HOLISTIC WASTE MANAGEMENT STRATEGY FOR VARANASI CITY

नगर निगम, वाराणसी

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November 2018

UN environment
United Nations Environment Programme

नगर निगम, वाराणसी

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Table of Contents

List of Tables

List of Figures

Abbreviations

CPHEEO	Central Public Health and Environmental Engineering Organization
C&D	Construction and Demolition
HIG	High Income Group
IEC	Information, Education and Communication
ILFS	Infrastructure Leasing & Financial Services Private Limited
kWh	Kilo Watt hour
LIG	Low Income Group
LCV	Light Commercial Vehicle
MIG	Middle Income Group
MSW	Municipal Solid Waste
NA	Not Available
NGO	Non-Governmental Organization
PPE	Personal Protective Equipment
SOP	Standard Operating Procedure
TPD	Tonnes Per Day
VNN	Varanasi Nagar Nigam

Executive Summary

With a population close to 1.3 million[1], Varanasi generates roughly 445 Tonnes Per Day (TPD)[2] of municipal solid waste, which is collected and transported along with other streams of waste including construction and demolition waste. The city is a major religious center and hence attracts a significant tourist population. With approximately 25,000 pilgrims visiting the city every day, environmentally sound waste management plays a key role in social, cultural and economic activities of the city. While some of the generated waste is processed in the compost and Refuse-derived fuel (RDF) plant and in the decentralized biomethanation plants, a major portion of the generated waste is openly disposed in a landfill/dumpsite.

In order to strengthen solid waste management in the city, Varanasi Nagar Nigam has prepared this "Holistic Waste Management Strategy for Varanasi", with support from the UN Environment Programme - International Environmental Technology Centre (IETC) and ICLEI – Local Governments for Sustainability, South Asia. The holistic approach to waste management shuns the traditional "silo" approach towards sectoral management of waste and promotes maximum resources utilization, improved efficiency and thereby taking a step towards circular economy.

Through this holistic waste management strategy and action plan, Varanasi Nagar Nigam intends to enhance local technical capacity, improve waste segregation and processing , enhance technical know-how of concerned officials and ensure active stakeholder involvement, without which a sustainable waste management system would not be possible..

The strategy is proposed for a 15 year planning horizon and is based on the principles of integrated solid waste management (ISWM), which not only focuses on technical aspects of MSWM but also addresses issues of waste minimization, reuse, and recycling, and of socio-cultural (inclusivity), institutional, financial, and legal aspects. The proposed interventions are in consonance with the new National Solid Waste Management, Rules 2016 and such compliance is considered in developing this strategy.

1. Projected population for the year 2018 in this study
2. Projection as per the present study

The key features of the Holistic Waste Management Strategy for Varanasi include:

- Promoting waste minimization by providing incentives, recycling, and resource recovery at source or as near to the source as possible
- Introducing and institutionalizing segregation at source, door to door collection of waste, street sweeping standards to meet the norms of SWM Rules, 2016
- Strategic approaches tailored to the city, specially, narrow, congested and dense areas of the city
- Strategies to ensure reliable service delivery
- Focus on collection and transportation of waste from ghats and temple areas
- Strategies for improving the existing operation of decentralized and centralized processing facilities to treat all the waste generated
- Need for a scientific disposal of waste is highlighted and the approximate area, capacity of sanitary landfill required over the time of next 15 years is provided
- The importance of training and capacity building of municipal staff, awareness of community and informal sector through Information, Education and Communication (IEC) activities
- Success of 100% segregation and door to door collection of waste is contingent on an effective tripartite cooperation between community, informal sector and municipal staff.

The strategy focuses on a decentralized and participatory approach for tapping the economic value of waste management as against the existing waste disposal centric approach. Institutional integration, citizen engagement and capacity building of staff responsible for municipal solid waste management are at the core of this Strategy. It is understood that strategies are dynamic and need to be tracked, updated and strengthened as demanded by external and internal situations. This requires that the strategies are well supported through appropriate institutional adoption with work instructions and proper allocation of responsibilities.

This action plan would facilitate the achievement of Varanasi's Vision of 'Nirmal Kashi' as envisioned under the Smart City Proposal and along the lines of Swachh Bharat Mission.

Vision

The vision behind this holistic solid waste management strategy is to develop the oldest living city of Varanasi into a "clean, green and livable city by adopting sustainable integrated waste management practices thereby providing healthy and quality life to its citizens".

Mission

Varanasi is one of the oldest cities with rich culture, spiritual depth and traditional components which gives it a status of religious capital of India. Under its Smart City Plan, the city aims to develop as 'Nirmal Kashi' which has improved scientific sustainable solid waste management in place.

The mission of the city is to facilitate and provide improved solid waste management services to all in a systematic, proactive, participatory and cost effective manner to maximize resource recovery thereby protecting public and environmental health.

Goal of Holistic Waste Management Strategy for Varanasi

In order to achieve the vision of developing Varanasi into a clean, green and livable city, following strategies were identified on the basis of the analysis of existing situation:

- **Strategy 1:** To introduce and promote at source waste reduction and reuse initiatives.
- **Strategy 2:** To ensure 100% coverage of street sweeping, primary and secondary collection and transportation services to prevent open dumping and burning of waste
- **Strategy 3:** To ensure 100% processing and scientific disposal of waste to ensure improved public health and environment of the city
- **Strategy 4:** To strengthen and build capacity of the existing institutional structure of Varanasi Nagar Nigam and other key stakeholders for providing improved solid waste management services

The overall goal of the holistic waste management strategy is to help **"the city of Varanasi to develop into 'Nirmal Kashi' with an improved integrated solid waste management system that is financially and environmentally sustainable, socially inclusive and contributes to an improved quality of life".**

Figure 1: Vision-Mission and Goals Identified for Varanasi

Holistic Waste Management Plan for Varanasi City

The holistic waste management plan for the city of Varanasi identifies suitable and optimal waste management strategies based on a multi-pronged approach, utilizing technical, environmental, social and economic considerations. The holistic approach promotes maximum resource utilization, improved efficiency of municipal solid waste management services and reduced disposal at landfill sites, thereby helping the city to move towards a circular economy.

Based on the above philosophy and to achieve compliance with the revised Solid Waste Management Rules, 2016 (Annex 1), and other statutory rules and regulations and therefore moving towards the goal of Swachh Bharat Mission, the strategy for Varanasi Nagar Nigam (VNN) encompasses the principles of Integrated Solid Waste Management Hierarchy (Figure 2). The strategy will be implemented with a wide range of stakeholders. Some of the key stakeholders and their roles are also identified in Annex 2.

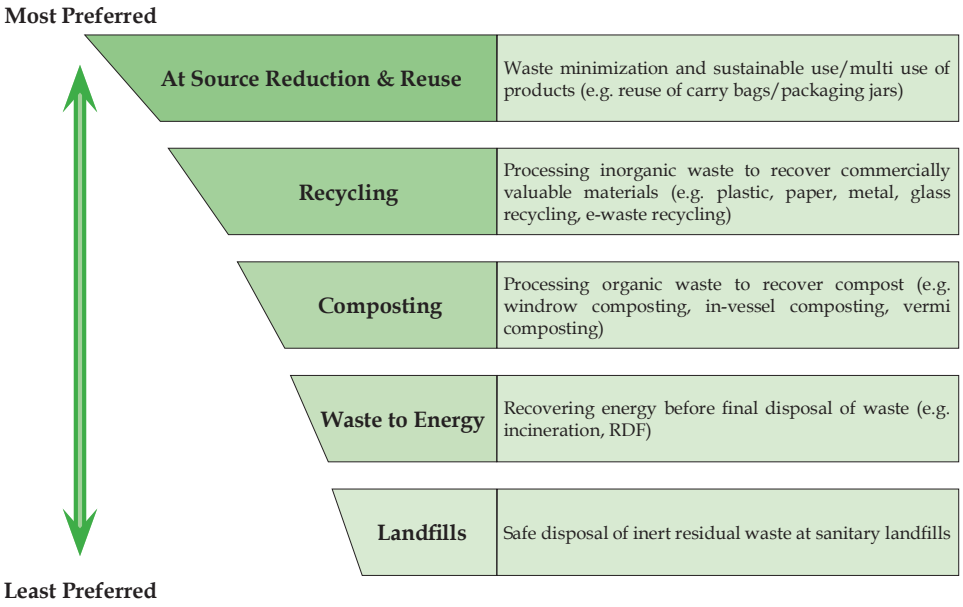

Figure 2: Integrated Solid Waste Management Hierarchy[3]

Strategy 1: To introduce and promote at source waste reduction and reuse initiatives.

Objectives:

- To implement principles of 3Rs (Reduce, Reuse and Recycle) to optimize resource management and reduce waste generation at source
- To promote initiatives like Extended Producer Responsibility (EPR), tax incentives and eco-labeling
- To promote segregated storage of waste at source
- To bring all stakeholders together and raise awareness to promote segregation

3. CPHEEO, Manual on Municipal Solid Waste Management, 2016

1.1. Waste Minimization

Waste minimization i.e. reduction at source and reuse is the first tenet of the Holistic Waste Management Strategy. It ensures minimized impact on health and environment and also results in reducing resources required for waste management, be it infrastructure, land, energy or other natural resources.

At the local level, framing rules and enacting local by-laws for banning use and/or sale of certain types of products and packaging that cannot be reused, repaired, recycled, or composted, will promote waste minimization. For e.g. banning of polythene and promotion of cotton bags could be the first step towards waste minimization. Awareness generation and education programs in schools and institutions, focusing on waste minimization and 'at source' waste management programs like household level composting; yard waste composting, will enhance community participation and uptake.

1.1.1. Storage at source

To introduce and implement the practice of segregated storage of waste at source, VNN is in the process of distributing color coded (green for wet waste and blue for dry waste) dust bins to households.

1.1.2. Actions to implement segregated waste collection

As part of the implementation of the holistic waste management strategy, the community should be sensitized and made aware to segregate waste at source and store it in different coloured bins. Segregating waste at source will ensure that waste is less contaminated and will enable efficient waste treatment/ processing. Several waste management plants are able to treat/process either the biodegradable/wet fraction or the non-biodegradable/ dry fraction of solid waste. When such facilities receive mixed waste, their efficiency is considerably impacted.

