HANDBOOK

on

Solid Waste Management

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MAKING DEMOCRACY WORK

MUMBAI VIKAS SAMITI

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PREAMBLE

Solid Waste Management is one of the key areas in the integrated development of any city. For the city of Mumbai with around 8780 MTD of solid waste, effectiveness of solid waste management plays an important role in having the sustainable environmental health. In contrast to the other civic utility services (e.g. water, sewage, electricity), the responsibility of this effectiveness lies not only with the MCGM but also with the people living in the city.

The document details out the classification of the solid waste and the end-to-end comprehensive process of segregation, collection, transport, treatment and disposal along with the stakeholders involved in it. It throws light on quantitative and qualitative aspect of solid waste management in representative countries across the world and then the various details about the solid waste in the city of Mumbai. The F/South success story covered is the role model to be adopted by all the wards.

The purpose of this document is to insist on the decentralised methods of processing of solid waste especially wet waste processing to be adopted by the MCGM. The document is also intended to spread conviction among people regarding these effective methods and their contribution in the same in achieving the dream of 'Zero Garbage' future for Mumbai.

Note: The exercise presented by MVS and Praja Foundation is indicative only. There is no backup for the figures presented in Chapter 3. Nevertheless, a philosophical thought has been introduced proposing strongly discontinuation of present centralised transport and disposal method into scientifically based decentralised method. MVS and Praja suggest that MCGM should setup a suitable group for the study of this paradigm shift and implement it in the next five years on war-footing. This will convert Mumbai into a clean city as expected in both smart and liveable Mumbai.

PREFACE

Praja Foundation

Praja Foundation (Praja) would like to appreciate their stakeholders; particularly, the Elected Representatives & government officials, the Civil Society Organizations (CSOs) and the journalists who utilize and publicize our data and, by doing so, ensure that awareness regarding various issues discussed are distributed to a wide-ranging population.

We would like to take this opportunity to specifically extend our gratitude to all government officials for their continuous cooperation and support. We appreciate the support given by our supporters and donors, namely European Union Fund, Friedrich Naumann Foundation, Ford Foundation, Dasra, Narotam Sekhsaria Foundation and Madhu Mehta Foundation and numerous other individual supporters. Their support has made it possible for us to conduct our study & publish this handbook. We would also like to thank our group of Advisors & Trustees and lastly but not the least, we would like to acknowledge the contributions of all members of Praja's team, who worked hard to make this handbook a reality.

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Mumbai Vikas Samiti

Mumbai Vikas Samiti (MVS), a non-government, not-for-profit and non-sectarian Think Tank Organisation is working towards an integrated, best-in-class development of City of Mumbai since 2008. The organisation set up by technical subject matter experts, entrepreneurs, social activists and management professionals has a compelling focus towards enabling change in the development process, encompassing diversity and inclusion at its core.

One of the objectives of MVS is to organise, collaborate and motivate the people of Mumbai for an action-oriented and impactful Janashakti (the people power) with clear awareness of their social responsibilities and accountable citizenship of the city of Mumbai. Due to this, though a Think Tank Organisation at its inception, MVS assumes mode of Action Tank Organisation when it comes to areas like Solid Waste Management. It's involved in spreading awareness of segregation and processing of wet waste using bio-composting methods in the identified municipal wards and also at the level of co-operative housing societies. Along with its partner Hariyali, it also supports the co-operative housing societies in setting up the bio-composting process till the first compost is harvested. It strongly supports the implementation of decentralised solid waste management to tackle the serious and impending issue of waste management in Mumbai.

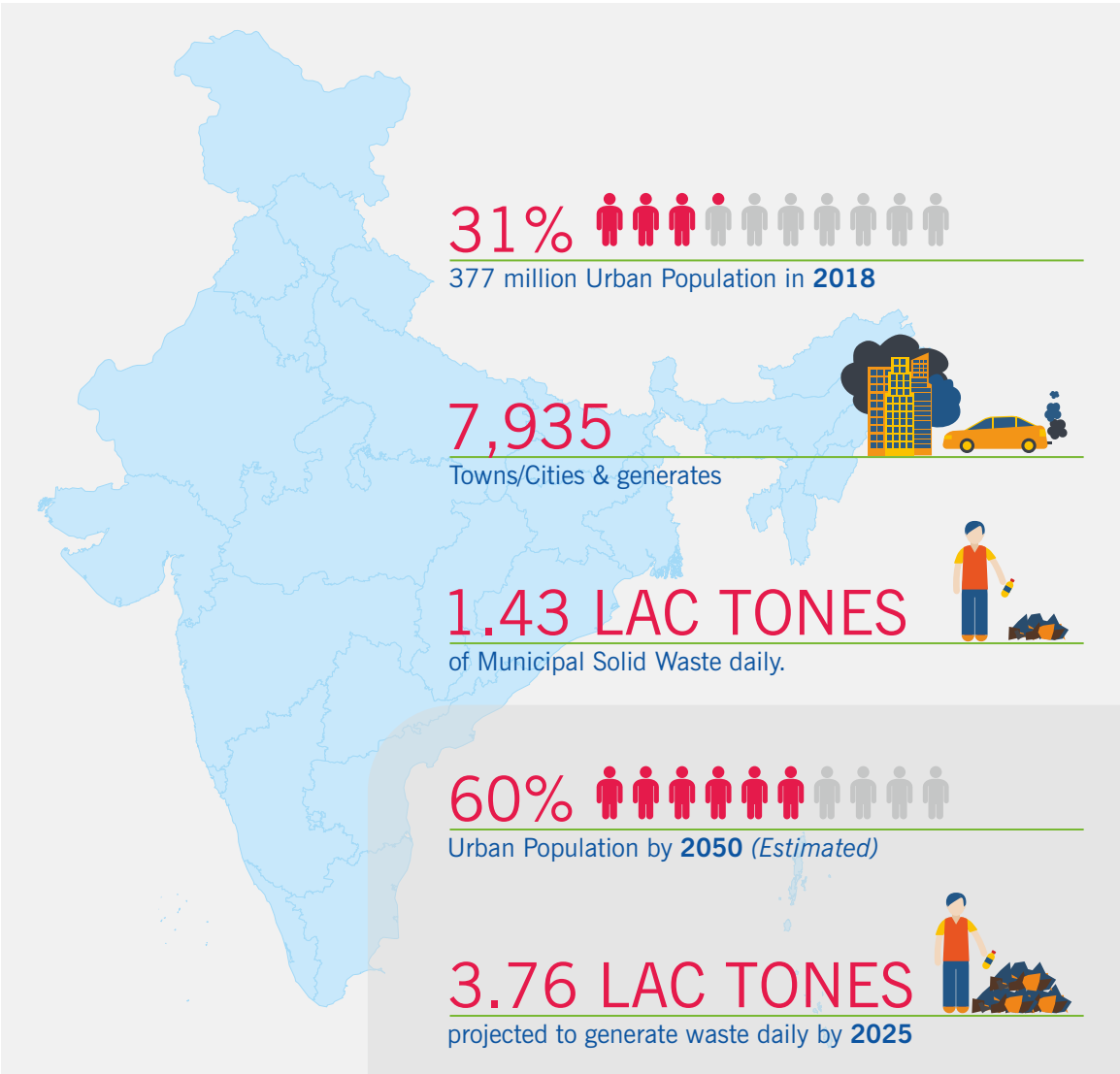
ABSTRACT

In most Indian cities, the problem of solid waste management is acute. Solid waste management is a critical service for the urban local bodies since many public health issues are connected with it. The situation is particularly bad in the unauthorized settlements and slums in urban areas where municipal solid waste management is virtually absent. Inadequate waste disposal may cause severe environmental and health problems. These problems may be attributed to the partial segregation of recyclable waste, absence of waste collection at source, unavailability of suitable infrastructure to treat and dispose the huge amount of waste generated. In order to meet these challenges, the present paper advocates decentralised solid waste management to minimize the problems of solid waste management in urban areas. The main purpose of the paper is to provide a comprehensive view of the decentralised approach to solid waste management along with the appropriate technologies to solve the problem of processing and treatment of waste.

This paper attempts to assess the various factors that govern the sustenance of a decentralised solid waste management system in Mumbai as well as need for zero-waste management. Our findings indicate that success and long-term sustainability of the model depend on sustenance parameters to a varying degree. Apart from the municipal corporation, there are multiple players who play a crucial role in managing the waste. Much of this is managed by informal sector and now emerging recyclers who are setting up processes for decentralised waste management. Most people are unable to achieve 100% decentralised management due to lack of appropriate channels for managing rejects and sanitary waste. More importantly, it is imperative to understand the failure and limitations of the municipal corporation since they are financially dependent on the centre and state for their functioning. But despite all those constraints, it makes sense to gauge energy and material recovery potentials and correlate to municipal waste management.

CHAPTER 1

WHAT IS SOLID WASTE MANAGEMENT?



India is rapidly transitioning from being an agriculture-based nation to an industrial and services-oriented country. Approximately 31% of India's population is now living in urban areas, which amounts to over 377 million urban people are living in 7,935 towns/cities[1]. It is estimated that by 2050, 60% of India's population will be living in cities[2]. Correspondingly, India currently generates 1.43 lac tonnes of Municipal Solid Waste daily. This number is projected to triple by 2025 to 376,639 tonnes of waste daily[3]. High population growth rates, rapidly varying waste characterization and generation patterns, growing urbanization and industrialization in cities all over the world are eliciting urgent attention towards Municipal Solid Waste Management (MSWM).

1: http://home.iitk.ac.in/~anubha/H13.pdf
2 & 3 : https://www.un.org/development/desa/publications/2018-revision-of-world-urbanization-prospects.html

Out of that 62 million tonnes of waste is generated annually in the country at present, 5.6 million tonnes is plastic waste, 0.17 million tonnes is biomedical waste, hazardous waste generation is 7.90 million tonnes per annum and 15 lakh tonne is e-waste. The per capita waste generation in Indian cities ranges from 200 grams to 600 grams per day. Government of India (GoI) underlined the fact that 43 million TPA is collected, 11.9 million is treated and 31 million is dumped in landfill sites, which means that only about 75-80% of the municipal waste gets collected and only 22-28 % of this waste is processed and treated. Waste generation will increase from 62 million tonnes to about 165 million tonnes in 2030 according to Press Information Bureau, Ministry of Environment, Forest and Climate Change, Government of India (April 2016).

