatment;
commingled waste (mixed garbage) not found appropriate for waste processing;
pre-processing and post-processing rejects from waste processing sites; and
non-hazardous waste not processed or recycled.

Source:https://www.hindustantimes.com/cities/sanitary-landfill-site-not-identified-in-a-year/story-Uhxc6KukpDKjN7WHTHrLTP.html

The strategy stated in the state policy and SWM strategy, as well as the municipal solid waste management (MSWM) plan of the urban local body, will guide the selection of a sanitary landfill site (ULB). These plans or planning documents are used to make decisions about building local landfills versus using regional dumps. The following steps are frequently included in site selection:

1. Location criteria
2. Search Area
3. Development of a list of potential sites
4. Data collection for potential sites
5. Field visit for local verification & identification
6. Selection of best ranked sites
7. Preliminary environmental impact investigation, and
8. Final site selection

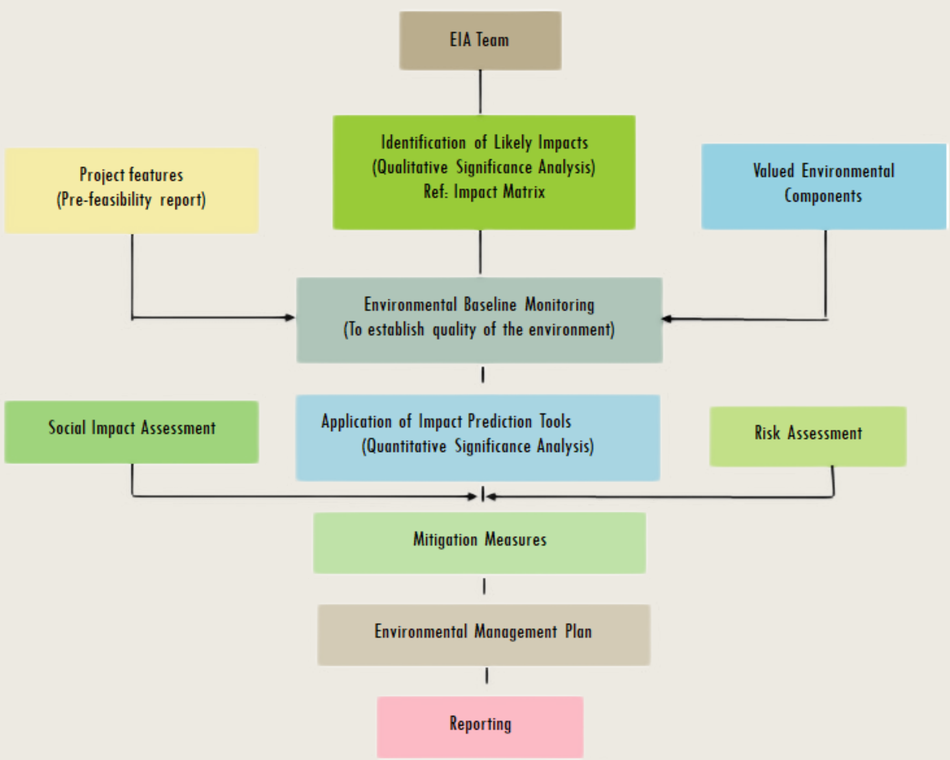
Environmental Impact Assessment Requirements

Based on the spatial scope and potential implications on human health, natural, and manufactured resources, the EIA Notification of 2006 split all infrastructure projects or activities into two categories: Category A and Category B.

All common MSWM facilities are considered Category B projects. However, facilities are considered Category A projects if they are located wholly or partially within 10 km from the boundary of following: wildlife reserves or protected areas (under The Wildlife Protection Act, 1972); critical polluted areas identified by the Central Pollution Control Board (CPCB); eco-sensitive areas as notified under Section 3 of the Environment Protection) Act, 1986; interstate boundary (this will not be applicable if states or union territories allow project setup in their land); and international boundary.