Figure 3: Color coded dust bin distribution to households in Habibpura

- **Residents** should segregate waste and store it in a segregated manner, in the color coded buckets provided by VNN.
- **Commercial waste generators** should also be sensitized to segregation and store waste at source.

Commercial waste typically consists of a significant portion of non-biodegradable waste and a minimal amount of biodegradable waste. Waste storage bins provided in commercial areas should be appropriately sized, considering this aspect. Based on the quantum of waste being generated by each facility, either bins (for entities producing less than 10 kg. of dry waste daily) or large size bags that can be reused (for entities producing between 10 kg. to 50 kg. of dry waste daily) may be made available/provided by VNN.

- **Bulk waste generators** including hotels, institutions and community halls having an average waste generation rate exceeding 100kg. per day should be mandated to segregate waste at source and practice on-site processing like composting, vermicomposting etc.
- A **green protocol** should be introduced to enforce event organizers to provide the necessary infrastructure and information for ensuring waste minimization and segregated waste collection. Such segregated waste is then to be collected by municipal sanitary workers. At present public events result in extensive littering and consequent unhygienic conditions in the area.

In order to inculcate the practice of segregated storage of waste at source, a sustained Information, Education and Communication (IEC) campaign needs to be implemented at the ward level, addressing questions on 'Why to segregate' and 'How to segregate'. Promotion of waste segregation needs to be implemented in a phased manner where:

- **Phase I:** focuses on households and commercial waste generators who should be made aware immediately by one-to-one interaction as well as mass awareness programs. Awareness generation activities should be a continuous process for at least six months (0-6 months) to sensitize at least 75 percent of households in each ward.
- **Phase II:** bulk generators including hotels and institutions etc. should be addressed for at least six months (0-6 months). Penalties for defaulters and rewards for good segregation practices should be introduced.
- **Phase III:** Awareness generation in areas with huge floating population like temples, ghats and vegetable/fruit/flower markets should be focused diligently for a longer time frame. IEC activities in these areas should be conducted throughout the year (0-12 months) owing to high footfall of tourists and pilgrims. VNN along with market association /shopkeepers / vendors should jointly organize IEC activities to engage customers in awareness creation. This initiative should be periodically repeated in subsequent years.
- Local groups or 'Mohalla Committee' should be formed in each ward to monitor waste management activities. VNN should also identify 'local champions' or an IEC campaign officer for each ward to engage and communicate with citizens thereby promoting zero garbage neighborhoods. The local champions or Mohalla Committee should also be felicitated from time to time on the basis of sensitization and awareness generated.
- Considering the religious importance of the city, it is necessary to bring religious leaders on board to support improvement in waste management activities. Stakeholders representing all temple authorities, ghats and other places of worship should be consulted for improving the waste collection and transportation activities. If possible, representatives from temples should be identified to monitor waste management in temple and ghat areas. Focus on discouraging devotees/visitors from using polythene bags. Adequate number of sign boards indicating location of bins and prohibiting littering should be put up. Appropriate signage that also appeals to the religious and cultural sentiments of the people will ensure that the Holy City is always kept clean. The location of litter bins may also be included in the mobile app which currently provides locations of public convenience facilities.
- Schools and colleges should also be involved in building the momentum for creating awareness. Students can be appointed as 'Safai Champs' to help in spreading the messages of segregation and other good practices in their school and nearby residential areas.
- VNN should also conduct healthy competition of cleanliness among wards, schools, temples, ghats and markets thereby motivating and building the enthusiasm.

Strategy 2: To ensure 100% coverage of street sweeping, primary and secondary collection and transportation services to prevent open dumping and burning of waste

Objectives:

- To provide infrastructure and manpower for ensuring separate transportation of segregated waste to promote maximum recovery of recyclables from entire city
- To ensure synchronization between primary and secondary collection in order to avoid spillage of containers, littering or manual handling
- To ensure that street sweepings and drain silt are not mixed with household wastes to avoid contamination
- To train, capacitate and integrate the informal sector for providing door to door collection services

2.1. Primary Collection

2.1.1. Actions for Improving Primary Collection

Providing for primary collection of waste is the first step towards an effective waste management system and VNN needs to strategically plan its infrastructure as well as manpower to be able to provide for this service. The primary waste collection system in the city can be a mix of motorized door to door collection (auto-hoppers, tractors etc.) and manual waste collection in areas inaccessible by vehicles. In order to ensure that waste is suitable for processing, the segregated waste should not be mixed during collection and transportation of waste. It is recommended to collect segregated wet and dry waste in carts provided with 8 bins/3 bins or compartmentalized vehicles. This will also increase efficiency in use of the existing machinery.

In order to improve the primary collection of waste for the city, the following infrastructure and manpower requirement is proposed:

- Push carts with 3 bins of 20 litre capacity for slums and narrow congested areas; cycle carts with 8 bins of 20 litre capacity and auto hoppers for rest of residential areas
- Auto hoppers (capacity of 0.6 tonne) for commercial and ghat areas
- It is proposed to use wheel barrows for collecting waste from narrow and inaccessible areas of markets, temples, commercial and hotels.

Since wheelbarrows are used for primary collection in several locations, in order to avoid manual handling of waste during transfer to the secondary collection system, it is suggested to install portable compactors with a tip cart mechanism. The tip cart mechanism will provide flexibility for manual feeding, wheel barrow feeding, and feeding by small vehicles thereby avoiding manual handling of waste. VNN should take measures to reduce the usage of wheel barrows to only street sweeping in future by replacing them with 8 bin/ 3 bin cycle carts / push carts in the future.

All the existing Kuda Ghars will be replaced by three transfer stations to improve the secondary collection services.

The proposed primary collection plan has considered the factors of accessibility to narrow and densely populated streets, requirement of segregated collection, distance to the secondary collection points and ease of operation. The system also incorporates specific utilization of the community bins for segregated collection of waste.

The primary waste collection from households can be divided into the following categories:

- **Category A –** Wards within 2Km radius of upcoming transfer stations: segregated waste is collected using cycle carts and 3 bin carts (for narrow streets) and directly disposed at transfer stations in segregated manner. Upto 5 TPD of wet waste from wards within close proximity to biomethanation plants should be transported directly to the plant for processing.
- **Category B –** Densely populated wards outside 2 Km radius of transfer stations: segregated waste collected using cycle carts and 3 bin carts (for narrow streets) disposed at community bins in segregated manner. Presently, 160 bins of 1.1 cu.m with capacity of storing 80 TPD (considering density of 500 kg/cu.m) of waste is available in the city. Additional number of community bins will be required to ensure segregated waste storage.
- **Category C –** Less densely populated wards outside 2 Km radius of transfer stations: waste collected using LWVs and disposed at transfer stations in segregated manner.

It is suggested that the wet waste from wards in proximity to the three biomethanation plants (upto 15 TPD) should be directly taken to these facilities, while rest of the wet waste should be taken to transfers stations to be compacted and transported to compost plant. In future, some of the wet waste could be processed in the proposed additional biomethanation plants based on their location and capacity. Combination of three bin push carts and cycle trolleys should be used in wards with narrow streets and high population density as shown in Figure 4.

It is further recommended to implement the following collection practices for maximum efficiency:

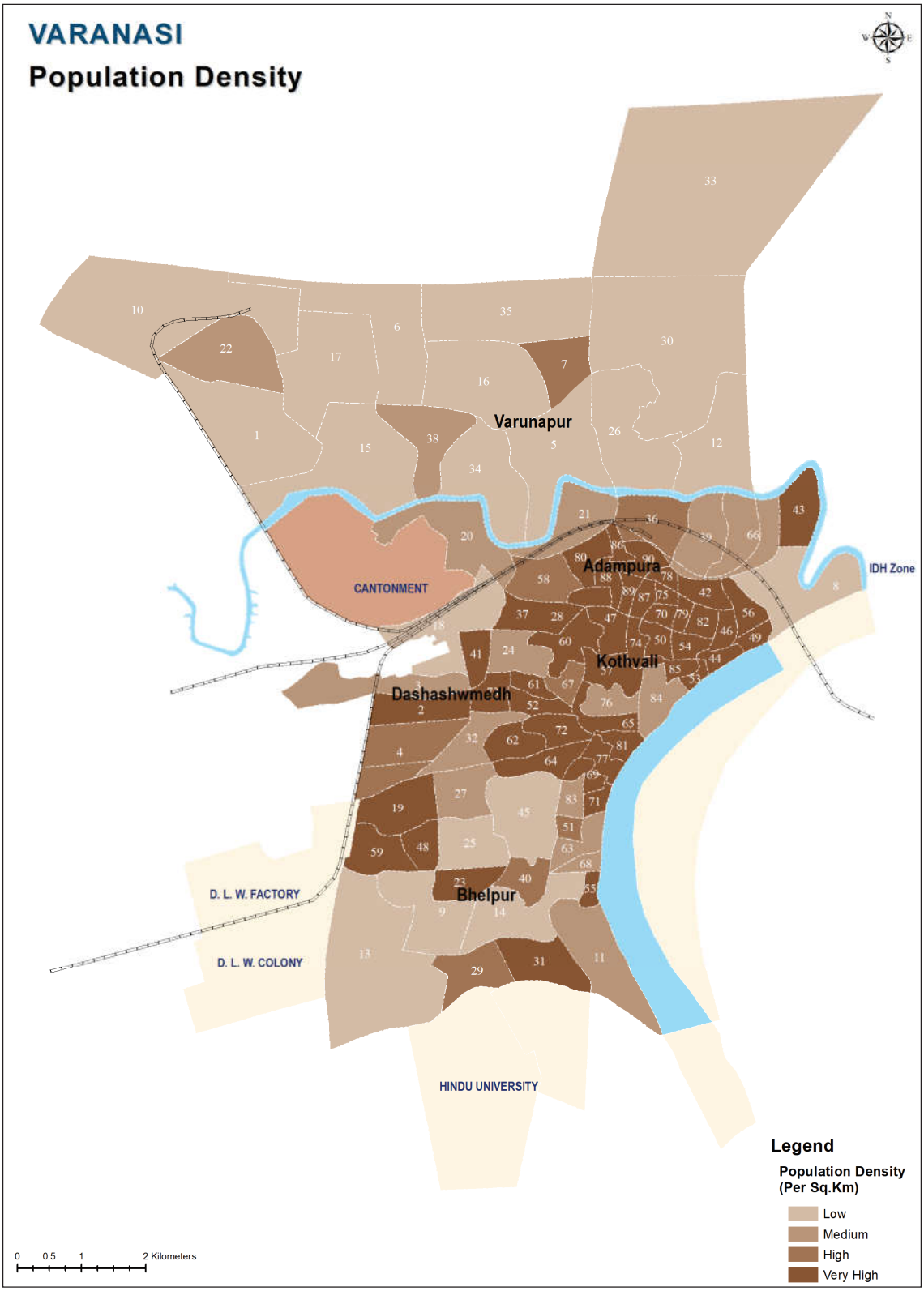

Figure 4: Population density map of Varanasi Nagar Nigam (Ward wise)