Solid waste thus, means any garbage, refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded materials including solid, liquid, semi-solid, or contained gaseous material, resulting from industrial, commercial, mining and agricultural operations, and from community activities, but does not include solid or dissolved materials in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges that are point sources or special nuclear or by-product material (Department of Environmental Conservation, New York State). In simple words, solid wastes are any discarded or abandoned materials which can be solid, liquid, semi-solid or containerized gaseous material. Uncontaminated solid waste resulting from the construction, remodelling, repair and demolition of utilities, structures and roads; and uncontaminated solid waste resulting from land clearing (in general called "debris") is also a type of solid waste.

Some of the major types of solid wastes are Municipal Solid Waste (MSW), Hazardous Wastes, Industrial Wastes, Agricultural Wastes, Bio-medical Wastes, and Waste Minimization.

In India, it is the responsibility of Urban Local Bodies (ULBs) to manage solid waste generated in cities. Management of said solid waste comprises segregation, storage, collection, relocation, carry-age, processing, and disposal of waste generated by households, hotels, communities; it is governed by the Municipal Solid Waste Rules, 2016[4]. Hence, MSWM is critical in sustainable metropolitan development. It is sad to note that despite urban waste generation showing a meteoric rise, more than 90% of India does not have a proper waste disposal system[5].

There seems to be almost no effort towards segregation of Municipal Solid Waste (MSW) and scientific disposal of construction and demolition debris (C&D), plastic wastes, commercial and industrial refuses, and e-waste.

Many Indian cities face the serious problem of solid waste management (SWM) due to rapid urbanization and ineffective deployment of SWM strategies and policies. Currently, India generates more than 1.43 lac metric tons, of which only about 33,800 tpd (i.e. 23.73%) is processed. Composting is the natural process of decomposing and recycling organic material into a soil amendment rich in humus known as

4: Explained in Chapter 3 of this Handbook.

5: http://www.indiaspend.com/cover-story/smaller-indian-cities-better-at-managing-waste-than-larger-ones-81875

compost. For any company or institution that produces food waste, this organic material can be easily decomposed into high quality compost. Fruits, vegetables, dairy products, grains, bread, unbleached paper napkins, coffee filters, egg shells, meat and newspapers can be composted. So, Compost is well decomposed organic waste such as plant waste, animal manure and land from the urine of the livestock hut. The segregation of waste at the source ensures that the waste is less contaminated and it can be collected and transported for further processing. Segregation of waste also optimizes waste processing and treatment technologies. That results in a high proportion of segregated material that could be reused and recycling, leading to lower consumption of virgin material. Various composting scheme of different scale, type and organizational structure currently exist in the country; however, a general consensus and consistent policy is lacking and very little independent site-specific information is available. [Pavan et al, 2014].

Classification of waste

Waste generated by countries, broadly categorised into wet waste and dry waste, can be further classified into:

Solid waste vegetable waste, kitchen waste, household waste etc.

Metal waste unused metal sheet, metal scraps etc.

Plastic waste plastic bags, bottles, bucket, etc.

Industrial waste waste which is produced by industrial processes or activities.

E-waste discarded electronic devices such as computer, TV, music systems etc.

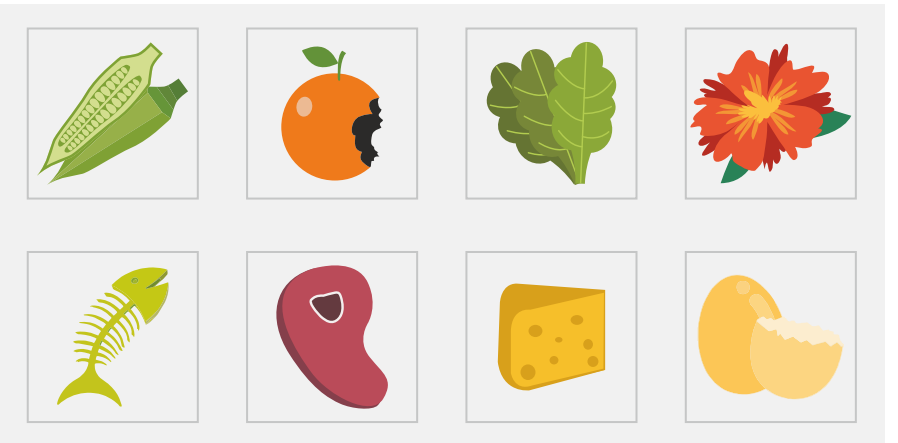
Nuclear waste unused materials from nuclear power plants Further we can group all these type of waste into wet waste (Biodegradable) and dry waste (Non-biodegradable).

Wet Waste includes the following:

The wet waste is primarily generated from kitchen (household, industries, commercial establishments, shops, institutions etc.) and consists mainly of followings:

- Food waste (cooked and uncooked), including eggshells and bones.
- Flower and fruit waste including juice peels and house-plant waste. Garden sweeping or yard waste consisting of green/dry leaves.
- Green waste from vegetable & fruit vendors/shops. Waste from food & tea stalls/shops etc.

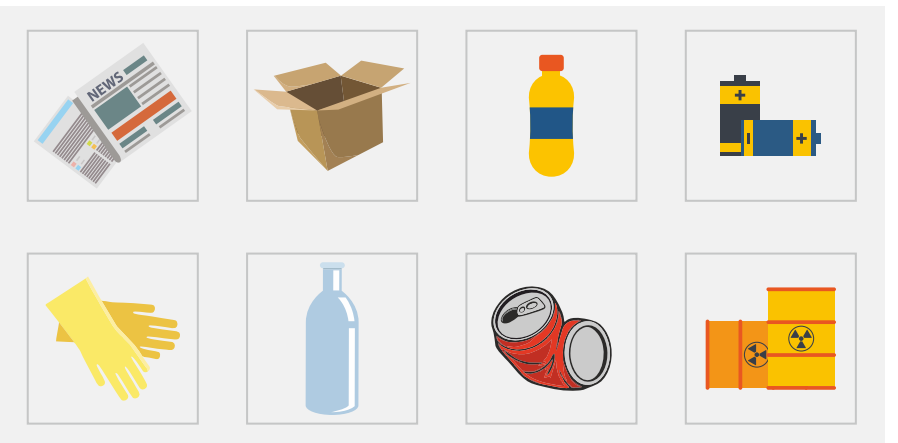
Wet waste is usually bio-degradable, i.e. it's capable of getting decomposed naturally.



Dry waste includes the following:

The dry waste is not naturally decomposable and usually man-made. It consists of items such as:

- Paper and plastic, cardboard and cartons
- Containers of all kinds excluding those containing hazardous material
- Packaging material
- Glass, metals, rags, rubber
- Road sweeping (dust etc.)



Time taken to decompose

Following table indicates the approximate time taken to decompose various type of wastes

Type of waste	Time taken to decompose
	
Vegetables, Fruit Skins, Waste Food	Paper Bags
3-4 Weeks	1 Month
	
Cloth Bags	Wood Pieces
5 Months	10-15 Years
	
Leather Shoes and Sandals	Iron Sheets
40-50 Years	50-100 Years
	
Aluminium Sheets	Plastic Bags
200-250 Years	1 Million Years

Waste Management Process – a comprehensive look

Waste management or Waste disposal is sum of all the activities and actions required to manage waste from its inception to its final disposal. This includes amongst other things, collection, transport, treatment and disposal of waste together with monitoring and regulation. It also encompasses the legal and regulatory framework that relates to waste management encompassing guidance on recycling etc. (Wikipedia, 2018)

Collection

Waste produced by houses is usually transferred into communal bins that are fabricated from metal, plastic or made from concrete or in combination of both. Street sweepings also find its way to community bins. These community waste bins are also used by other essential commercial sectors in the vicinity of disposal bins along with household waste except where some commercial complexes or industrial units engage municipal authorities for the transfer of their waste to disposal site by paying some amount.
Following flowchart shows the general waste collection process:

Fig. 1 – Collection Process Flowchart

In residential areas, the most common collection methods are curb or alley, Setout-setback, and backyard carry. In curb or alley service, the residents carry the single-use plastic bags and containers to the curb or collection point, and then return the empty container after pickup. Setout service utilizes a crew that carries the containers to the collection point. A separate collection crew empties the containers and residents returns the empty containers. In Setout-setback service, a third crew returns the empty containers. In backyard carry service, the collection crew transfers the solid waste into a wheeled barrel, and then unloads it into the collection truck. The containers remain in the backyard. Many communities have also instituted regulations for separation of solid wastes at the source by residents.

Methods of waste collection

Followings are the main methods of waste collection:

- **Door-to-Door Collection**

- Waste collectors visit each individual house to collect garbage. The user generally pays a fee for this service.
- Door-to-door collection by private waste collectors (contracted)
- Municipalities hire businesses/private contractors to pick up garbage for a fee.

- **Community Bin Collection**

Citizens bring their garbage to community bins that are placed at fixed points in a neighbourhood or locality. MSW is picked up by the municipality, or its designate, according to a set schedule. Community bin collection has not worked historically due to lack of active participation from the citizens. 100 percent door to door waste collection has been achieved in 329 cities of Goa, Gujarat, Karnataka, Madhya Pradesh, Mizoram, Nagaland, Odisha, Sikkim, Tamil Nadu and Telangana. In Goa, self-help groups are involved in the entire Margao Municipal Council. The Kochi Municipal Corporation has successfully implemented a bin-less system in a few wards of the city.

Transportation	

Modes of transportation for MSWM practised in India are bullock carts, hand rickshaws, compactors, trucks, tractor, trailers, and dumpers. In door-to-door collection, compactor/pickup trucks pick up waste and transfer it to the landfill/dumping site. If the disposal site is too far from the city, the time spent by the crew of the pickup truck in unproductive travel becomes impractical and economically unfeasible. Hence, areas with transitory capabilities, called transfer stations, are established at convenient locations. Trucks carry waste from door-to-door collection to transfer stations, following which the garbage is taken to dumping grounds for disposal.

The objective is to reduce the volume of garbage generated, alter the physical form, and recover usable materials. It is important that the transfer station be located as near as possible to the generation center. Hence, good access roads as well as secondary or supplemental means of transportation also become a

necessity. Also, the site must be environmentally acceptable. If more than one transfer station and disposal sites are used, then optimum allocation of wastes from each transfer station to each disposal site becomes necessary.

Methods of solid waste treatment and disposal	

Traditionally, the '3 Rs' (Reduce, Reuse, Recycle) and have been the backbone of garbage generation as well as disposal. However, with the advent of Integrated Solid Waste Management (ISWM), a fourth 'R' (Recover) appears to have made its way in the fray recovery. The principle followed is that waste is seen as a resource instead of a problem. Waste is composted or incinerated and manure or energy is extracted, which can be used for various purposes. Additionally, the citizenry's capacity is being built around using less and recycling more, leading to a changing approach towards garbage and its disposal.