EIA is a multi-stage process that identifies and quantifies the unique environmental and ecosystem implications of a proposed project. The public consultation phase of the EIA approval procedure is crucial. Concerns of local residents and anyone with a realistic stake in the project's or activity's environmental implications are sought.

Approach for EIA Study



Source: Technical EIA Guidance Manual, for Common MSWM facilities

Legacy Waste Management

MSW dumps that turn into virtual mountains have sparked concern, prompting the Hon'ble NGT to order the CPCB to draught a Standard Operating Procedure (SOP) for the implementation of bio-mining and bioremediation of legacy solid waste. Legacy garbage pollutes the entire ecosystem surrounding the dump site, increasing the danger of uncontrollable fires and other hazards.

Solid waste dumps that have reached capacity or won't be able to accept any more waste following the construction of new, properly built landfills should be closed and repaired after a thorough study of the site. To avoid future legacy trash production, collection, recovery, and long-term disposal, local authorities and Panchayats were required to assess and analyse all existing dumpsites in accordance with the guidelines. ULB is responsible for ensuring that the dumpsite is remedied either in-house or by contacting a professional agency. ULB will have to pay an agency for the cost of legacy waste cleanup because it is impossible to predict the likelihood of collecting recyclables from severely polluted garbage or the money generated from selling recyclables in order to keep the entire model afloat. ULB can use one of the five models for legacy waste bio-remediation and bio-mining, or develop its own cost-effective, space-efficient, and sustainable solution, introduce new technology, or install various other machinery/equipment based on the practical circumstances of legacy waste. It is not a good idea to cap dumpsites. However, if there is a scientific landfill site for municipal trash that has been built according to MoEF&CC's standards and recommendations and has been filled to capacity, the idea of capping can be explored.

Financial & Contracting mode for implementation of MSWM Plan

Planning for a comprehensive MSWM system should be based on precise financial estimates that account for all relevant expenditures, including hidden costs and revenues. The cost implications should be factored into the municipality's solid waste management plan. It is proposed that a full cost account be studied in order to narrow down the entire cost involved in the plan's implementation. The following are the components of complete cost accounting to consider:

Elements of full cost accounting

Front end costs

- Land
- Permits
- Building Construction
- IEC Activities

Capital costs

- Fixed cost for plant and machinery
- Cost of capital

Operating Costs

- Debt service cost
- O&M maintenance costs involved in daily activities
- Cost of refurbishments

Contingent Costs

- Remediation Costs
- Liability Costs (e.g., property damage personal injury)

Back-end costs

- Site closure
- Building & Equipment decomissioning
- Retirement & health benefit for empolyees

Environmental Costs

- Costs involved in mitigating environmental effects
- Downstream impacts

Social Costs

- Quality of life
- Aesthetic impacts
- Community image
- Effects on property values

Monitoring and Evaluation of MSWM Plan

With the purpose of continuing progress toward achieving service delivery standards, the MSWM plan should be evaluated every 2–3 years, depending on current plans for the urban area and the size of the area for which the plan is prepared. The following are the service level benchmarking (SLB) indicators from the Ministry of Urban Development (MoUD):

Performance Indciators	Unit	Definition	Minimum frequency of performance measurement & reporting	Smallest geographical area for measurement
Extent of segregation of municipal solid waste	100%	Percentage of households and other establishments that segregate their garbage into wet and dry waste at the source.	Monitoring of performance – daily Reporting and Evaluation– monthly	Ward level
Extent of municipal solid waste recovery	80%	Percentage of municipal waste recovered or processed by the ULBs, households and informal sector	Monitoring of performance – daily Reporting and Evaluation: monthly	Ward level
Extent of scientific disposal of municipal solid waste	100%	Percentage of waste disposed at the landfill, which is designed, operated and maintained as per set standards	Monitoring of performance – daily Reporting and Evaluation – monthly	ULB level
Efficiency in redressal of customer complaints	80%	Percentage of complaints related to municipal waste management redressed within a given time period	Monitoring of performance – daily Reporting and Evaluation – monthly	Zone of ULB level
Extent of cost recovery in SWM services	100%	This indicator denotes the extent to which the ULB is able to recover all operating expenses relating to SWM services from operating revenues of sources related exclusively to SWM.	Monitoring of performance – quarterly Reporting and Evaluation – annually	ULB level
Efficiency in collection of SWM charges	90%	It is defined as current year revenues collected, expressed as a percentage of the total operating revenues, for the corresponding time period	Monitoring of performance – quarterly Reporting and Evaluation – annually	ULB level