(Note: Low density area: less than 11594.5 per sq.Km; Medium Density area: 11594.5 - 17391.6 per sq.km, High Density area: 17391.6 - 23188.7 per sq.km and Very High Density area: population of greater than 23188.8 per sq.Km)

- Household biomedical waste including soiled cotton, diapers, sanitary napkins and other such waste should be wrapped in newspaper and marked with red-cross so that sanitary workers could handle them with caution.
- Domestic hazardous/ toxic waste material should be collected separately once a week or deposited by the waste producers in special bins that may be provided by the VNN at various places in the city for depositing such wastes.
- Garden waste should be stored separately and handed over to VNN at least once in a week.
- The existing primary collection need to be optimized according to the waste generation rates.
- Synchronization of primary waste collection, disposal in community bins and transportation is critical in order to ensure segregated storage at the secondary collection points.
- Self Help Groups (SHGs)/NGOs and Community Based Organizations (CBOs) should be mobilized to generate awareness among citizens towards segregation of waste at source and avoid open dumping.
- VNN should also explore the opportunity to train and capacitate informal sector to augment the existing municipal workforce in providing for door to door collection. Informal sector can be institutionalized and provided with necessary infrastructure. It is essential to levy user charges for providing solid waste management services in order to ensure financial sustainability of the system. Levying of user charges can be done in phases based upon the socio-economic conditions of the wards and cross-subsidization should be considered for slums and LIGs.

Pune Municipal Corporation is a good example of cross-subsidization of collection charges between LIG households and other households. User charge @ Rs 30/month/slum household, Rs 50/month/ other household and Rs 100/month/commercial entity is collected for door to door waste collection service. City Corporation of Panaji (CCP) has levied user charges for door to door waste collection: @ Rs. 30/month/ household (collected along with the annual property tax); and @ Rs.100 to Rs.7500/month from commercial and institutional establishments depending on nature of operations, size of establishment and volume of waste generated. Similarly for lifting and transporting of C&D waste CCP charges Rs.330/cu.m

Pilot implementation of Door to Door Collection of Segregated Waste in Ward 21, Habibpura, Varanasi

The holistic waste management strategy was developed, implemented and showcased at a pilot scale in Ward No. 21, Habibpura, Varanasi Nagar Nigam. As a part of the pilot intervention, ICLEI-South Asia, with support from UNEP-IETC, hired three Swachh Sewaks to generate awareness and sensitize community to segregate waste into two categories i.e wet and dry. Over a period of five months, timely and routine collection of waste from households helped in building trust among citizens, thereby, reducing littering and open dumping. On an average, the segregated door to door collection is practiced in more than 60 percent of the total households in Ward 21. The sanitary workers were also trained to recover different streams of valuable recyclables from the dry waste. The valuables from the dry waste is segregated during primary collection and sold off to the local recycler thereby, generating additional revenue for the sanitary workers. The pilot intervention over a period of four months was successful in addressing the main challenges of waste reduction, waste collection and littering without any additional investment, hence proving that the management system is self-sustainable and can be adopted in other wards of VNN, through a proper handholding and capacity building process.

It is expected that 30% of all cycle carts and push carts used by VNN will phase out every five years, whereas 10% of the motorized vehicles will phase out every seven years. In case of vehicles operated and maintained by private contractors along with regular maintenance, both carts and motorized vehicles are considered to undergo a standard 10% damage and phase out during the same period. While purchasing the required additional vehicles, low carbon emission vehicles like electric powered rickshaws and carts can also be considered in future.

Alternative model using Low carbon transport system

Electric push carts and E-autorikshaws can be used instead of existing push carts and diesel autos. The alternate battery operated vehicles will have the added advantage as follows:

- Ergonomic design
- Eco-friendly
- Suitable for narrow streets and sharp turns
- Suitable for segregated collection
- Closed and tall structures will prevent stray animals from scavenging waste

2.2. Street Sweeping

2.2.1. Actions for Efficient Street Sweeping

Following actions are recommended to improve street sweeping in the city:

- Street sweeping should be done on a daily basis. The system of using pushcarts for street sweeping is suggested to be continued but it is necessary to have a well-planned, time-bound daily system for street sweeping including adequate staffing and equipment.
- The existing beat routes need to be optimized according to CPHEEO Rules 2016 as mentioned below:
  - High density roads: 1 person per 300–350 running meters of road length
  - Medium density roads: 1 person per 500 running meters of road length
  - Low density roads: 1 person per 750–1,000 meters of road length
- Considering round the clock waste generation at the ghats and areas around temples, it is recommended that at least three shifts of street sweeping are practiced each in morning and evening in order to maintain the hygiene, cleanliness and aesthetics.
- Each street sweeper shall also in parallel continue drain cleaning to remove silt from underground drains / manholes to ensure that street sweeping is not dumped into drains.
- Further, it needs to be ensured that street sweepings and drain silt are not mixed with household wastes to avoid contamination. Separate street corner bins should be provided to store street sweepings and should be ensured that it is transported directly to the landfill site. This needs focus especially when the segregated waste from households will be further processed in biomethanation and composting plants.
- 100 litre twin bins for collecting segregated litter waste and others have been installed at prominent places (commercial and market areas) in the city.
- Also, ensuring availability of appropriate tool will help in improving the efficiency of the work force. Sanitary Inspector will be responsible for ensuring availability of equipment – metal plate/tray and long handle brooms on a regular basis.
- Sweepers shall be sensitized not to burn waste on the street and in each ward.

2.3. Secondary Collection

As an effort to revamp the waste collection system in the city, VNN has decided to replace all the Kuda Ghars with three transfer stations (each 300 TPD capacity) to be located across 3 different locations in the city as shown in the Figure 5. In future, the waste will be brought at the transfer stations and compacted before being sent to Karsada processing facility.

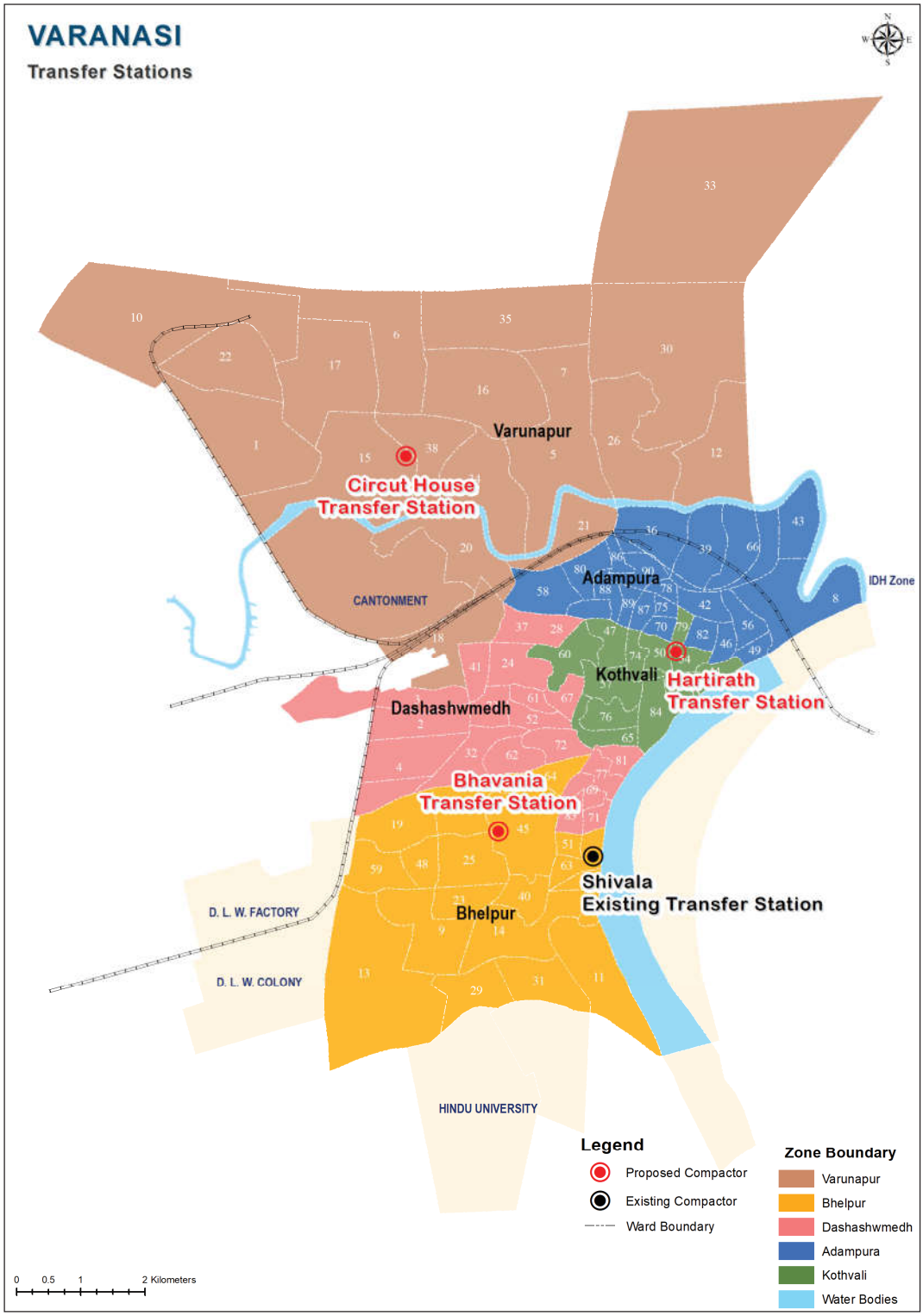

Figure 5: Location of Proposed Transfer Stations in the city

2.3.1. Actions for efficient secondary collection

Community Bins

As per CPHEEO guidelines, 2016, it is recommended that secondary waste storage capacities should be designed to accommodate at least double the expected daily in-flow of waste to avoid overflowing bins.