Common methods of municipal solid waste disposal include[6]
Followings are the key methods of disposing municipal solid waste:

1. Waste reduction

A reduction in waste generation has a two-fold benefit in terms of greenhouse gas emission reductions. First, the emissions associated with material and product manufacture are avoided. The second benefit is eliminating the emissions associated with the avoided waste management activities.

2. Recycling/material recovery

The key advantages of recycling and recovery are reduced quantities of disposed waste and the return of materials to the economy. This is often carried out by informal waste pickers at collection points and disposal sites recover a significant portion of discards.

3. Aerobic Composting/Anaerobic Digestion

Composting with windrows or enclosed vessels is intended to be an aerobic (with oxygen) operation that avoids the formation of methane associated with anaerobic conditions (without oxygen). When using an anaerobic digestion process, organic waste is treated in an enclosed vessel. Often associated with wastewater treatment facilities, anaerobic digestion will generate methane that can either be flared or used to generate heat and/or electricity. Generally speaking, composting is less complex, more forgiving, and less costly than anaerobic digestion. However, composting requires that waste be segregated.

4. Incineration

Involves incineration of waste.

6: https://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1334852610766/What_a_Waste2012_Final.pdf

5. Landfill

Waste is sent to a disposal site, where it is dumped. The waste or residue from other processes should be sent to a disposal site. Landfills are a common final disposal site for waste and should be engineered and operated to protect the environment and public health. Landfill dumping can either be open-dumping, controlled dumping, or sanitary landfilling. Sanitary landfilling is the least harmful to the environment, where the waste is compacted and covered with a leachate, and gasses that are released are captured for further usage.

6. Palletisation

Palletisation of waste involves solidifying organic waste material to produce fuel pellets or briquettes. The pellets can then be used as a generator of electricity, on pellet stoves, coal-fired power plants, etc.

7. SlurryCarbTM process

Technology that converts organic waste into renewable fuel.

8. Pyrolysis

Biomass thermo conversion technology. It is the thermal degradation of wet waste in the absence of oxygen (anaerobic process).

Ragpickers – The unsung heroes[7]

Ragpickers sustain themselves by collecting, sorting, and segregating waste and then trading waste to make a living. Ragpickers end up being responsible for preventing a large chunk of plastic and non-degradable waste from going into the land for millions of years. And yet, ragpicking is an informal sector, unrecognised as a profession by the Indian government. They work without job security, salary or dignity. They also face grave health hazards, being exposed to infections and respiratory diseases on a daily basis. Even though the contribution of ragpickers to the waste management scenario has been recoginsed by an environment minister, there seems to be no policy change.

image credit: Reuters/Anindito Mukherjee

7: http://www.indiaspend.com/cover-story/why-ragpickers-unrecognised-and-unpaid-are-critical-for-waste-management-in-india-43164

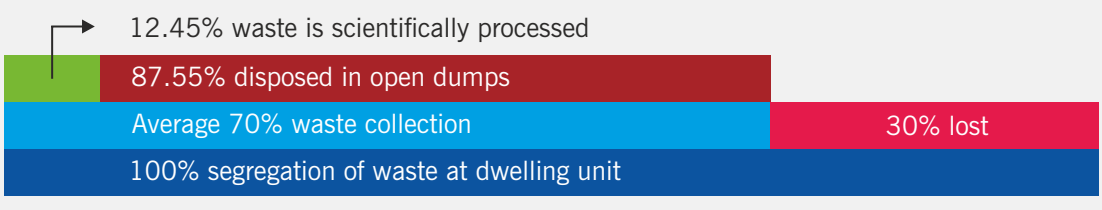
Waste Management in India - the legislative framework

With the increasing industrial growth and development, one of the consequences that is often ignored is the effective implementation of end-to-end, integrated disposal management systems and processes. If the disposal of such wastes is not regulated and managed properly, it can lead to serious environmental issues. In India, waste management is governed by Ministry of Environment and Forest, who work together with State Pollution Control Board set up in various States. Certain laws are also present in the legal setup which helps in regulation of waste in India.

The Union Ministry of Environment, Forests and Climate Change (MoEF&CC) notified the new Solid Waste Management Rules (SWM), 2016 which replaced the Municipal Solid Wastes (Management and Handling) Rules, 2000.The Rules applies to every urban local body, outgrowths in urban agglomerations, census towns as declared by the Registrar General and Census Commissioner of India, notified areas, notified industrial townships, areas under the control of Indian Railways, airports, airbase, Port and harbour, defence establishments, special economic zones, State and Central government organizations, places of pilgrims, religious & historical importance as may be notified by respective state government from time to time and to every domestic, institutional, commercial and any other non residential solid waste generator except industrial waste, hazardous waste, hazardous chemicals, bio-medical wastes, e-waste, lead acid batteries and radio-active waste. The SWM Rules 2016 mainly emphasise on segregation at source, collection and disposal of sanitary waste, Collect Back scheme for packaging waste, user fees for collection, waste processing and treatment, promoting use of compost, promotion of waste to energy, management of waste in hilly areas and Constitution of a Central Monitoring Committee. The details are provided in Annexure.

Solid waste management practices and their challenges in India

In India, MSWM is governed by Municipal Solid Waste Handling Rules. However, majority of ULBs do not have appropriate action plans for execution and enactment of the MSWR (CPCB Report, 2013). Unfortunately, no city in India can claim 100% segregation of waste at dwelling unit and on an average only 70% waste collection is observed, while the remaining 30% is again mixed up and lost in the urban environment. Out of total waste collected, only 12.45% waste is scientifically processed and rest is disposed in open dumps (CPCB Report, 2013). Environment friendliness, cost effectiveness, and acceptability to the local community are major attributes to achieve efficient solid waste management system. However, this end-to-end process (segregation to disposal) is neither planned nor implemented effectively across ULBs (Joshi et al, 2016)



At many places, solid waste is transported inadequately as they lack proper transport facilities and its disposal is also not done in a scientific manner. The trucks used for transportation of waste are generally open and uncovered which tends to spill waste onto the road resulting in unhygienic conditions. More than 80 percent of waste is disposed of indiscriminately at dump yards in an unhygienic manner by the municipal authorities leading to problems of health and environmental degradation (Planning Commission, 2014). Dumping grounds are not sustainable landfills as these dumping grounds have no foundations, liners, levelling, cover soil, leachate managements and treatment facility (Jha et al., 2011). Majority of cities dispose their waste in low lying areas outside the city without taking precautions or operational control. Cities are facing the problem of the limited availability of land for waste disposal especially big cities. Finding new landfill sites is major constraints including the 'not in my backyard (NIMBY) syndrome. People want a good facility for municipal solid waste but not near the vicinity of their households. This attitude of the people has made the task difficult for the ULBs with respect to SWM (Satpal Singh, 2017).

Considering the graveness of the problems, it is imperative to undertake the decentralised solid waste management since the existing centralised system is not suitable for waste with high organic content and is also not cost effective. It does not allow integration of informal waste workers (Karthikeyan, et al., 2012). Wastes are not collected in efficient manner under this system. As a result, overflowing garbage bins at the public collection sites, scattered waste all over is common scenario prevailing in most of the cities. In addition, centralised system has a limited scope for community participation, livelihood generation and innovation whereas, the decentralised system do not suffer from these limitations. Decentralised system is more appropriated as it encourages civic responsibilities and provides effective SWM by engaging the local people in the waste management and helps in changing the mindset of people towards the waste management. The system is based on door to door waste collection and sensitizing residents for segregation of waste. The technologies like waste recycling, vermicomposting and small-scale bio-gas for this system are very simple, cost effective and labour intensive (Satpal Singh, 2017).

Thus, the objectives of decentralisation are creating a clean hygienic environment free of garbage in the selected area, minimizing of waste disposal, utilizing waste as a resource for the generation of wealth, converting biodegradable waste into compost, to educate the community and make them aware of their roles and responsibilities, to involve community in solid waste management. Vermi-composting and bio-composting technology are promising technique that has shown its potential in certain challenging areas like augmentation of food production, waste recycling, management of solid wastes etc. There is no doubt that in India, where on side pollution is increasing due to accumulation of organic wastes and on the other side there is shortage of organic manure, which could increase the fertility and productivity of the land and produce nutritive and safe food, the need for decentralised solid waste management and eventual zero-waste management is critical.

CHAPTER 2

DECENTRALISED SOLID WASTE MANAGEMENT THE CURRENT NEED

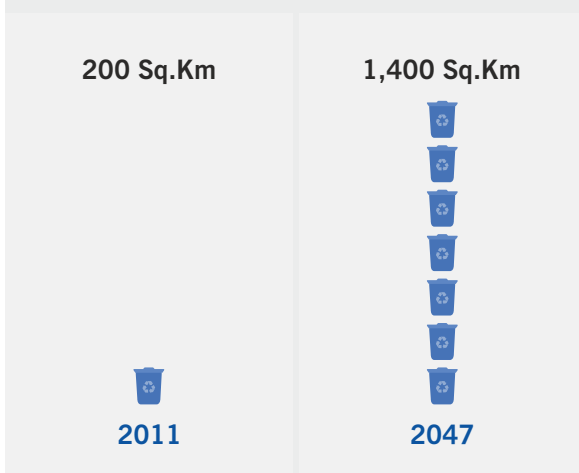
With India's urban population slated to increase from the current 330 million to about 600 million by 2030, and per capita income continuing to rise, the challenge of managing municipal solid waste (MSW) in an environmentally and economically sustainable manner is bound to assume gigantic proportions. The country has over 5,000 cities and towns, which generate about 40 million tonnes of MSW per year today. Going by estimates of The Energy Research Institute (TERI), this could well touch 260 million tonnes per year by 2047. MSW management is a part of the responsibilities entrusted to the municipal governments. As indicated earlier, the main stages in MSW are waste generation, collection and transport, treatment and value addition, and residue management. The options available are land filling, composting, energy production, etc. Until now, MSW management has been considered to be almost the sole responsibility of urban governments, without the participation of citizens and other stakeholders. The Centre and the Supreme Court, however, have urged that this issue be addressed with multiple stakeholder participation. Cities in India spend approximately 20% of the city budget on solid waste services. Even so, a considerable proportion of MSW, ranging from 20-40%, is not managed at all. MSW is also transported inadequately, as many cities lack proper transport facilities, and its disposal in many cases is not done in a scientific manner. This, in turn, leads to poor public sanitation, and higher incidence of disease-causing vectors. The urban development ministry is planning to set up service level benchmarking (SLB) for access to central funds under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), which will also include MSW management. The urban public will also demand better performance, and under the delimitation exercise, it now has the electoral power to manifest such demand through electoral behaviour.