STATUS AS PER THE LATEST MPR OF STATES

Uttarakhand

No. of MSW Processing Facilities- No facility exists
Utilization of existing MSW Processing facilities- NIL
Total no. of wards- 1130
Wards with Door to door collection service- 1130
No. of wards practicing segregation at source: 913

Urban Population- 3440814
Urban Local Bodies- 91
Municipal Solid Waste Generation- 1255.77 TPD approx
Bio-Medical Waste generation- 3.81 MTPD
Total plastic waste generation- 183000 MTPA

Uttar Pradesh

No. of MSW Processing Facilities- 16 plants
Installed Capacity- 5.475 TPD
Utilization of existing MSW Processing facilities- 5.475 TPD
Total no. of wards- 12022
Wards with Door to door collection service- 12022
No. of wards practicing segregation at source: 8924

Urban Population- 4.5 Crore
Urban Local Bodies- 651
Municipal Solid Waste Generation- 14468 TPD approx
Bio-Medical Waste generation- 37.21 MT/Day
Total plastic waste generation- 254401.8 Ton per annum

JHARKHAND

No. of MSW Processing Facilities- 1
Installed Capacity- 50 TPD
Utilization of existing MSW Processing facilities- 50 TPD
Total no. of wards- 932
Wards with Door to door collection service- 883
No. of wards practicing segregation at source: 798

Urban Population- 58,42,555
Urban Local Bodies- 50
Municipal Solid Waste Generation- 2228 MTPD
Bio-Medical Waste generation- 7256.957 Kg/Day
Total plastic waste generation- 43332 Ton per annum

BIHAR

Urban Population- 1.28 crores
Urban Local Bodies- 142
Municipal Solid Waste Generation- 4281.27 TPD approx
Bio-Medical Waste generation- 27846.15 kg/day

Total no. of wards- 3398
Wards with Door to door collection service- 3398
No. of wards practicing segregation at source: 3295

WEST BENGAL

No. of MSW Processing Facilities- 18 plants
Installed Capacity- 1778 TPD
Total no. of wards- 2645
Wards with Door to door collection service- 588

Urban Population- 20905615
Urban Local Bodies- 125
Municipal Solid Waste Generation- 1778 TPD approx
Bio-Medical Waste generation- 41571.4 kg/day
Total plastic waste generation- 300236.12 MT/year

*Data has been collected from latest NGT related MPR received from states.

NMCG's action plan

In the meeting of the Central Monitoring Committee (CMC) constituted by Hon'ble NGT held in the month of July, 2021 regarding polluted river stretches. NMCG reflected on its efforts and action plan with regard to Solid Waste Management, that would further help in maintenance and conservation of River Ganga. NMCG along with MoHUA has come up with a document regarding rivers and Cities Master plan titled "Strategic Guidelines for Mainstreaming Urban River Master Plans". State-wise action plan of NMCG has been mentioned below.

JHARKHAND

Out of 36 MSW processing plants proposed in Jharkhand, 35 plants have been sanctioned and 5 plants are yet to be sanctioned.

UTTAR PRADESH

37 new proposed plants are expected to be operational by March 2022.

The deadline for operationalization of plant at Fatehpur has been shifted to March 2022 from June 2021.

The deadline for operationalization of 7 plants at Sambhal, Badaun, Mirzapur, Ballia, Rampur, Jhansi & Rampur have also been revised to March 2022 from October 2021.

The land issues for 8 SWM plants at Bareily, Firozabad, Loni, Nazibabad, Bhadoi, Basti, Gorakhpur & Akbarpur that are still unresolved will be looked into.

UTTARAKHAND

Out of 91 ULBs in State, DPRs have been approved for 88 ULBs and sent to Government of India.