- Community bins should be appropriately located, considering the density of population and subsequent quantum of waste that may be deposited in the bins. The waste disposed in community bins should be collected and disposed at the transfer station on a daily basis.
- Bins placed in ghats, temples, slums should be cleared twice in a day.
- All open dumping sites should be cleaned expeditiously and damaged bins should also be replaced; in a phased manner.
- Two types of community bins are available with VNN i.e 1.1 cu.m and 3.5 cu.m capacity bins which are synchronized with transportation vehicles like compactor trucks and dumper placer trucks respectively.
- The bins should be color coded for ease of understanding by the sanitary workers during disposal of waste. In order to prevent littering, once 100 percent door to door collection is established, the bins should be accessible only to the sanitary workers, who would open them for disposing waste collected from primary collection.
- Considering the presence of a large number of smaller capacity bins in the city at short distances, it is desirable to reduce the number of bins as soon as door to door collection system becomes operational and the large containers (4.5 cu.m or 7 cu.m) may be placed at a distance of 500 metres.
- All the newly purchased twin bins should be placed in commercial areas, ghats and public places at reasonable spacing ranging from 200 to 250 meters depending on local conditions. It is recommended that all the commercial waste be disposed in these bins. Street sweeping waste should be disposed in designated black color bins.
- The 100 litre bins can be tipped directly into LCVs. Waste in ghats is generated continuously and hence to maintain the aesthetics of the area it is required to provide multiple working shifts (morning and evening) of manpower for emptying the bins.

Transfer stations

Varanasi Nagar Nigam is planning to replace all the existing Kuda Ghars by installing three transfer stations to improve the collection services. However, there is a need to identify catchment areas for the upcoming new transfer stations and also reroute the waste to the three transfer stations namely at Bhavania, Circuit house and Hartirath to improve collection services, public health and environment and aesthetics. A transfer station already exists in the Shivala area.

- The secondary collection system should be planned in a manner that ensures efficient movement of waste from the wards to each of the transfer stations.
- In order to cover all the wards presently catered to by the existing Kuda Ghars, it is suggested that each Transfer station should receive waste from wards that are located within a 3 Km radius, as shown in Figure 6.
- The dry and wet waste collected separately by the primary collection vehicles and the waste collected from secondary points (separate community bins for wet waste and dry waste) by the secondary collection vehicles will be taken to the transfer stations. Only 15 TPD of wet waste should to be taken to the existing three decentralised biomethanation plants and the remaining wet waste should be sent to Karsada Plant for composting.

Dry waste should be sent to the Karsada plant. Recyclables (glass, metal, plastic, paper and card board) are to be segregated at the RDF facility and should be sold for further processing in an environmentally sound recycling facility. The remaining dry waste, which may include a mix of textile, leather, mixed plastics that are not amenable to recycling, soiled paper and card board that is not amenable to recycling, waste wood chips etc., should be further compacted and baled at the RDF facility.

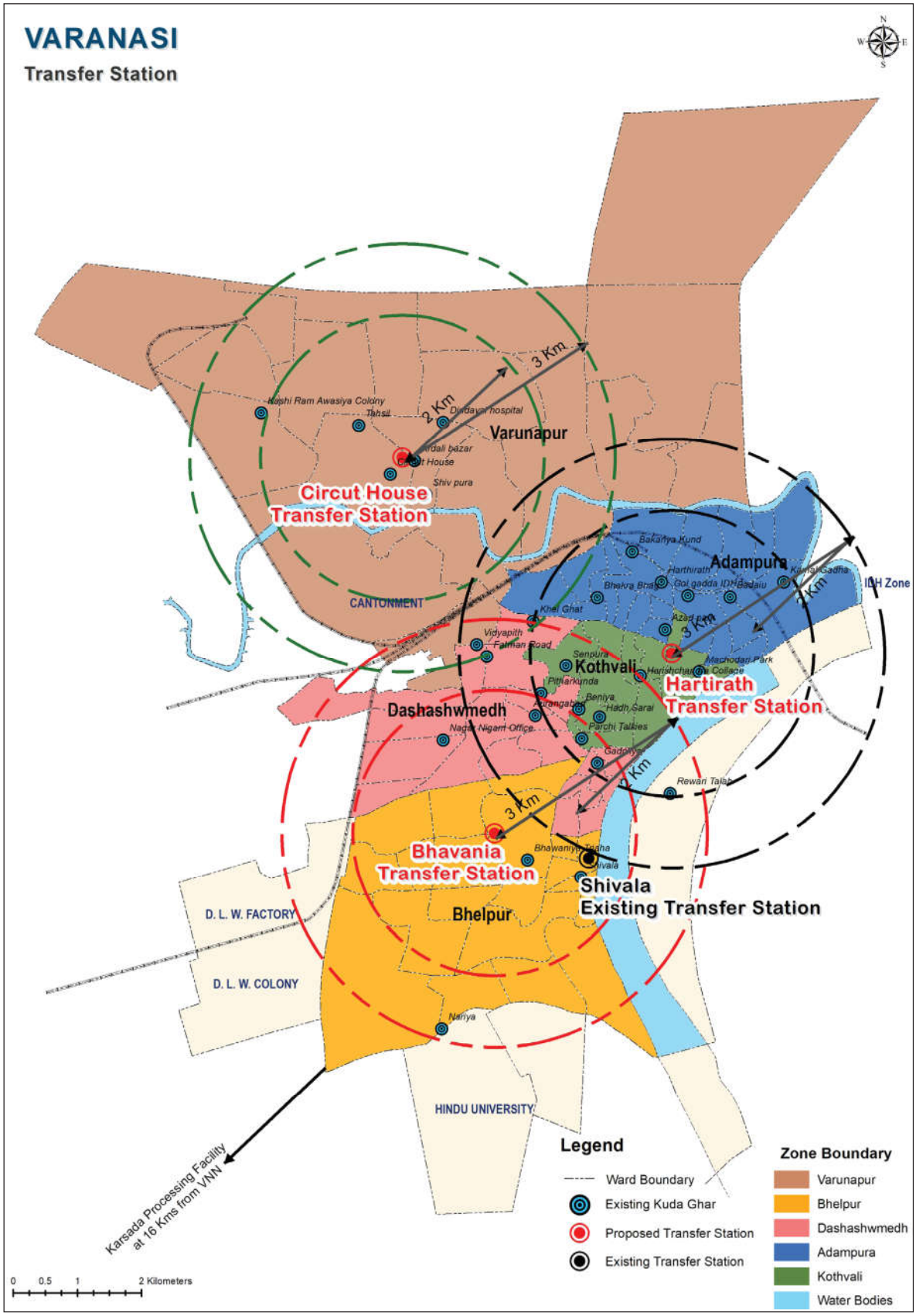

Figure 6: Buffer zone of the 3 proposed transfer stations

2.4. Secondary Transportation

Waste is transported from secondary storage points to the disposal point through the use of dumper placers and compactors. Presently, there is no infrastructure gap as far as secondary transportation of waste is concerned in Varanasi. The secondary collection vehicles if used optimally can serve the purpose of waste collection till 2035 without any requirement of additional purchase.

2.4.1. Actions to Improve Secondary Transportation

There is a need to plan and design the frequency of transportation of waste to prevent overflowing of waste from the containers/trolleys and dustbins to improve overall efficiency. VNN proposes the following actions to improve efficiency of the secondary transport system:

- The transportation of waste from the secondary bins is being planned in accordance with the frequency of containers becoming full. The locations where the containers are placed may be grouped into three categories as under:
  - Containers placed in dense and highly populated areas like temples, ghats, and markets and are required to be cleared more than once a day.
  - Containers placed in lean residential areas which are required to be cleared once a day.
  - Containers placed near institutional areas which are required to be cleared every alternate days
- In order to improve the efficiency of waste collection, it is necessary to ensure route optimization.
- Collection routes are to be effectively planned to minimize transport distances and ensure an equitable distribution of workload amongst staff.
- All the vehicles may be utilized in at least two shifts, depending on waste generation, to lift all containers, to ensure full utilization of the fleet of vehicles and to limit the size of the fleet in total.
- Fleet management is another area that needs attention. Since waste-transport vehicles have a useful life of 8-10 years, financial planning should consider timely replacement of vehicles older than 10 years to minimize down time and repair costs.
- The workshop, public or private, should have adequate technical staff, spares and preventive maintenance schedules to ensure that at least 80% of the vehicles remain on the road each day and the down time of repair/maintenance is minimized to the extent possible.
- Spare assemblies should be kept available which could be given as replacements until necessary repairs are carried out.

2.5. Waste from Ghats

The city of Varanasi is known for its 87 ghats where religious rituals are performed every day. Ghats are visited by more than a million tourists/pilgrims thereby generating huge quantum of waste. Presently, 84 Ghats are managed by ILFS who provide street sweeping throughout day and night. The system is required to be maintained as such, in order to facilitate continuous collection and transport of waste from the Ghats throughout the day. Any waste from Ghats presently being sent to any other Kuda Ghar, also needs to be rerouted to the Shivala compactor/transfer station alone. However, there is no data available on the quantum and characteristics of the waste generated in the Ghats, which makes assessment difficult.

2.5.1. Actions for a holistic approach

- There is an urgent need to record data regarding quantum and characteristics of waste being generated in the Ghats. The private operator should maintain records for the quantum of waste that is collected and submit this information to VNN on weekly basis.
- Characterization of waste should be conducted once in two years to assess the quality of the waste and ensure if the waste could be processed in the existing biomethanation or composting plants or if it needs to be simply incinerated.

- Strong awareness generation and sensitization of tourists/locals/pilgrims should be undertaken to avoid littering and usage of polythene bags.
- Waste should be segregated into dry and wet (pious offerings, flower waste) at the Ghats to ensure easy processing of waste.