The current solutions to MSW management favour centralised arrangements, in some cases using Public-Private Partnership (PPP). For encouraging PPP in centralised composting, it is essential that urban local bodies evolve risk-sharing arrangements to encourage private sector participation, and improve marketability of the resulting compost. The centralised arrangements include using landfill sites, developing future sites, building of waste-to-energy plants, and centralised large waste-to-compost facilities.

However, these have five major limitations

They do not distinguish between different needs of the neighbourhoods within each city, and between cities. The centralised arrangements are often capital and land intensive. TERI estimates that for disposing MSW, the land requirement will rise from 200 sq. km in 2011 to 1,400 sq. km in 2047. The urban areas, which have the largest concentration of MSW, are also the most land-scarce, and therefore, the opportunity cost of using such land for MSW disposal is also very high.

Land requirement for disposing MSW



Centralised arrangements leave limited scope for community-based participation, social entrepreneurship, livelihood generation, and innovations. Certain modes of centralised systems (such as incineration plants) may not permit access to the recyclable material, and make available space to segregate waste and add value to it locally. The livelihoods of a large number of persons (such as rag-pickers and scavengers) currently involved in India in waste management in the informal sector may be adversely affected by these modes. In the medium term, however, the numbers of such individuals must be reduced through retraining and restructuring their work content.

The centralised waste disposal arrangements shift the problem from the source of waste generation to waste disposal sites. They also involve long distance transportation of waste, with possible negative externalities and higher fuel consumption. Given India's energy dependence, and continuing high oil prices, such an option would be enormously expensive, while not meeting the desired quality standards.

Centralised waste treatment in India is more susceptible to neighbourhood resistance (NIMBY syndrome), and to resulting judicial activism. This is particularly the case when the organic and non-organic wastes are not separated, as has recently been the case in Delhi.

Hence, there is a need of decentralised solid waste management system and processes aligned accordingly. The decentralised community-based waste management arrangements do not suffer from the above limitations. For example, they treat solid waste near to the origin. In some cases, the treated waste becomes an economic resource, which can be used, thereby eliminating the need for transport, landfill, or treatment at the waste disposal site. They also encourage civic responsibility, and innovation. Requiring large commercial premises (such as hotels, hospitals, educational institutions, corporate canteens) to install waste management system on the premises and appropriate user charges merit serious consideration. Separating solid waste into organic and inorganic components also needs to be enforced through city regulations.

There are several residential complexes in cities such as Pune and Bangalore, which process organic waste on their premises using technology available with several private entrepreneurs. Non-organic waste is collected and sold. Compost from organic waste is used for neighbourhood gardens' needs, with the excess being sold to private companies. Small neighbourhoods are also organising for decentralised organic waste management, in some cases combining them with maintenance contracts for neighbourhood gardens. Appropriate organisational incentive structures, however, need to be created to make such arrangements affordable to waste-generating communities, and to expand their reach. Possibilities of combining such decentralised MSW arrangements with the corporate social responsibility initiatives of business and non-profit organisations with a potential to benefit from the better environment should also be explored.

However, given the current dominance of centralised arrangements, India has little alternative but to make them work better, while simultaneously encouraging decentralised and other innovative arrangements. A more scientific and integrated MSW management has the potential to significantly improve the quality of life in urban areas. Decentralised arrangements could bring about citizen

participation, generate livelihoods, and contribute to environmental sustainability and economic efficiency (Asher and Gandhi, 2008).

Centralised v/s Decentralised Solid Waste management – a comparative analysis

Centralised management system refers to 'centralised approach' in planning, decision making, implementation, monitoring and evaluation as part of the operationalisation of any initiative/intervention. Considering the strain in resources available at Urban Local Bodies' disposal, the decentralised method of solid waste management has emerged as the more viable option in comparison with its centralised alternative.

The Decentralised Solid Waste Management (DSWM) aims at reducing the quantity of waste at the source. It involves the management of municipal solid waste by various small waste management centres within the locality. Such centres are called Integrated Resource Recovery Centres (IRRC) which can be either profit making or not-for-profit organizations engaged in collecting, transporting and processing of waste. The decentralised system is not only sustainable and financially viable but also helps to improve the quality of life and working conditions of waste pickers. Decentralised or at source segregation and treatment of waste has become the most practical and acceptable solution to the management of garbage. Many bulk waste generators such as large industries, hotels, IT companies and municipal corporations have started adopting various decentralised waste management solutions as a part of their overall waste management strategies. Segregation waste at source greatly aides in recovery of waste generated, as wet waste gets composted and dry waste gets recycled/scientifically disposed.

Therefore, the DSWM becomes a system to provide a clean environment and hygienic living conditions by reducing the amount of waste at the source. It involves the management of municipal solid waste by several small waste management centres within the locality. Decentralised organic Solid Waste composting promotes green growth, reduces greenhouse gas emissions and also reduces transportation of organic SW to waste disposal site. In order to encourage innovation and adoption of decentralised waste recycling solutions, government should consider fiscal and financial incentives for setting up and operation of 'Garbage to Garden' and 'Garbage to Gas'.

Methodologies for DSWM Treatment includes Recycling of Waste, Decentralised Composting, Pit/Vermi Composting, Small Scale Anaerobic Digestion and Mechanical Composting. Mechanical composting is a process designed to optimize the use of resources remaining in residual waste. Usually, it is designed to recover materials for one or more purpose, and to stabilize the organic fraction of residual waste. The benefits of this process are that materials and energy may be recovered, void space requirements are reduced and gas and leachate emissions from landfill are significantly reduced. The mechanical composting phase involves segregation and conditioning of wastes.

Economic aspects of Decentralised SWM System indicates that if segregate of solid waste is done at source than 60- 70% cost will be reduced with compare to total solid waste cost as per segregation of solid waste, organic waste will be compost with mechanical composting & it is recyclable as composting.

Conclusion

It's very evident that the solid waste management is a critical issue in India today. Most of the challenges of the solid waste management and environmental sustainability are still unanswered. It is pertinent to note that the improvement in the solid waste management is the greatest challenge being faced by the municipal authorities. The decentralised approach could be one of the effective methods to solve the problems of waste management in India as it has potential to reduce the quantity of waste by changing the mindset of the people and reduces the transportation cost, reduces the traffic congestion, reduces the amount of air pollution, road maintenance cost, and contamination of ground water through the seepage of leachates. More importantly, it reduces the amount of waste in landfill sites as the land is a major constraint of the solid waste management system. Finding new landfill sites around cities is nearly impossible because of various constraints like lack of space for locally unwanted land uses, population density and the scale of India's increasing urban sprawl. Decentralised approach is not only sustainable and financially viable but also helps to improve the quality of life and working condition of the waste pickers. It could bring about citizen participation, and contribute to environmental sustainability and economic efficiency.

An analysis of various technological options indicates that due to lack of segregation of waste at source, the recycled products are mostly of poor quality and low cost, incapable of finding markets occupied by virgin materials-based products. As a result, both the people involved in the trade as well as the products produced from recycled waste are a largely neglected a lot. In addition, the recycling industries face a number of problems such as (i) reuse and recycling of waste is labour oriented and inadequate, (ii) the processing of waste by small scale industries is not compliance with regulatory requirements. Also, there is no policy for recyclable products. Compost is rarely financially competitive to heavily subsidized chemical fertilizers and traditional cow dung or poultry manure. Therefore, there are fewer buyers available in the market for the compost. The market for compost is still underdeveloped despite its potential. The analysis further indicates that no technology is perfect. All of them have advantages and disadvantages as well. In order to overcome the above cited problems of solid waste management, community based decentralised solid waste management should be promoted with the community participation but with municipal support. In this regard, the policy paper or action plan should be prepared to promote the community based decentralised waste management system. Zero waste approach should be introduced to minimize the waste and change the consumption habits of people. Government should prepare the plan for recycling products which encompasses the quality of products, guidelines to the recycling industries including the compliance with regulatory requirements and marketing policy for recycled materials and compost. (Satpal Singh, 2017)

Solid Waste Management in Mumbai[8]

It's very evidently observed that on an average Mumbai generated about 8,780 metric tons per day (MTPD) of solid waste. Municipal solid waste comprises compostable matter, paper and cardboard from residential and commercial premises, sand and fine earth from street sweeping and other materials such as plastics, metals, glass, etc. Though plastic composes only 0.75% of the total waste generated, it causes maximum nuisance such as clogging of drains. Moreover, considering that its combustion poses a health hazards due to the release of toxic gases and that it is not biodegradable, MCGM has banned the plastic bags.

A. Waste Collection & Disposal System

a. Street Sweeping: The total road length in Mumbai is about 1,950 km. At present 100 per cent of the road length are swept in one or two (in case of about 75 km of roads) shifts by municipal staff (67 per cent of the roads) and private contractors (33 per cent of the roads). Sweeping is carried out in beats (a pair of sweepers per beat) – a total of 4,200 beats are carried out per day at 4,000 to 5,000 sq.m per pair of sweepers in island city area and 8,000 to 10,000 sq.m per pair of sweepers in the suburbs.

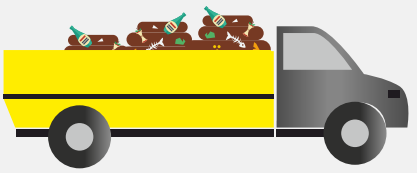
Power sweeping has been introduced in island city area in about 50 km of roads in wards A, D, G/South and G/North, and is proposed to be scaled up with about 150 km identified for the immediate phase.

Garbage management in the four beaches – Girgaon Chowpaty, Shivaji Park-Mahim Juhu and Versova Beach – is outsourced to private entities for five-year periods based on a comprehensive performance based maintenance contract.

b. Waste collection: Waste collection is through community bins (83%) and house-to-house collection (13%). There are a total of about 4,338 community collection bins of various types and capacities, including 1 cum compactor containers, skip containers of various sizes, sheds, stationary compactors and refuse vehicles (on hire). The collection from collection bins is carried out in 3 shifts and transported either to the three transfer stations or directly to the disposal points. Waste collected through skip vehicles is generally transferred to the transfer stations; from where it is transported through bulk refuse carriers. The following table presents a summary of vehicles employed for waste collection and transportation.