550 tonnes of SLF is operational at Haridwar and Dehradun. State is exploring possibilities of establishing Waste to Energy plants.

NMCG receives a number of representations on solid waste being dumped in Uttarkashi, which is an eco-sensitive zone. Therefore, State may develop solid waste management facilities in consultation with experts in the field.

WEST BENGAL

Works related to Solid Waste Management in 12 model towns are to be completed within one year. No legacy waste is found dumped within 1 kms of rivers. Scientific solid waste processing has started in 21 ulbs

BIHAR

NMCG indicated that critical issues pertaining to ongoing projects needs to resolved for timely completion of projects.

Swacch Bharat & Ganga Rejuvenation

Swachh Bharat represents Indian culture's inherent cleanliness. The restoration of the "Nirmal and Aviral Dhara" would be critical to the rejuvenation of the Ganga, which serves as the umbilical lifeline for the Ganga Basin's socioeconomic mosaic. The Prime Minister established the Swachh Bharat Mission to ensure that all solid waste created is managed scientifically. In order to achieve swachhata, the focus must move from a segmented method to a complete, integrated, and targeted approach to the Ganga river basin. Since ever-increasing population pressure has resulted in networks of irrigation canals and densely populated cities generating household, industrial, and commercial waste, which is disposed of in the Ganga and its tributaries, the problem has been exacerbated by excessive water withdrawal and waste refuse in the rivers, resulting in an extremely polluted drainage system. The Swachh Bharat Mission's particular focus on Ganga rejuvenation is a subset of the Swachh Bharat Mission's overall goal of reducing pollution. The process of converting the drive into a long-term process gains momentum and efficacy. The Rivers will have to be brought back to life. Unnecessary pollution and water depletion will have to be reduced.

Case study

01

Gorai Dumping Ground, Mumbai : Scientific Landfill Closure and Methane Capture

Source: Swachh Bharat Urban and Mid-day

The Gorai dumpsite in Mumbai was the first known example of a garbage dumpsite being capped scientifically in India. This is a specific example of a dumpsite that was closed and capped in a systematic manner. This strategy would normally be acceptable for a dumpsite that has been closed and new rubbish dumping has stopped. The Gorai dumpsite is located in Mumbai's western suburbs and has been in operation since 1972. The 19.6-hectare site is close to a village and near Gorai Creek. Around 2.34 million tonnes of trash were piled up to a height of 26 metres at the location, inflicting significant environmental harm to the creek and the surrounding area and making the situation unsustainable.

The Municipal Corporation of Greater Mumbai (MCGM) took the challenge and established a scientific plan for controlled closure and scientific capping based on a thorough survey and collaboration with Infrastructure Leasing & Financial Services Ltd (IL&FS) (Environmental Division).

Outcomes

The project's outcomes are as follows:

The quality of life in the neighbourhood has significantly improved, according to residents.

- The project has resulted in the creation of 19 hectares of green space and the regeneration of mangroves that had been destroyed due to toxic leachate from the landfill.
- The effort has improved public health and cleanliness, as well as reducing foul odours, fires, and vermin nuisances, as well as enhancing stream water quality and increasing bird population.
- Property values in the neighbourhood increased as the MCGM's property tax collection increased.

The initiative's proved impact is a critical aspect that might be adjusted to local needs and replicated across the country's historic open dumpsites.

Garbage dumpsite closure and scientific capping are required to reduce pollution potential. Leachate enters groundwater, vector breeding occurs, and air pollution occurs when old dumpsites are left untreated and allowed to deteriorate. More leachate is created as precipitation infiltrates the system. This process continues for years until the waste material gets stagnant, which in warm regions might take anywhere from 20 to 50 years.
The following items were included in the scientific closure plan:

(I) laying of construction and demolition (C&D) waste and compaction;
(ii) laying of liner system consisting of: (a) top vegetation layer; (b) 300 mm thick top soil layer; (c) geocomposite layer; (d) 1.5 mm geomembrane layer; (e) 200 g/m2 and 400 g/m2 geotextile; and (f) 300 mm thick drainage layer;
(iv) construction of a landfill gas collecting, venting, and flaring system;
(v) installation of a leachate collection system (LCS) employing perforated pipes along the fill's perimeter, followed by storage in a leachate tank and delivery to the nearest sewage treatment plant (STP)
(vi) sheet piling on the seaward side to prevent leachate from entering the creek;
(vii) surface water drainage to channel storm water;
(viii) construction of bunds, access roads, and a compound wall on the landward side of the site;
(ix) landscaping, greenery, irrigation, and lighting of the area; and
(x) post-closure care for 15 years with close monitoring of indicative parameters such as leachate.

The construction and operation and maintenance (O&M) contract for this project was given to a collaboration of an Indian and a German company through open competitive bidding. The construction took 24 months and cost over Rs.50 crore, with the operation and maintenance costing around Rs.12 crore for 15 years of post-closure care.

Bodhgaya-Floral Waste to Khadi Dye

Case study

02

Source: This Bihar Startup Is Turning Floral Waste Into Natural Dyes (youthkiawaaz.com)

The Mahabodhi Temple Complex is one of four sacred locations associated with the life of the Lord Buddha, specifically his achievement of Enlightenment. Devotees at Bodhgaya's Mahabodhi Temple offer over 50-60kg of flowers. According to the statistics of the Bodhgaya Temple Management Committee (BTMC), 50-60 kilogrammes of flowers are used every day at the temple during the lean pilgrim season, and 300-400 kilogrammes of flowers are utilised during the high pilgrim season, which occurs between December and February.

Taking inspiration from the dilemma, NIFT alumni Praveen Chauhan founded MATR, a social organisation that aims to recycle waste and promote the usage of Khadi in the international market. MATR handles the temple's garbage by transforming floral waste into natural dyes and increasing Khadi sales by appealing to people's sentimental attachment to the temple's flowers and leaves.

Key highlight

The enterprise is helping in solving the floral waste problem in the temple and providing sustainable livelihood opportunity to the local artisan and women through a social revenue generating model without increasing the burden on the treasury of the temple trust. The idea of the project is simple and could be easily scaled up in other holy pilgrim sites of the country.

The "Happy Hands Project" was launched by MATR in collaboration with Because of Nature, an Australian sustainable clothing designer. By reusing discarded flower debris from the old Mahabodhi Temple to generate natural dyes for Khadi items, the programme aims to provide local women with long-term employment. To conduct the initiative "Happy Hands Project," the Bodhgaya Temple Management Committee (BTMC) signed a Memorandum of Understanding (MoU) with "MATR" and "Because of Nature."On September 15, 2018, the project was officially launched. A training programme for 50 women was held during the first 10 days. They not only learned, but also shared their opinions on the various colours of dyes that can be made from flowers in the workshop. Because marigolds, which come in only three colours (orange, yellow, and dark brown), account for 95% of the flowers donated at the temple, the team devised creative techniques to make khadi clothing appealing. After days of testing, it was discovered that the dye may be reused numerous times, each time producing a lighter hue.

Process:

Every morning, five women from the organisation visit the temple, collect temple rubbish, and transport it to a tiny cluster 6 kilometres outside of town. The marigold blooms are color-coded and stored for drying. The flowers are dried, then pulverised by hand and stored for boiling. The next stage is mordanting (the use of a mordant or dye fixative to set dyes on fabrics). The fabric is treated in amla juice and washing soda before drying. Hundreds of hues of Khadi can be made from marigolds depending on the dyer's skill.

MATR produces a variety of khadi clothing, the majority of which are exported overseas. Ninety percent of the profit is distributed among "MATR," "Because of Nature," and the ladies. The remaining 10% of the proceeds from Khadi sales is donated to the Bodhgaya Temple.

The project's long-term goal is to serve the holy town of Bodh Gaya's 60-70 large temples and hundreds of lesser temples. The "Happy Hand Project" wants to utilise all of the temple's floral waste and expand the business by hiring 200 more women from the communities. The fabric is currently available for purchase through shops. The team will spin and weave the fabric on their own starting next year.