Strategy 3: To ensure 100% processing and scientific disposal of waste to ensure improved public health and environment of the city

Objectives:

- To ensure 100% processing of waste through set of decentralized and centralized processing plant
- To ensure quality feed (segregated wet waste) and improve operation and maintenance of decentralized processing plants thereby utilizing to their maximum capacity
- To renovate and upgrade the existing centralized processing plant to ensure scientific treatment of waste and improved quality of end-products of waste processing i.e composting and RDF to match the industry standards.
- To establish market linkages with the existing cement plants for utilizing RDF within 500 km radius of Varanasi.
- To scientifically dispose inert in sanitary landfill

3.1. Processing and Disposal

The city of Varanasi has decentralized as well as centralized processing plants. VNN intends to leverage the opportunity of presence of decentralized as well as centralized plants to process waste and also generate revenue, where possible.

Table 1: Processing and Disposal Facilities at VNN

Processing	Decentralized	Biomethanation – 3 plants of 5TPD each
		Dry Waste Collection and Recycling Centre – Upto 10TPD
	Centralized	Compost and RDF – 500 TPD
Disposal		Landfill at Karsada

3.1.1. Actions for efficient processing and disposal

After introducing segregated collection of waste, segregated wet and dry waste should be appropriately delivered to the decentralized and centralized processing facilities, thereby increasing their operational efficiency.

With the implementation of seven sanctioned additional biomethanation plants, wet waste from different parts of the city should be transferred to these plants and utilized for energy generation.

The wet waste at Karsada processing facility can be processed into compost while the dry waste can be processed into RDF installing adequate presorting lines at site.

There are 43 cement plants with appropriate kilns and boilers required for utilizing RDF within 500 km radius of Varanasi. 3 cement plants are within 200 kms and could be explored as potential end users of RDF.

Actions to improve Dry Waste Collection and Recycling Centre

- Only source segregated dry recyclables waste shall be brought to the Dry Waste and Recycling Centre to ensure optimal utilization of resources and space
- It must function only as a sorting centre for the streams of waste collected and not to store waste
- Sanitary workers should perform only secondary and tertiary sorting of the waste
- Deployment of suitable technology/tools and infrastructure to support sorting must be ensured. A belt conveyor may be installed for easy sorting. It should be ensured that the efficiency of daily sorting is maintained at 500kg/person. Alternately, a semi-mechanical plant of capacity 5 TPD may be installed
- Hygiene of collection centre should be maintained all the time. Therefore, all materials should be cleared on an agreed periodic/weekly basis and the service provider should ensure that there is no accumulation of waste in and around the centre
- All workers must be provided with PPEs
- Operator should maintain a daily record/receipt of weight of the transfer station
- Service provider should link with informal workers and well as local kabadiwalas/scrap dealers for the sale of recyclables.
- A transparent process should be followed for the sale of recyclables. Tenders may be invited to take advantage of the highest possible market rate.

Considering the decentralized and centralized processing facilities available with VNN, it is realized that the processing facilities are adequate to treat waste for at least next ten years. Once the seven additional biomethanation plants are operational, 35 TPD of wet waste is to be transferred to these facilities. Rest of the compacted segregated waste once brought to the processing facility should be subjected to secondary sorting to remove glass and metals. Wet waste is processed into compost while dry waste is processed into refuse derived fuel. The improved process efficiency will also ensure reduced rejection rates resulting in lesser material dumped in the sanitary landfill as well.

Construction and Demolition Waste Processing Plant: VNN is planning to set up a construction and demolition waste processing plant of 200 TPD capacity. The operation of the plant will conform to the requirements of the Construction & Demolition Waste Management Rules, 2016.

Also, the city is planning to install a gasifier to utilize RDF.

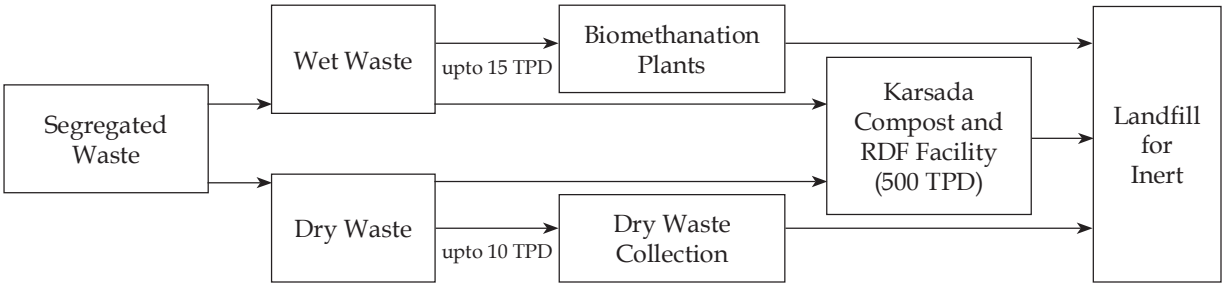

Figure 7: Waste flow for processing and disposal (Short-term)

Following measures for processing and disposing waste are proposed for the city. Various options are divided into short term and long term solutions considering the time required for planning and commissioning of any plant and described below in Table 2.

Table 2: Short-Term and Long-Term Solutions for Processing Waste

Short Term Solutions (Within next 2 years i.e 2018-2020)	Long Term Solutions (Within 3-5years i.e 2020-2025)
Decentralized	Decentralized
3 Biomethanation Plants	10 Biomethanation Plants
Centralized	Centralized
Integrated Processing Facility (Compost +RDF)	Integrated Processing Facility (Compost +RDF)
	C&D Waste Processing Facility
	Gasifier
Disposal – Landfill at Karsada	Disposal-Only 20% of generated waste (inert) will be disposed at Karsada

Strategy 4: To strengthen and build capacity of the existing institutional structure of Varanasi Nagar Nigam and other key stakeholders for providing improved solid waste management services

Objectives:

- To clearly delineate the roles and responsibilities of various administrative units responsible for waste management
- To ensure adequate human resources as per the norms suggested in CPHEEO Manual for providing municipal solid waste management services
- To identify and address professional development, technical and financial management training needs for the staff of Varanasi Nagar Nigam
- To raise public awareness of all key stakeholders through continuous information and education campaigns and demonstration projects
- To generate awareness and sensitization towards existing rules and policies for improved solid waste management system

4.1. Proposed Institutional framework

A well-developed institutional framework is critical in implementing a successful waste management system. The table 3 presents the manpower requirement as per norms of CPHEEO Manual, 2016.

Table 3: Manpower Requirement for MSWM Services in Varanasi

Activity	Norms as per CPHEEO Manual 2016	Requirement for VNN (as per CPHEEEO Manual requirements)	
Street Sweeping of 1170 Kms of road length	High density roads: 1 person per 300– 350 running meters of road length[4]	3343	
Door to Door Collection in Households[5]	1 person per wheelbarrow (1188 wheelbarrows required)	1188	2243
	1 person per 3 bins carts (519cyclecarts required)	519	
	1 person per 8 bins carts (377 cycle carts required)	377	
	1 driver and 2 labour per LCV and tractors (53 motorised vehicles required)	159	

Recommendations to be included in the existing infrastructural framework are as mentioned below:

- Adequate number of sanitary workers and drivers need to be hired immediately.
- There is an immediate need to establish a system to identify and organize the informal sector stakeholders like rag pickers and small scale recyclers into cooperatives/group or societies that can work in cooperation with the formal system of waste management, which in turn will enhance the efficiency of waste collection and recycling.
- Identity cards should be provided to all the sanitary workers, drivers, swatch sewaks (volunteers) and the informal sector members involved in waste collection.

4. Population density of VNN in 2011 was 13192 people per square Kilometer and hence is considered high
5. 212618 households in 2018 in VNN, based on data extrapolated from 2011 Census data

- It should be strictly monitored that sanitary workers, drivers or anyone managing municipal waste is handling the waste wearing the proper protective gears (PPE i.e. personal protective equipment) such as gloves, uniforms, shoes and other equipment.
- Recognizing the efforts of local champions, rewarding RWAs for their concerted efforts in initiating segregation practices and participation in awareness generation should be institutionalized.
- Strict measures (penalties if required) should be taken to prevent citizens and sweepers from disposing waste into drains or burning waste. One of the measures should be to make the same staff responsible for cleaning streets as well as adjacent drains.
- Incentives for sanitary workers for collecting most of the waste, ensuring segregation in their allotted wards etc should be introduced in the system to build the enthusiasm.
- Strict action (penalties if required) needs to be taken against households and other waste generators who do not cooperate with door to door waste collection and still litter the streets
- Strict monitoring in terms of attendance of the workers should be established. In absence of a worker, backup staff needs to be readily available to be deployed in their beat routes. The backup staff could be temporary staff or an agency/NGO could be assigned to provide the additional staff
- Stakeholder committee for waste management need to be formed by VNN. The committee should include representatives from VNN, private contractors, citizens, local NGOs and other stakeholders to discuss issues with waste management. The committees need to have regular meetings to resolve any hiccups in waste collection and management
- A roadmap needs to be developed by VNN for capacity development of all stakeholders regarding waste segregation and other major challenges of waste management in the city.
- City Sanitation Unit (CSU) can play a very important role in monitoring the overall activities and also keeping a track on the progress.
- Proper training and capacity development need to be imparted to all sanitary staff and informal sector workers regarding segregation of waste, proper handling of hazardous and sanitary waste and other critical precautionary measures while joining or inducting into the system.
- The requirement of staff, according to norms mentioned in the CPHEEO manual 2016 need to be recruited immediately by the Solid Waste Management team of VNN in order to enable the efficient functioning of the system.

4.2. Information Education and Communication Framework for Varanasi Nagar Nigam

A successful and sustainable awareness and behavior change campaign is seen as an essential part of a successful municipal solid waste action plan as many potential solutions will require the users to change their current practices like segregating the waste into two bins.

It has been realized that by only providing infrastructure and capital has never been sufficient to bring the changes required. Many contextual factors, including the behavior of the community, social, cultural, economic, and political and programme environment influence individual behavioral change. Therefore, the range of behavior change activities often extends beyond conventional communication, to link and coordinate communication activities with training, infrastructure support, product and service improvements, social norm change and even new or improved policies. Thus, it is realized that IEC campaigns are essential to bring about a behavioral change among the citizens in managing their waste.

Information, education, and communication (IEC) is a multilevel tool for promoting and sustaining behavior change in individuals and communities. It comprises of a variety of information and communication media, participatory planning and decision making approaches as well as exposure and local involvement activities aiming at not only influence social norms, attitudes and values of individuals/communities but also to create a sense of ownership and responsibility among target communities.