8:http://www.mcgm.gov.in/irj/go/km/docs/documents/MCGM%20Department%20List/City%20Engineer/Deputy%20City%20Engineer%20(Planning%20and%20Design)/City%20Development%20Plan/Solid%20Waste%20Management.pdf

Vehicles employed for waste collection and transportation



Open trucks
- 5/10
- 18
- 29
- 47

Compactors
- 15
- 138
- 158
- 296

Skip Vehicles
- 2.5/5
- 123
- -
- 123

Dumpers
- 5/10
- 82
- 197
- 279

JCB machines
- -
- 22
- 30
- 52

Bulk Refuse Carriers
- 22
- 18
- -
- 18

Other vehicles (Jeeps, Tempos)
- -
- 8
- 186
- 194

Type of Vehicle	Total
Capacity per vehicle (cu. m)	-
No. of Municipal Vehicles	409
No. of Private Vehicles	600
Total No. of Vehicles	1,009

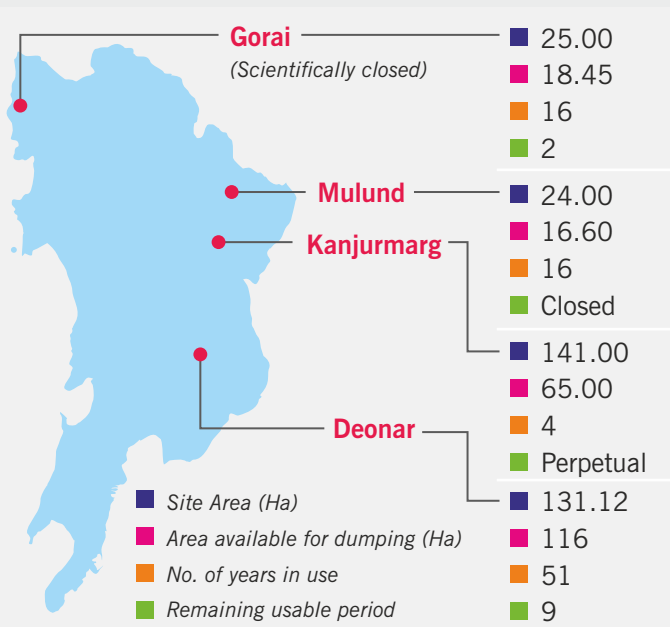
The daily collection and transportation of waste is carried out in two shifts with an average number of about 1,000 to 1,354 trips per day.

MCGM has adopted innovative mechanisms for waste collection in slum areas – the "Slum Adoption Scheme" – wherein local community based organizations (CBO) are registered[8] and provided a monthly honorarium of Rs. 2,500 per 1,000 population for waste collection and cleaning of small nallahs and drains in identified slum pockets. The amount of honorarium is reduced to Rs. 1,800 in the second year and to Rs. 370 in the third year. The concept of this scheme is to encourage community to own up local initiatives in planning and execution at the grassroots level. The CBO is authorized and expected to collect Rs. 10 per month per household in lieu of services provided. As of now, MCGM has registered about 249 such CBOs covering about 4.8 million of slum population, and intends to cover 100 per cent of the slums under this scheme.

Another scheme being implemented is the Advance Locality Management (ALM) system, which entails extensive interaction and involvement of MCGM with local neighborhood groups in the wards. These groups form the ALM Street Committees, and coordinate with the respective Ward Officer for better management of civic road related issues, especially garbage management. At present there are about 584 such ALM Street Committees in the 24 wards of the city, focusing on Zero Garbage (ZG). The focus is on reduction of waste, storage and disposal, involving rag pickers for collection and disposal of dry waste. For wet disposal, composting is being adopted in several wards.

c. Waste Processing and Disposal: Most of the municipal solid waste collected is disposed off at the landfill sites at Deonar, Mulund and Kanjurmarg as mere dumping and leveling. On the whole, only about 100 to 150 MTPD is treated to localized composting, biogas generation etc. The Deonar dumping ground is the largest (131 Ha) receiving about 4800 MTPD of garbage. Kanjurmarg receives 3000 MTPD. The total area available for land fill / dumping in three landfill sites is about 151 Ha with very few years of life remaining, as depicted in the table below.

Current Municipal Solid Waste Disposal Sites



8:CBOs are local registered bodies under the Societies Registration Act, 160 and Public Trust Act, 1950 or Cooperative Act, 1961.

All the dumping sites are located in dense habited areas. In order to reduce the odor and health nuisances, MCGM has engages tractors mounted with spraying equipment to spray water mixed with eco-friendly disinfectants on the piled garbage which has shown positive results (in Gorai, where levels of Hydrogen Sulphide has substantially reduced). Moreover, MCGM has planted about 7,000 trees around Gorai dumping ground. A plantation program for Mulund & Deonar is also under implementation. Further 1000 trees on the northeast side are proposed to be planted to provide a buffer between refuse site & residential area.

It may be noted that all the Deonar and Mulund disposal sites have almost outlived their productive/carrying capacity, except Deonar, which could possibly be used for a few more years. In view of this, MCGM is already on the look-out for augmenting the disposal capacity by a combination of acquiring new sites and employing better technology so as to minimize the amount of waste to be land filled. The Government of Maharashtra has allotted MCGM a site at Kanjurmarg, measuring about 141.77 Ha for this purpose in October 2005. MCGM has started the implementation of various technology options including recycling and disposal methods so as to optimize the available land for disposal and also recover as much possible from the garbage so as to minimize the land fill requirement.

Summary of Solid Waste Management & Disposal Arrangements in Mumbai

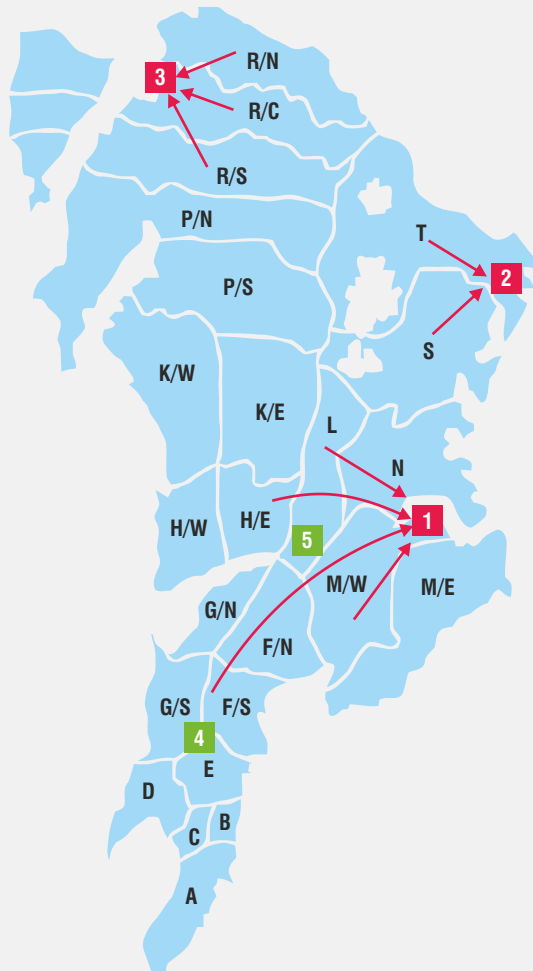
Zone	Area (sq.km.)	Population (2001) in million	No. of collection points	Transportation vehicles - by type	Transfer Station	Treatment / Disposal Point
Zone I	28.51	1.36	282		Mahalakshmi Refuse Transfer Station	Deonar
Zone II	39	1.97	753	Mix of compactor, Dumper	Mahalakshmi & Kurla Refuse Transfer Stations	Deonar
Zone III	66.79	2.42	805	Placer, Dumper		Deonar
Zone IV	190.31	2.68	983	Tempo, etc.		Gorai
Zone V	67.58	1.86	815		Kurla Refuse Transfer Station	Deonar
Zone VI	87.05	1.64	700			Mulund
Total	**479.24**	**11.91**	**4,338**			

d. Construction debris: Construction debris is being disposed off in abandoned mines/quarries within MCGM limits. MCGM has designed a new system of construction debris collection and disposal involving the private sector. A detailed plan with a policy framework and guidelines has been drafted by MCGM to roll out the proposed plan.

[Construction & Demolition and De-silting Waste - (Management and Disposal) Guidelines, September 2005] – which entails utility agencies, developers and other debris generators to prepare a debris disposal plan and seek an approval from MCGM as part of the building permission process. It is proposed to contract out the collection, transportation and disposal/recycling of the construction debris to private operators who would provide skips of appropriate sizes to debris generators for debris collection and would transport the same to the designated disposal/recycling site for a fixed fee. Expression of Interests have been sought and received from prospective entities for collection, transportation and recycling of construction and debris waste, and private operators will be short listed and appointed shortly.

Biomedical waste management: The total biomedical waste generated in Mumbai is about 25 MTPD. While some of the big medical institutions have their own incinerators for treatment and disposal of biomedical waste, MCGM had developed a 10 MTPD biomedical waste treatment and disposal facility on a BOT basis comprising one incinerator, two autoclaves and shredder at the municipal GTB hospital, Sewree. However, this facility was forced to shut down operations as it did not comply with emission norms. About 3 MTPD of biomedical waste that is generated from the municipal medical facilities is currently being disposed at the Hazardous Waste Treatment and Disposal facility at Taloja.

Map showing transfer stations and disposal site locations in Mumbai



1. Deonar Disposal Site
2. Mulund Disposal Site
3. Gorai Disposal Site
4. Mahalakshmi Refuse Transfer Station
5. Kurla Refuse Transfer Station

Key Issues & Strategies proposed by the MCGM

The total solid waste generation in Greater Mumbai is expected to reach about 10,000 MTPD by 2025. While MCGM is currently managing to collect and transport most of the waste to the existing three disposal sites, these sites are nearing their usable life. Moreover, MCGM is resorting to mere dumping / land filling at the disposal sites with very little localized treatment and disposal in the form of composting.

MCGM will need to identify additional disposal sites, but more importantly will need to adopt technology and mechanisms that ensure substantial reduction in the quantity of waste to be land filled, given the high constraint on land availability within its territorial jurisdictions. The landfill facility should be developed as a scientific engineered landfill. The 141.77 Ha Kanjur Marg site allotted to MCGM for waste disposal should be used judiciously so as to minimize the amount of waste to be land filled thereby enhancing its life.

This would call for, apart from adopting advanced technology for large-scale waste treatment, recycling and disposal, maximizing source segregation, localized recycling and encouraging localized treatment and disposal options like composting. MCGM has carried out several pilot initiatives in this aspect, such as the Slum Adoption Scheme and the Advance Locality Management system, and will need to scale up such pilot initiatives citywide.

The corporation has attempted to create public awareness through various media such as advertisement, newspapers, television, banners, morning processions, etc. As a preventive / discouraging measure, MCGM has appointed Nuisance Detectors Mukadams in each ward to police polluters who can issue police sanads under the provisions of Mumbai Police Act, 1951, Section 22 & Rule 115. This initiative should be encouraged and sustained so as to usher in a sense of accountability and responsiveness among citizens.