Guwahati: Non-recyclable Multilayered Plastic Waste Recycling

Case study

03

Source: Segregating waste to save Guwahati | The Third Pole

The municipal corporation's Health and Sanitation Department is responsible for Guwahati's solid waste management. In the city, there is 100% door-to-door collection. The Guwahati Municipal Corporation (GMC) is divided into 31 wards, with one NGO assigned to each ward for primary collection and street sweeping, as well as dumping the garbage collected to neighbouring secondary collecting bin/s. The work of the Primary Collection is overseen by the ward's Sanitary Supervisors. The collection of monthly User Charges from families and commercial entities is also entrusted to NGOs..

Recommendation

Guwahati has been able to achieve 100% door to door collection through convergence with local NGO, the next step for the city should be towards source segregation and treatment of different waste streams in a scientific manner. The municipal corporation should try to revive the ISWM plant and promote household and community-based initiatives.

The NGOs employ a total of 450 people who operate a total of 480 tricycles and 64 autotippers across the city. GMC manages the secondary collection and transportation (C&T) with a fleet of contemporary compactors and tippers. Zonal engineers and supervisors are in charge of this, with the help of a fleet of hand carters and sweepers. In Guwahati, there are two working Transfer Stations on RGB Road near Nursery, Ganeshguri, and Bhangagarh. On a daily basis, 85-90 percent of waste is hauled to the Boragaon dump site, which spans 48 acres of land.

The Windrow composting factory contains all of the necessary technology to create 200 MT of compost each day. This factory is now not operational since the requisite segregation is not achieved, and it generates low-quality compost that is polluted with plastics and heavy metals. The facility was developed at a cost of roughly Rs 5 crore.

The IAS Colony has just launched a zero-waste campus programme in collaboration with Environ, a local Guwahati NGO. There are 60 families in the IAS colony, which generate 70 kilogrammes of wet garbage every day. The waste in the colony is separated and utilised to generate compost. A portion of this dry organic waste, which consists of dried leaves, flowers, and twigs, is also used in the composting pile, which is gathered from the campus's lawns and gardens. The goal of the project was to promote community-based composting in Guwahati. Within the premises, the compost and leachate obtained are used for horticulture purposes. Following the project's success, similar programmes to manage garbage at the source have been launched in various Guwahati colonies. Guwahati generates 37 MT of non-recyclable multilayered plastic garbage every day, accounting for 12.37 percent of the state's total production. Taking the gravity of the situation into account, three Assam Engineering College engineers, Rupam Choudhury, David Pratim Gogoi, and Mousum Talukdar, established Zerund Bricks Manufacturing Pvt. Ltd. with an initial capital cost of Rs. 50 lakhs. The company manufactures innovative Plastic Embedded Light Weight Bricks from multilayered plastic waste produced from plastic carry bags, biscuits & chips packs, and other chocolate wrappers, all of which contribute to environmental issues. The company contributes to the management of 600 kg of plastic waste every day by using it to make bricks. Because the brick is lighter than red clay bricks, the total dead load of the structure is reduced by up to 40%, lowering the overall cost of the structure. The brick is now available in a larger size. The bigger size reduces the total number of mortar joints in the walls, resulting in reduced cement and sand consumption in the joints and, as a result, lower infrastructure construction costs. “Green Recycling Industry” at Bongshar, Kamrup is Assam's only Plastic Bottle Recycling Unit, where 3MT waste Polyethylene Terephthalate (PET) bottles are recycled for the production of 'Hot Washed PET Flakes.' Flakes and PET powders are used to make various polyester garments and second-grade PET bottles. Trash collectors take the waste plastic bottles and compress them into bundles. The bales are subsequently delivered to the processing plant. After arriving at the facility, the sorting procedure begins, with pet bottles being segregated from other debris. It is recycled into PET flakes, which are a novel form of recycling. These flakes are then transferred to various factories where they are processed into various finished goods.

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Indian Institute of Public Administration

Indraprastha Estate, Delhi - 110002
Website- www.iipa.org.in

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