Target Groups: The IEC campaign in Varanasi will include not only households, shops, and commercial and institutional premises, but also all the other stakeholders such as tourists, pilgrims, municipal officials, elected

representatives, schools, non-government organisations (NGOs), the informal sector, media, etc. to ensure their participation in managing city waste by discharging their role effectively.

Primary Target Group	Secondary Target Group
• Residential (HIGs/MIGs/HIGs), • Commercial establishments • Temples and other religious units • Schools/Colleges/Institutes • Sanitary workers • Tourists and Pilgrims • Informal Sector	• Associations and Organizations • NGOs and CBOs • Senior Officials/Councilors, VNN • Local leaders • Service providers/ Private Operators

Table 4: IEC for Improving Municipal Solid Waste in Varanasi

Target Groups	Waste Generation	Primary Collection	Secondary Collection	Processing	Landfill Disposal	Proposed IEC Activities	Expected Timeframe
Residential Colonies (HIG/MIG/LIG)	● To minimize waste generation ● To reuse and recycle as much as possible ● To stop open dumping and store waste into bins ● To segregate waste into wet and dry waste and domestic hazardous waste ● To reduce littering	● To sensitize towards informal waste collectors ● To pay user charges ● To be informed about C&D waste disposal		● To participate towards decentralized waste processing activities		● Distribution of ● Pamphlet/ Brochures ● Advertisements on TV ● FM Radio ● Hoardings with messages ● Newspapers ● Handbills ● Performance like street plays and rally's at ward level through involvement of NGOs/SHGs specially in LIG colonies ● Exhibitions ● Seminars ● Small Group discussions	● Every once in a month; to be carried for at least six months
Slum Dewellers	● To minimize waste generation ● To reuse and recycle as much as possible ● To stop open dumping and store waste into bins ● To segregate waste into wet and dry waste and domestic hazardous waste ● To reduce littering	● To sensitize towards informal waste collectors ● To pay at least the cross-subsidized user charges ● To deposit waste at the community bins provided ● To be informed about C&D waste disposal	● To not to litter near community bins ● To not to burn waste			● Door to door ● Communication ● Advertisements on TV ● FM Radio ● Hoardings with ● Messages ● Performance like street plays and rally's at ward level through involvement of NGOs/SHGs specially in LIG colonies ● Small Group ● Discussions	● Every once in a month; to be carried for at least one year

Target Groups	Waste Generation	Primary Collection	Secondary Collection	Processing	Landfill Disposal	Proposed IEC Activities	Expected Timeframe
Schools/Colleges/ Institutions	● To minimize waste generation ● To reuse and recycle as much as possible ● To reduce littering ● To stop open dumping and store waste into bins ● To promote volunteerism and motivation for taking part in promoting 'clean city' drives and other environmental sanitation drives	● To be sensitive towards sanitary workers ● To adapt and promote waste segregation practices		● To promote decentralized processing and recycling initiatives at their school, colleges and institutes		● Posters ● Street Plays ● Essay Competition ● Walkathon/ Rallies	● Once in four months for at least one year
Sanitary Staff	● To prevent littering by communicating penalties for littering ● To be aware of types of waste and segregation	● To collect segregated waste separately ● To ensure that the waste collected is dumped at designated bins/ sites ● To collect user charges and penalties, if any ● To use PPEs	● To ensure that waste is not burnt ● To not to litter waste near bins ● To ensure bins are emptied at regular intervals ● To transport segregated waste separately ● To avoid any malpractices while transporting waste ● To encourage separate collection of C&D waste	● To ensure that recyclables are separated ● To promote both the processing facilities i.e decentralized and centralized ● To promote composting, ● vermicomposting etc. on ward level	● To ensure that waste is not burnt at the site ● To prevent waste scavenging ● To ensure that only inert are dumped at the site	● Small group discussions ● Workshops ● Training programmes ● Handbills	● Once every month for at least 6 months

Target Groups	Waste Generation	Primary Collection	Secondary Collection	Processing	Landfill Disposal	Proposed IEC Activities	Expected Timeframe
Informal Sector	● To reduce littering ● To not mix the waste and collect segregated waste only	● To ensure segregation of waste into wet, dry and domestic waste ● To ensure coordination with secondary waste collectors/ sanitary staff to ensure disposal at designated sites	● To prevent any littering around bins ● To reduce open dumping post recycling	● To be informed of various processing facilities and be able to involve into decentralized processing facilities	● Street plays ● Inter-personal interaction ● Workshops ● Training programmes ● Posters	● Once in every three months for at least an year	
Private Operators	● To promote waste minimization ● To promote reuse and recycling on waste ● To be aware of types of waste generated ● To ensure recyclables are ● Collected separately	● To promote segregation of waste and ensure collection of segregated waste ● To sensitize community to pay user charges	● To ensure that waste is not burnt ● To not to litter waste near bins ● To ensure bins are emptied at regular intervals ● To transport segregated waste separately ● To avoid any malpractices while transporting waste ● To encourage separate collection of C&D waste	● To ensure that recyclables are separated ● To be aware of both the processing facilities i.e decentralized and centralized ● To promote composting, ● vermicomposting etc. on ward level	● To ensure that waste is not burnt at the site ● To prevent waste scavenging ● To ensure that only inerts are dumped at the site	● Posters ● Handbills ● Flyers ● Small group discussions ● Workshops ● Training programmes ● FM jingles ● TV ● Newspapers	● Once every three months for at least a year

Annex 1: Legislative Framework for MSWM Service Provision

National Rules and Policies

The Ministry of Environment and Forests and Climate Change (MoEF&CC) notified the Municipal Waste (Management and Handling) Rules in September 2000. The Rules provide detailed guidelines on various aspects of Municipal Solid Waste Management and identify the Central Pollution Control Board (CPCB) and the State Pollution Control Boards (SPCB) as nodal agencies to monitor its implementation directly in the Union Territories and the States respectively. The MSW (M&H) Rules, 2000 have been revised as Solid Waste Management Rules, 2016.

Other policy initiatives which inform and guide provision of MSWM services include the recommendations of the Technical Advisory Group on MSWM (2005) and the Inter-Ministerial Task Force on Integrated Plant Nutrient Management (2005), the Hazardous Waste (Management, Handling & Transboundary Movement Rules (1989, 2008), Bio-Medical Waste (Management & Handling) Rules (1998, draft 2011 and 2016), the Plastic Waste Management Rules, 2016 and the E-waste Management Rules, 2011 and 2016, all of which cover specific types of waste generated in Urban Local Bodies, but which are not regulated by the SWM Rules, 2016. However, they provide guidance to the management of certain streams of waste which may otherwise inadvertently find their way into the municipal waste streams.

The National Urban Sanitation Policy (NUSP) introduced in 2008 broadly covers aspects of urban sanitation. Municipal solid waste management is an important focus area in the NUSP. The NUSP stipulates that MSWM should also be covered in the State Sanitation Strategy (SSS) and the City Sanitation Plan (CSP). This requires close linkages between the waste management and the sanitation planning in a particular ULB.

The National Mission on Sustainable Habitat (NMSH) approved in 2008 under the National Action Plan on Climate Change (NAPCC) highlights the importance of adopting recycling strategies in order to avoid greenhouse gas (GHG) emissions. There are the Rules/Regulations/Policies/ Reforms which guide the municipal solid waste management service delivery. Provisions for floating tax free bonds by ULBs, income tax relief to waste management agencies, introduction of double accounting system in ULBs, development of Model Municipal Bye-Laws are other major policy/ regulatory directives which guide ULBs in certain aspects of planning for and operationalizing MSW services.

The Swachh Bharat Mission launched on 2nd October, 2014 with an aim to achieve a 'Clean India' by 2019. It consists of two sub-missions – SBM (Gramin) for rural areas and SBM (Urban) for urban areas. The mission focuses on promoting modern and scientific municipal solid waste management system along with affecting behavioural change regarding healthy sanitation practices. It also aims at capacity augmentation of ULB's and creating an enabling environment for private sector participation. The mission requires ULB's to prepare detailed project reports (DPRs) having a viable financial model. ULBs are entitled to Central Government Grant in the form of maximum of 20% Viability Gap Funding (VGF) for each project. ULBs shall also get INR 214 per person based on Census 2011 population.

The table below mentions all the important policies and initiatives on MSWM in India.

Table 5: Existing Rules and Other Legislative Frameworks for Managing Municipal Solid Waste

Rules and other directives	Highlights	Available at:
MSW (Management and Handling) Rules 2000 and revised SWM, Rules 2016	Municipal Solid Waste (Management & Handling) Rules, 2000 by Ministry of Environment, Forest and Climate Change (MoEFCC) Revised SWM Rules, 2016 notified in 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	http://www.moef.nic.in/content/so-1357e-08-04-2016-solid-waste-management-rules-2016?theme=moef_blue http://www.moef.gov.in/sites/default/files/C%20&D% 0rules%202016.pdf
Revised Manual on Municipal Solid Waste Management, 2016	Municipal Solid Waste Management Manual 2000 by Ministry of Housing and Urban Affairs (MoHUA) and CPHEEO Revised guidelines published by MoHUA and CPHEEO in year 2016 Provide implementation guidelines for all aspects of MSWM, including segregation, collection, transportation, treatment and disposal	http://cpheeo.gov.in/cms/manual-on-municipal-solid-waste-management-2016.php
Swachh Bharat Mission, (SBM), 2014	Swachh Bharat Mission guidelines published by the MoHUA in 2014 Cover Household toilets, community and public toilets also 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	http://swachhbharaturban.gov.in/writereaddata/SBM_Guideline.pdf
National Urban Sanitation Policy (NUSP), 2008	Policy prepared by the Ministry of Urban Development in 2008 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	http://mohua.gov.in/upload/uploadfiles/files/NUSP_0.pdf
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	http://www.moef.gov.in/sites/default/files/PWM%20Rules,%202016_0.pdf http://www.moef.nic.in/sites/default/files/Bio%20medical%20waste%20management%20(amendment)183847.pdf http://www.moef.gov.in/sites/default/files/EWM%20Rules%202016%20english%2023.03.2016.pdf http://www.moef.nic.in/sites/default/files/HAZMAT-606.pdf
Other Relevant Rules and Task Force Reports	Inter-ministerial Task Force on Integrated Plant and Nutrient Management using City Compost, 2005 Fertilizer Control Order (FCO), 2009; Phosphate Rich Organic Manure (PROM), 2013 by Ministry of Agriculture Report of the Task Force on Waste to Energy, Planning Commission, 2014	http://mohua.gov.in/pdf/58452c498aca9ipnm_reports.pdf http://fert.nic.in/sites/default/files/Policy_for_encouraging_production_and_availability_of_fortified_and_A_ZACLINDO-GULFSPICKSFLMFCLKFCLSFCIPLCIL_0.pdf http://planningcommission.nic.in/reports/genrep/rep_wte1205.pdf http://planningcommission.gov.in/reports/genrep/rep_energyvol2.pdf