MCGM is currently carrying out a study to evaluate and finalize appropriate waste treatment and disposal technologies and alternate project structures involving public-private- partnership formats for implementation of the identified options.

CHAPTER 3

MUMBAI TOWARDS A 'ZERO-GARBAGE' FUTURE

The exercise presented by MVS and Praja Foundation is indicative only. There is no backup for the figures presented in this chapter.

Image source: www.dnaindia.com

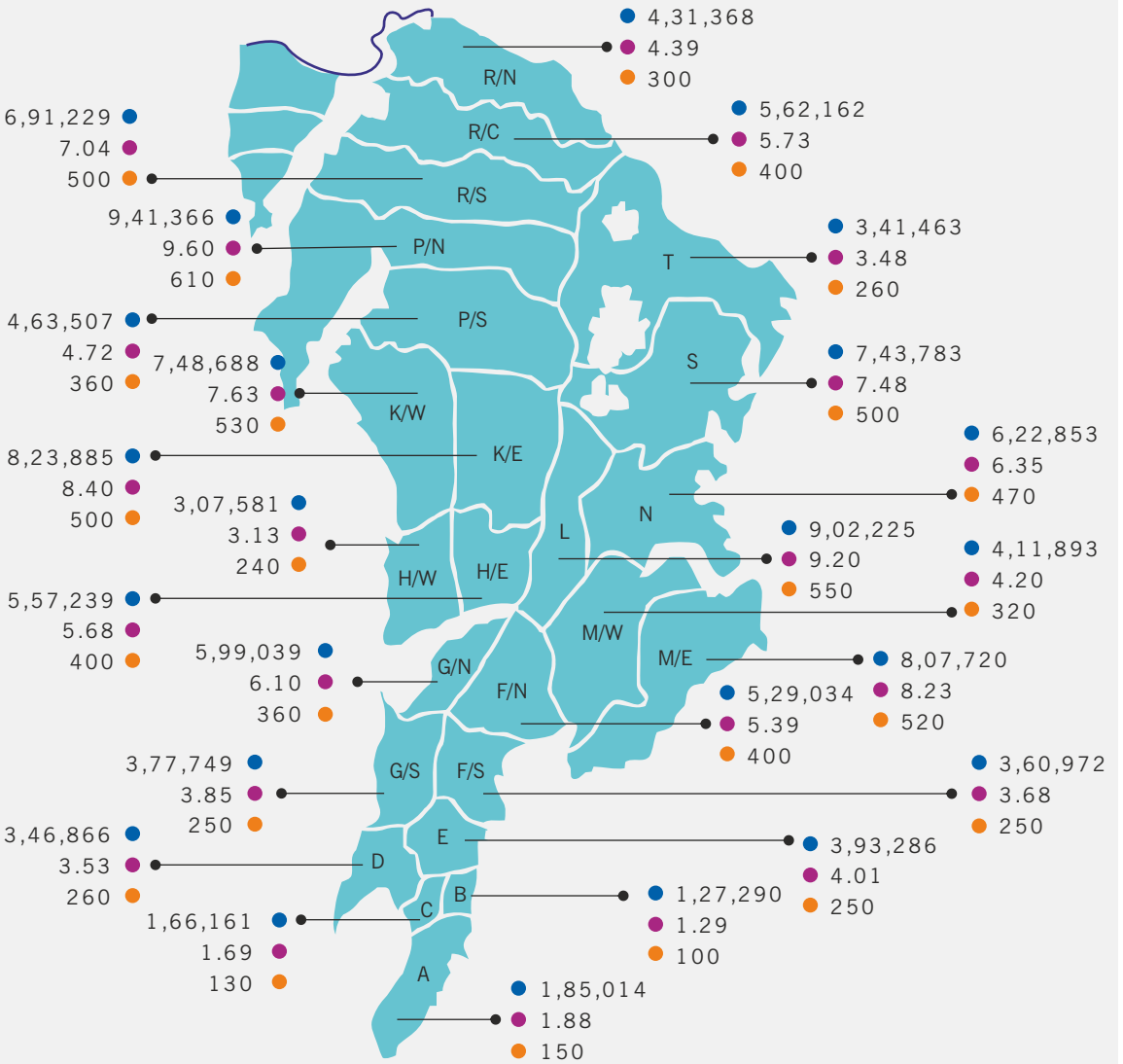
Introduction

The current scenario of Solid Waste Management in the city is in an abysmal state. Landfill dumping is carried out in an unscientific manner, posing a threat to the environment and health of people staying in the vicinity of the dumping grounds. The tasks undertaken by the MCGM with respect to solid waste management are very vast. Of the total budgetary allocation provided for the Solid Waste Management department, more than 60% is expended in salaries and 20-25% is spent on transportation of waste. The progress on behalf of the MCGM on segregation of waste at source, which is a globally accepted and adopted practice, is quite less. Additionally, exacerbating the situation is the lack of a scientific approach that is being employed by the MCGM towards SWM. Scientific disposal of solid waste is beneficial for not just the environment, but it also has the potential to generate employment, advance technology and reap economic benefits. The following piece aims to provide a solution to overcome this dire situation and to improve the existing situation. It also aims to provide a roadmap to the MCGM, which, if implemented, can drastically improve the garbage situation of Mumbai city.

Quantitative aspects of Solid Waste Management in Mumbai, in proportion to its population

The amount of waste generated in a specific region is dependent on various aspects, especially the residential population and the number of commercial complexes of that region. The MCGM comprises of 24 administrative wards. The approximated quantity of solid waste generated in Mumbai is given in the following table.

Graph 1: Approximated quantity of solid waste generated



- 2011 Population
- 2016 Approximately Population (in lakhs)
- 2016 quantity of solid waste generated (MTD)*

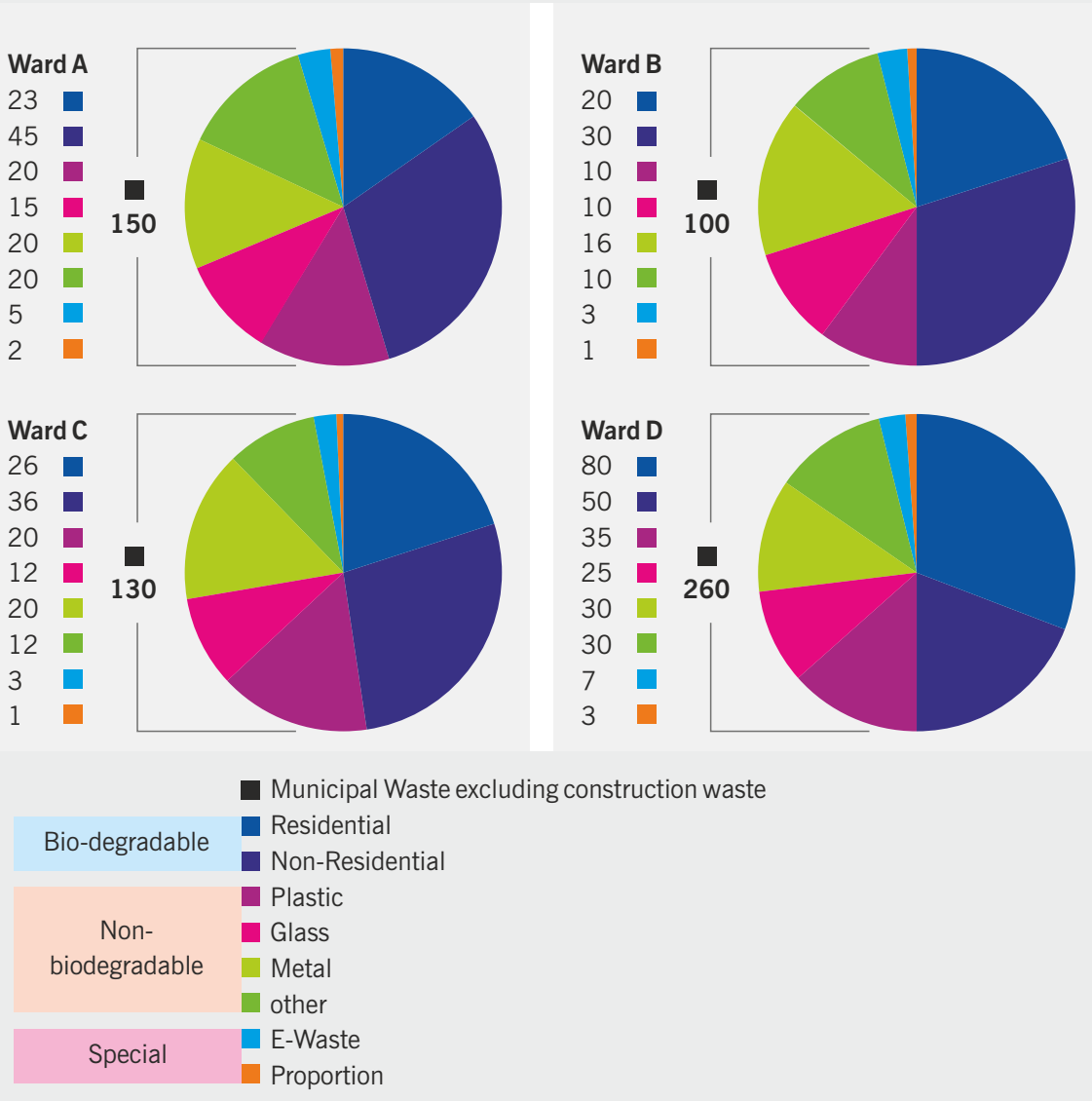
Total

- 1,24,42,373
- 126.68
- 8610.00

Classification of solid waste in Mumbai

There are broadly two types of waste; bio-degradable and non-biodegradable. Municipal Solid Waste can also further be classified into wet waste and dry waste, and is generated in residential complexes, commercial complexes, restaurants, etc. Wet waste consists of cooked food, leafy vegetables, fruits, leaves of trees, etc. On the other hand, dry/non-biodegradable waste consists of plastic, e-waste, paper, construction and demolition waste, metals, etc. Similarly, another classification of waste consists of medical (bio) waste, which consists of injections, sanitary napkins, cotton, etc. The ward wise approximated percentage and quantity of such classified solid waste is given in the following table:

Break-up of type of waste generated, ward-wise (all figures in MTD)



Municipal Waste excluding construction waste

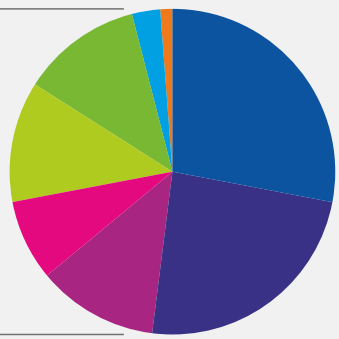
Bio-degradable	Residential
	Non-Residential
Non-biodegradable	Plastic
	Glass
	Metal
	other
Special	E-Waste
	Proportion