Annex 2: Role of Stakeholders

While the onus of providing municipal solid waste management services in urban areas lies with the ULBs, Central and State Governments have a significant role to play in defining the frameworks within which service provision can be planned and executed by ULBs. The following are identified as prescribed authorities under the Rule and their roles and responsibilities vis-à-vis ensuring the implementation of the provisions of the Solid Waste Management Rules, 2016 are also specified:

Table 6: Role of stakeholders

Level of Government	Role
Central Government	● Legal & Policy Framework: The SWM Rules, 2016 by the Ministry of Environment Forest & Climate Change (MoEFCC) mandate provision of MSWM services by municipal authorities in urban areas in the country. ● Clause 5: Duties of Ministry of Environment, Forest and Climate Change: 1. The MoEFCC shall be responsible for over all monitoring the implementation of these rules in the country. It shall constitute a Central Monitoring Committee under the Chairmanship of Secretary, Ministry of Environment, Forest and Climate Change comprising officers not below the rank of Joint Secretary or Advisor from the following namely: (i) Ministry of Urban Development (ii) Ministry of Rural Development (iii) Ministry of Chemicals and Fertilizers (iv) Ministry of Agriculture (v) Central Pollution Control Board (vi) Three State Pollution Control Boards or Pollution Control Committees by rotation (vii)Urban Development Departments of three State Governments by rotation (viii) Rural Development Departments from two State Governments by rotation (ix) Three urban local bodies by rotation (x) Two census towns by rotation (xi) FICCI, CII and (xii) Two subject experts 2. This Central Monitoring Committee shall meet at least once in a year to monitor and review the implementation of these Rules. The Ministry of Environmnet, Forest and Climate Change may co-opt other experts, if needed. The Committee shall be renewed every three years. ● Clause 6: As per the SWM Rules, 2016, the Ministry of Urban Development (MoUD) shall coordinate with State Governments and Union territory Administrations to: a. take periodic review of the measures taken by the states and local bodies for improving solid waste management practices and execution of solid waste management projects funded by the Ministry and external agencies at least once in a year and give advice on taking corrective measures; b. formulate national policy and strategy on solid waste management including policy on waste to energy in consultation with stakeholders within six months from the date of notification of these rules; c. facilitate States and Union Territories in formulation of state policy and strategy on solid waste management based on national solid waste management policy and national urban sanitation policy; d. promote research and development in solid waste management sector and disseminate information to States and local bodies; e. undertake training and capacity building of local bodies and other stakeholders; and f. provide technical guidelines and project finance to states, UTs and local bodies on solid waste management to facilitate meeting timelines and standards. ● Clause 7: Duties of Department of Fertilisers, Ministry of Chemicals and Fertilisers:- The Department of Fertilisers through appropriate mechanisms shall ,- a. Provide market development assistance on city compost; and b. ensure promotion of co-marketing of compost with chemical fertilizers in the ratio of 3 to 4 bags: 6 to 7 bags by the fertilizer companies to the extent compost is made available for marketing to the companies

Level of Government	Role
	• Clause 8: Duties of Ministry of Agriculture, Government of India: The Ministry of Agriculture through appropriate mechanisms shall: a. provide flexibility in Fertilizer Control Order for manufacturing and sale of compost; b. propagate utilization of compost on farmland; c. set up laboratories to test quality of compost produced by local authorities or their authorised agencies; and d. issue suitable guidelines for maintaining the quality of compost and ratio of use of compost vis-a-vis chemical fertilizers while applying compost to farmland. • Clause 10: Duties of Ministry of Power: The Ministry of Power through appropriate mechanism shall: a. decide tariff or charges for the power generated from the waste to energy plants based on solid waste b. compulsory purchase of power generated from such waste to energy plants by distribution company • Clause 10: Duties of Ministry of New and Renewable Energy Sources: The Ministry of New and Renewable Energy Sources through appropriate mechanisms shall: a. facilitate infrastructure creation for waste to energy plants; and b. provide appropriate subsidy or incentives for such waste to energy plants c. provide appropriate • Clause 14: Duties of Central Pollution Control Board.- The Central Pollution Control Board shall: a. co-ordinate with the State Pollution Control Boards and the Pollution Control Committees for implementation of these rules and adherence to the prescribed standards by local authorities; b. formulate the standards for ground water, ambient air, noise pollution, leachate in respect of all solid waste processing and disposal facilities; c. review environmental standards and norms prescribed for solid waste processing facilities or treatment technologies and update them as and when required; d. review through State Pollution Control Boards or Pollution Control Committees, at least once in a year, the implementation of prescribed environmental standards for solid waste processing facilities or treatment technologies and compile the data monitored by them; e. review the proposals of State Pollution Control Boards or Pollution Control Committees on use of any new technologies for processing, recycling and treatment of solid waste and prescribe performance standards, emission norms for the same within 6 months; f. monitor through State Pollution Control Boards or Pollution Control Committees the implementation of these rules by local bodies; g. prepare an annual report on implementation of these rules on the basis of reports received from State Pollution Control Boards and Committees and submit to the Ministry of Environment, Forest and Climate Change and the report shall also be put in public domain; h. publish guidelines for maintaining buffer zone restricting any residential, commercial or any other construction activity from the outer boundary of the waste processing and disposal facilities for different sizes of facilities handling more than 5 tons per day of solid waste; i. publish guidelines, from time to time, on environmental aspects of processing and disposal of solid waste to enable local bodies to comply with the provisions of the rules; and j. provide guidance to States or Union Territories on inter-state movement of waste.

Level of Government	Role
State Government	● The SWM Rules, 2016 indicate that the Secretary-in charge of the Department of Urban Development/ Local Self Government department of the concerned State or the Union territory, as the case may be, shall have the overall responsibility for the enforcement of the provisions of these rules in the metropolitan cities. The Secretary, Urban Development Department in the State or Union Territory through the Commissioner or Director of Municipal Administration or Director of local bodies shall: a. prepare a state policy and solid waste management strategy for the state or the union territory in consultation with stakeholders including representative of waste pickers, self help group and similar groups working in the field of waste management consistent with these rules, national policy on solid waste management and national urban sanitation policy of the ministry of urban development, in a period not later than one year from the date of notification of these rules; b. while preparing State policy and strategy on solid waste management, lay emphasis on waste reduction, reuse, recycling, recovery and optimum utilization of various components of solid waste to ensure minimization of waste going to the landfill and minimize impact of solid waste on human health and environment; c. state policies and strategies should acknowledge the primary role played by the informal sector of waste pickers, waste collectors and recycling industry in reducing waste and provide broad guidelines regarding integration of waste picker or informal waste collectors in the waste management system d. ensure implementation of provisions of these rules by all local authorities; e. direct the town planning department of the State to ensure that master plan of every city in the State or Union Territory has provisions for setting up of solid waste processing and disposal facilities except for the cities who are members of common waste processing facility or regional sanitary landfill for a group of cities; and f. ensure identification and allocation of suitable land to the local bodies within one year for setting up of processing and disposal facilities for solid wastes and incorporate them in the master plans (land use plan) of the State/cities through metropolitan and district planning committees or town and country planning department; g. direct the town planning department of the State and local bodies to ensure that a separate space for segregation, storage and decentralized processing of solid waste is demarcated in the development plan for group housing or commercial, institutional or any other non-residential complex exceeding 200 dwelling or having a plot area exceeding 5000 square meters; h. direct the developers of Special Economic Zone, Industrial Estate, Industrial Park to earmark at least five percent of the total area of the plot or minimum five plots or sheds for recovery and recycling facility i. facilitate establishment of common regional sanitary landfill for a group of cities and towns falling within a distance of 50 km (or more) from the regional facility on a cost sharing basis and ensure professional management of such sanitary landfills; j. arrange for training and capacity building of local bodies in managing solid waste, segregation and transportation or processing of such waste at source k. notify buffer zone for the solid waste processing and disposal facilities of more than five tons per day in consultation with the State Pollution Control Board; and l. start a scheme on registration of waste pickers and waste dealers ● Clause 12: Duties of State Pollution Control Board or Pollution Control Committee: 1. The State Pollution Control Board or Pollution Control Committee shall: a. enforce these rules in their State through local bodies in their respective jurisdiction and review implementation of these rules at least twice a year in close coordination with concerned Directorate of Municipal Administration or Secretary-in-charge of State Urban Development Department; b. monitor environmental standards and adherence to conditions as specified under the Schedule I and Schedule II for waste processing and disposal sites;

Level of Government	Role
	c. examine the proposal for authorization and make such inquiries as deemed fit, after the receipt of the application for the same in Form I from the local body or any other agency authorized by the local body; d. while examining the proposal for authorization, the requirement of consents under respective enactments and view of other agencies like the State Urban Development Department, the Town and Country Planning Department, District Planning Committee or Metropolitan Area Planning Committee, as may be applicable, Airport or Airbase Authority, the Ground Water Board and other relevant agencies shall be taken into consideration and they shall be given four weeks time to give their views, if any; e. issue authorisation within a period of sixty days in Form II to the local body or an operator of a facility or any other agency authorized by local body stipulating compliance criteria and environmental standards as specified in Schedules I and II including other conditions, as may be necessary; f. Synchronize the validity of said authorization with the validity of the consents; g. suspend or cancel the authorization issued under clause (a) any time, if the local body or operator of the facility fails to operate the facility as per the conditions stipulated; provided that no such authorisation shall be suspended or cancelled without giving notice to the local body or operator, as the case may be; and h. on receipt of application for renewal, renew the authorisation for next five years, after examining every application on merit and subject to the condition that the operator of the facility has fulfilled all the provisions of the rules, standards or conditions specified in the authorisation, consents or environment clearance; 2. The State Pollution Control Board or Pollution Control Committee shall, after giving reasonable opportunity of being heard to the applicant and for reasons thereof to be recorded in writing, refuse to grant or renew an authorisation. 3. In case of new technologies, where no standards have been prescribed by the Central Pollution Control Board, State Pollution Control Board or Pollution Control Committee, as the case may be, shall approach Central Pollution Control Board for getting standards specified. 4. The State Pollution Control Board or the Pollution Control Committee, as the case may be, shall monitor the compliance of the standards as prescribed or laid down and treatment technology as approved and the conditions stipulated in the authorisation and the standards specified in Schedules I and II under these rules as and when deemed appropriate but not less than once in a year; 5. The State Pollution Control Board or the Pollution Control Committee may give directions to local bodies for safe handling and disposal of domestic hazardous waste deposited by the waste generators at hazardous waste deposition facilities. 6. The State Pollution Control Board or the Pollution Control Committee shall regulate Inter-State movement of waste.
District Level	**Duties of District Magistrate or District Collector or Deputy Commissioner:** The District Magistrate or District Collector or Deputy Commissioner shall: a. Facilitate identification and allocation of suitable land for setting up solid waste processing and disposal facilities to local bodies in his district in close coordination with the Secretary-in-Charge of State Urban Development Department within one year from the date of notification of these rules; b. Review the performance of local bodies, at least once in a quarter on waste segregation, processing, treatment and disposal and take corrective measures in consultation with the Commissioner or Director of Municipal Administration or Director of local bodies and Secretary-in-charge of the State Urban Development.

Level of Government	Role
Urban Local Bodies	The local authorities shall,- a. prepare a solid waste management plan as per state policy and strategy on solid waste management within six months from the date of notification of state policy and strategy and submit a copy to respective departments of State Government or Union Territory Administration or agency authorised by the State Government or Union Administration; b. arrange for door to door collection of segregated solid waste from all households including slums and informal settlements, commercial, institutional and other non-residential premises. From multi-storage buildings, large commercial complexes, malls, housing complexes etc. this may be collected from the entry gate or any other designated location; c. Establish a system to recognize organizations of waste pickers or informal waste collectors and promote and establish a system for integration of these authorized waste-pickers and waste collectors to facilitate their participation in solid waste management including door to door collection of waste; d. facilitate formation of Self Help Groups, provide identity cards and thereafter encourage integration in solid waste management including door to door collection of waste; e. frame bye-laws, incorporating the provisions of these rules within one year from the date of notification of these rules and ensure timely implementation; f. prescribe from time to time user fee as deemed appropriate and collect the fee from the waste generators on its own or through authorised agency; g. direct waste generators not to litter i.e throw or dispose of any waste such as paper, water bottles, tetra packs etc. or burn or bury waste on streets, open public spaces, drains etc. and to segregate the waste at source as prescribed under these rules and hand over the segregated waste to authorized waste pickers or waste collectors authorized by the local body h. setup material recovery facilities or secondary storage facilities with sufficient space for sorting of recyclable materials to enable informal or authorized waste pickers and waste collectors to separate recyclables from the waste and provide easy access to waste pickers and recyclers for collection of segregated recyclable waste from the source of generation or from material recovery facilities; Bins for storage of bio-degradable wastes shall be painted green, those for storage of recyclable wastes shall be printed white and those for storage of other wastes shall be printed black; i. establish waste deposition centres for domestic hazardous wastes and give direction for waste generators to deposit domestic hazardous waste at this centre for its safe disposal. Such facility shall be established in a city or town in a manner that one centre is set up for the area of twenty square kms or part thereof and notify the timings of receiving domestic hazardous waste at such centres; j. ensure safe storage and transportation of the domestic hazardous waste to the hazardous waste disposal facility or as may be directed by the State Pollution Control Board or the Pollution Control Committee; k. direct street sweepers not to burn tree leaves collected from street sweeping and store them separately and handover to the waste collectors or agency authorised by local body; l. provide training on solid waste management to waste-pickers and waste collectors; m. collect waste from vegetable, fruit, meat, poultry and fish market on day to day basis and promote setting up of decentralised compost plant or bio-methanation plant at suitable locations in the markets or in the vicinity of markets ensuring hygienic conditions; n. collect separately waste from sweeping of streets, lanes and by-lanes daily, or on alternate days or twice a week depending on the density of population, commercial activity and local situation; o. set up covered secondary storage facility for temporary storage of street sweepings and silt removed from surface drains in cases where direct collection of such waste into transport vehicles is not convenient. Waste so collected shall be collected and disposed of at regular intervals as decided by the local body;

Level of Government	Role
	q. transport segregated bio-degradable waste to the processing facilities like compost plant, bio-methanation plant or any such facility. Preference shall be given for on site processing of such waste; r. transport non-bio-degradable waste to the respective processing facility or material recovery facilities or secondary storage facility; s. transport construction and demolition waste as per the provisions of the Construction and Demolition Waste Management Rules, 2016 ; t. involve communities in waste management and promotion of home composting, bio-gas generation, decentralized processing of waste at community level subject to control of odour and maintenance of hygienic conditions around the facility; u. phase out the use of chemical fertilizer in two years and use compost in all parks, gardens maintained by the local body and wherever possible in other places under its jurisdiction. Incentives may be provided to recycling initiatives by informal waste recycling sector; v. facilitate construction, operation and maintenance of solid waste processing facilities and associated infrastructure on their own or with private sector participation or through any agency for optimum utilization of various components of solid waste adopting suitable technology including the following technologies and adhering to the guidelines issued by the Ministry of Urban Development from time to time and standards prescribed by the Central Pollution Control Board. Preference shall be given to decentralized processing to minimize transportation cost and environmental impacts such as: (i) bio-methanation, microbial composting facility, vermicomposting, anaerobic digestion or any other appropriate processing for bio-stabilisation of biodegradable wastes;(ii) waste to energy processes including refused derived fuel for combustible fraction of waste or supply as feedstock to solid waste based power plants or cement kilns w. Undertake on their own or through any other agency construction, operation and maintenance of sanitary landfill and associated infrastructure as per Schedule I for disposal of residual wastes in a manner prescribed under these rules; x. make adequate provision of funds for capital investments as well as operation and maintenance of solid waste management services in the annual budget ensuring that funds for discretionary functions of the local body have been allocated only after meeting the requirement of necessary funds for solid waste management and other obligatory functions of the local body as per these rules; y. make an application in Form-I, for grant of authorisation for setting up waste processing, treatment, or disposal facility, if the volume of waste is exceeding five metric tones per day including sanitary landfills from the State Pollution Control Board or the Pollution Control Committee, as the case may be; z. submit application for renewal of authorisation at least sixty days before the expiry of the validity of authorisation; aa. prepare and submit annual report in Form IV on or before the 30th April of the succeeding year to the Commissioner or Director, Municipal Administration or designated Officer; bb. the annual report shall then be sent to the Secretary-In-charge of the State Urban Development Department and to the respective State Pollution Control Board or Pollution Control Committee by the 31st May of every year cc. educate workers including contract workers and supervisors for door to door collection of segregated waste and transporting the unmixed waste during primary and secondary transportation to processing or disposal facility; dd. ensure that the operator of a facility provides personal protection equipment including uniform, fluorescent jacket, hand gloves, raincoats, appropriate foot wear and masks to all workers for handling solid waste and the same are used by the workforce; ee. ensure that provisions of setting up of centers of collection, segregation and storage of segregated wastes are incorporated in building plan of a group housing society or market complex; and

Level of Government	Role
	ff. frame bye-laws and prescribed criteria for levying of spot fines for persons who litters or fails to comply with the provisions of these rules and delegate powers to officers or local bodies to levy spot fines as per the bye laws framed; and gg. create public awareness through information, education and communication (IEC) campaign and educate the waste generators on the following: i. not to litter; ii. minimise generation of waste; iii. reuse the waste to the extent possible; iv. practice segregation of waste into bio–degradable, non-biodegradable (recyclable and combustible), sanitary waste and domestic hazardous wastes at source; v. practice home composting, vermicomposting, bio-gas generation or community level composting; vi. wrap securely used sanitary waste as and when generated in the pouches provided by the brand owners or a suitable wrapping as prescribed by the local body and place the same in the bin meant for non-biodegradable waste; vii. storage of segregated waste at source in different bins; viii. handover segregated waste to waste pickers, waste collectors, recyclers or waste collection agencies; and ix. pay monthly user fee or charges to waste collectors or local bodies or any other person authorized by the local body for sustainability of solid waste management. hh. Stop landfilling or dumping of mixed waste soon after the timeline as specified in Rule 23 for setting up and operationalization of sanitary landfill is over; ii. Allow only the non-usable, non-recyclable, non-biodegradable, non-combustible and non-reactive inert waste and pre-processing rejects and residues from waste processing facilities to go to sanitary landfill and the sanitary landfill sites shall meet the specifications as given in Schedule I, however, every effort shall be made to recycle or reuse the rejects to achieve the desired objective of zero waste going to landfill; jj. Investigate and analyse all old dumpsites and existing operational dumpsites for their potential bio-mining and bio-remediation and wheresoever feasible; take necessary actions to bio-mine or bio-remediate the sites; kk. In absence of the potential bio-mining and bio-remediation of dumpsite, it shall be scientifically capped as per landfill capping norms to prevent further damage to the environment.

The state of Uttar Pradesh has drafted a Solid Waste Management Policy with an objective to achieve higher standards of cleanliness in the towns and cities of Uttar Pradesh for healthy, hygienic and liveable environment. The policy is developed to facilitate preparation and implementation of a decentralized / integrated and cost-effective Solid Waste Management System in the state with adequate revenue flow from SWM fee and other sources. Considerable emphasis is on waste reduction, reuse, recycling, recovery and optimum utilization of various components of Municipal Solid Waste (MSW) to ensure minimum amount of waste being dumped at the landfill and therefore reduced impact on human health and environment. The strategy promotes utilization of technology options for waste to compost and waste to energy. The policy also focuses on ensuring end-use or treatment of recovered waste resources (high value recyclables, low value recyclables, compost, combustible material (RDF) to waste to energy users, either through partnerships, sale or reuse. Importance of awareness among stakeholders, institutions and organizations in achieving an optimal development and operation of a decentralized/ integrated and cost-effective solid waste management system is also highlighted.

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