Break-up of type of waste generated, ward-wise (all figures in MTD)

Ward E

70
60
30
20
30
30
7
3

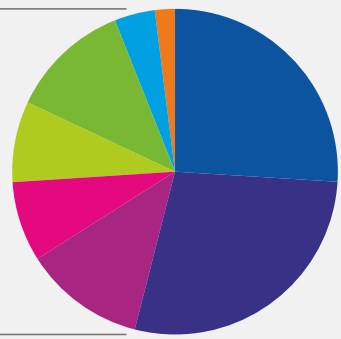
250



Ward F/S

65
70
30
20
20
30
10
5

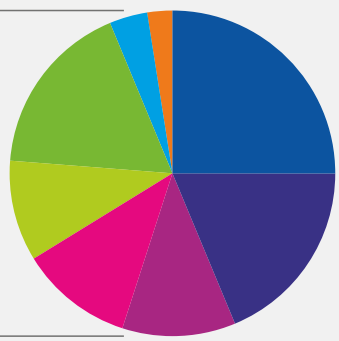
250



Ward F/N

100
75
45
45
40
70
15
10

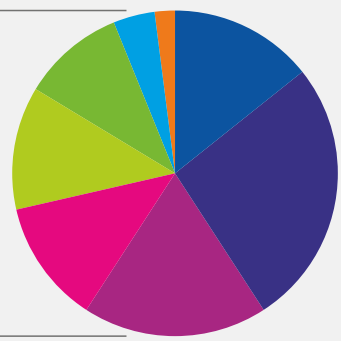
400



Ward G/S

35
65
45
30
30
25
10
5

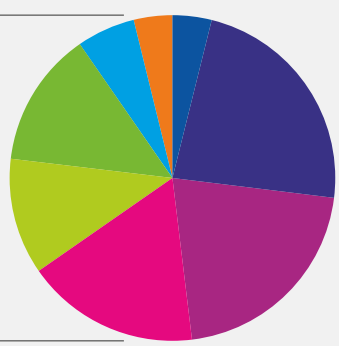
250



Ward G/N

10
60
55
45
30
35
15
10

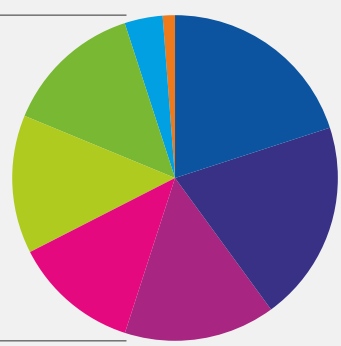
360



Ward H/E

80
80
60
50
55
55
15
5

400

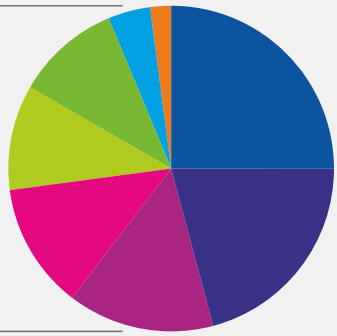


Break-up of type of waste generated, ward-wise (all figures in MTD)

Ward H/W

60
50
35
30
25
25
10
5

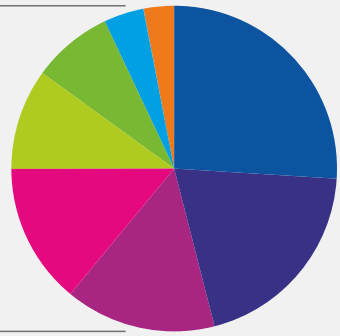
240



Ward K/E

130
100
75
70
50
40
20
15

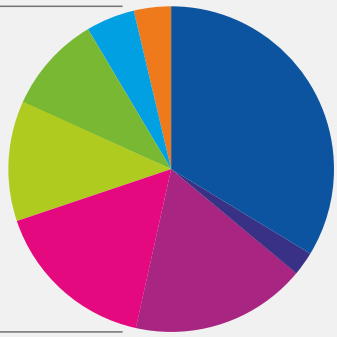
500



Ward K/W

140
10
75
70
50
40
20
15

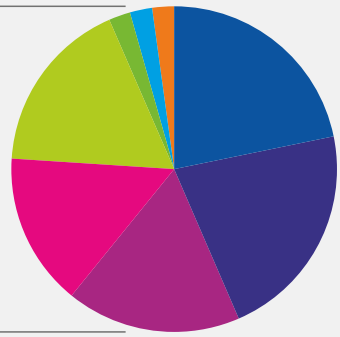
500



Ward L

100
100
80
70
80
10
10
10

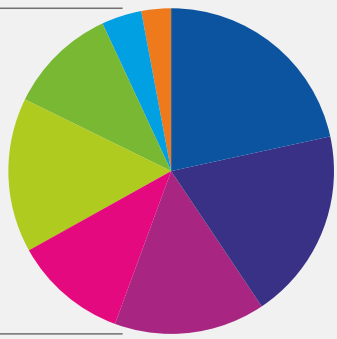
550



Ward M/E

110
100
80
60
80
55
20
15

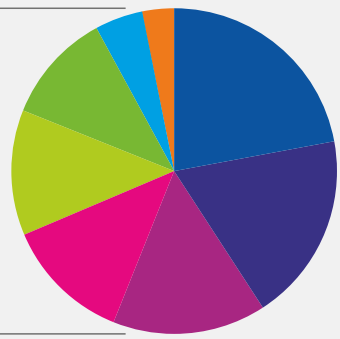
520



Ward M/W

70
60
50
40
40
35
15
10

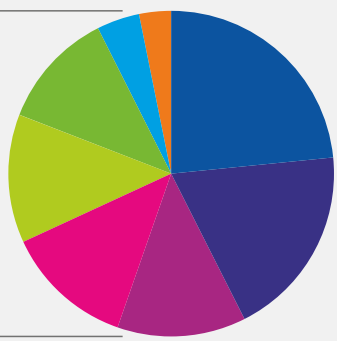
320



Ward N

110
90
60
60
60
55
20
15

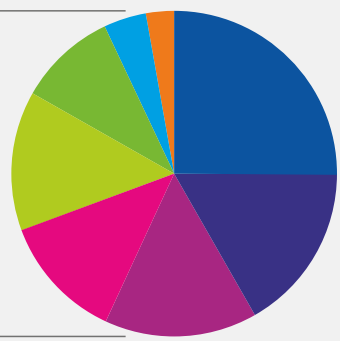
470

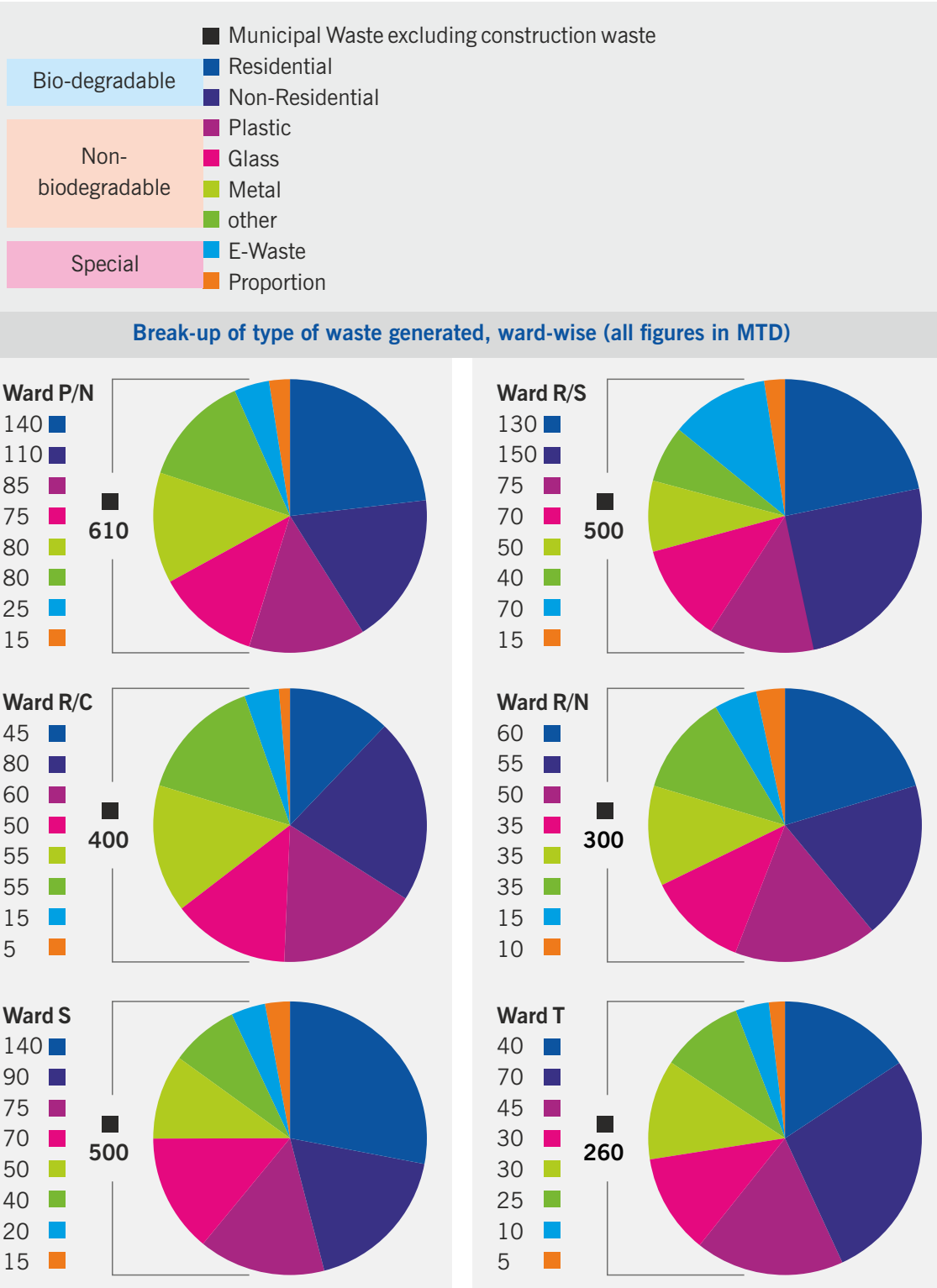


Ward P/S

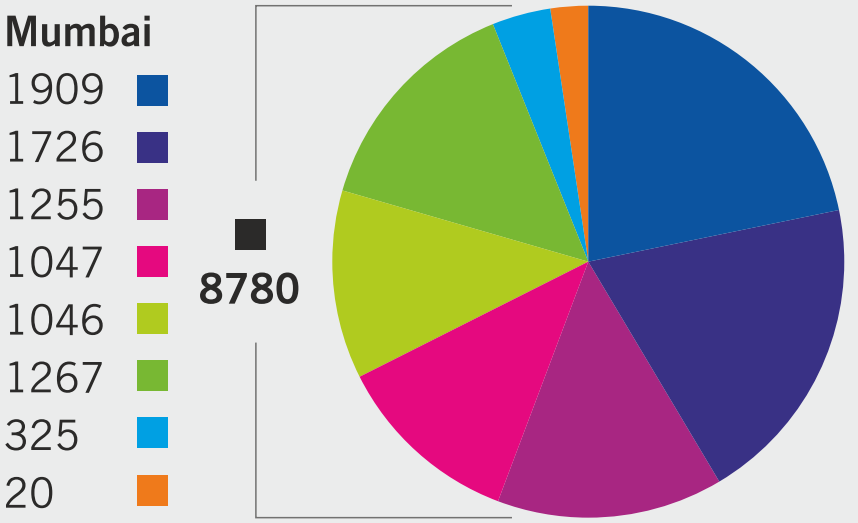
90
60
55
45
50
35
15
10

360



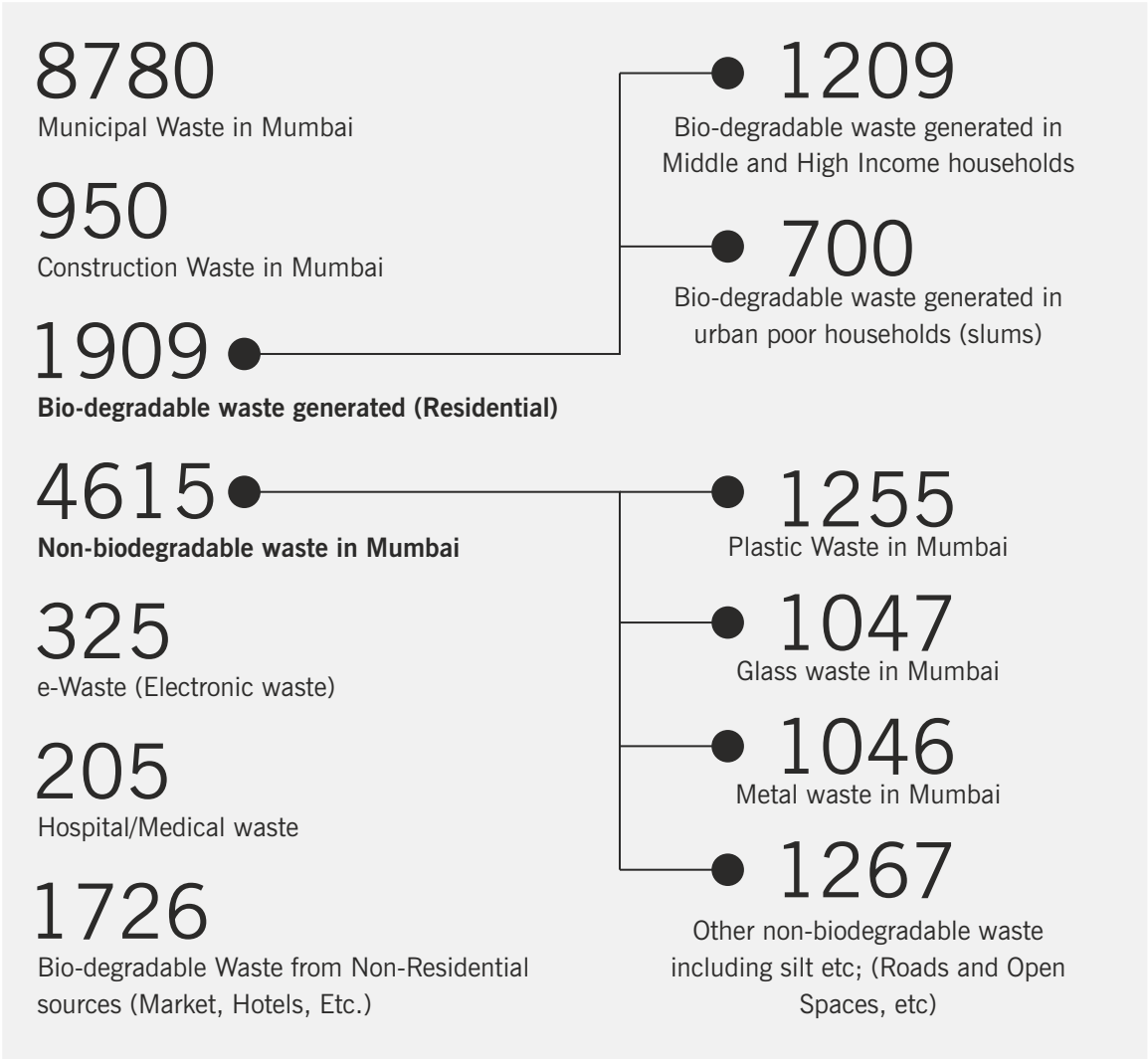

Municipal Waste excluding construction waste
Bio-degradable
Residential
Non-Residential
Non-biodegradable
Plastic
Glass
Metal
other
Special
E-Waste
Proportion
Break-up of type of waste generated, ward-wise (all figures in MTD)
Ward P/N
140
110
85
75
80
80
25
15
610
Ward R/S
130
150
75
70
50
40
70
15
500
Ward R/C
45
80
60
50
55
55
15
5
400
Ward R/N
60
55
50
35
35
35
15
10
300
Ward S
140
90
75
70
50
40
20
15
500
Ward T
40
70
45
30
30
25
10
5
260

Break-up of type of waste generated, Mumbai (all figures in MTD)



Further categorisation of municipal waste in Mumbai

The summary of the approximated classified waste for the entire MCGM area is given in the following table.



The above table gives details of the general status of the various categorisations of waste generated in the city of Mumbai. The data is given ward-wise. The data which is calculated is based on the experience of Mr. Patankar of MVS. The figures are not to be treated as official figures from the MCGM, but must be treated as indicative in nature. The following tables give a deeper understanding of the quantity and type of waste generated. The data is generated to work out approximate expenditure to manage each type of waste and potential of earnings from the waste disposal including by-product. It identifies type of possible treatment, collection, disposal, O&M (Operational & Maintenance) expenditure to work out macro-economics for decentralised system for the MCGM.

Worksheet: Bio-degradable waste generated by middle- and high-income households

Total Quantity	**1209 MTD**
Responsibility	Citizens
Collection	Citizens
The nature of treatment process	Aerobic Composting
Unit rate Capital cost	Rs.2 L/M.T.D.
Unit Rate Operation & Maintenance cost per year	Rs.40 L/years
Capital Expenditure	Rs. 2418 L
Operation & Maintenance Expenditure	Rs. 1200 L/Year
Production of fertilizer in the form of compost	36,270 MT/year
The income from the compost	Rs. 3627L/Year
Land Cost	Nil
No of Composting plants of 0.5 MT each for Mumbai	2418 Nos.
Average no. of Plants per ward	100 Nos.
Expenditure on Transport	Nil

Worksheet: Bio-degradable waste generated by urban poor households (slums)

Total Quantity	**700 MTD**
Responsibility	1600 CBO
Collection by CBO from House Hold	1600 CBO
The nature of the process	Aerobic Composting in 1600 Compost Plants
Unit rate for capital cost transport & treatment of solid waste	Rs. 3L/M.T.D.
Unit rate for Operation & Maintenance Costs for transportation	Rs. 4L/M.T.D.
Production of fertilizer in the form of compost	21,000 M.T/year
Capital cost	Rs. 2100 L
Operation & Maintenance Expenditure	Rs. 2800 L/year
Income generated from 21000 MT/year	Rs. 2100 L/Year
Land Cost	Nil
No of Composting plants	1400 Nos.
Avg no. of plants per ward	60 Nos.
Expenditure on Transport *(Accounted for in Operation & Maintenance Cost)*	Nil

Worksheet: Bio-degradable waste generated by non-residential sources

Total Quantity	**1726 M.T.D.**
Responsibility	MCGM
Collection	MCGM
The nature of the process	
5 plants of 1 MTD capacity for composting in each ward 14 plants of 5 MTD capacity for Bio methanation in each ward	Aerobic Composting (120 M.T.D.) & bio methanation (1606 M.T.D.)
Composting Unit Rates:	
Capital Cost	Rs. 2 L/M.T.D.
Operation & Maintenance Cost	Rs. 10 L/M.T.D.
Bio methanation Unit Rates:	
Capital Cost	Rs. 25 L/M.T.D.
Operation & Maintenance Cost	Rs. 15 L/M.T.D.
Production of fertilizer in the form of compost	3600 M.T./Year
Production of methane gas	

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Capital Expenditure on Composting	Rs. 240 L
Capital Expenditure on Biomethanation	Rs. 42,000 L
Operation & Maintenance	
Composting	Rs. 1200 L/year
Biomethanation	Rs. 23,700 L/year
Income generated	
Compost	Rs. 360 L /year
Gas	Rs. 2730 L/year
Land Cost	Nil
No. of Composting plants per ward (of 1 M.T.D. each)	5 Nos/Ward
No. of Biomethenation plants per ward (of 8 M.T.D capacity each)	14 Nos/Ward

Worksheet: Plastic waste (non-bio-degradable waste)

Quantity	**1255 M.T.D.**
Residential	630 M.T.D.
Non- Residential	625 M.T.D.
Responsibility	
Residential	Citizens
Non- Residential	MCGM
Collection	
Residential	Citizens
Non- Residential	MCGM
The nature of the process	Give to the vendors and factoring units
Unit Rate	
Capital Expenditure for Residential waste	Rs. 1.5 L/M.T.D.
Capital expenditure for Non- Residential waste	Rs. 0.5 L/M.T.D.
Operation & Maintenance expenditure for residential waste	Rs. 0.5 L/MTD/year
Operation & Maintenance expenditure for non-residential waste	Rs. 1.0 L/M.T.D/year

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Capital Expenditure	
Residential	Rs. 945 L
Non- Residential	Rs. 313 L
Operation & Maintenance Expenditure	
Residential	Rs. 615 L/year
Non- Residential	Rs. 624 L/year
Land Cost	
Residential	Nil
Non- Residential	Nil
Income from the process	
Residential	Rs. 18,900 L/year
Non-residential	Rs. 18,750 L/year
Expenditure on Transport (accounted for in Operation & Maintenance costs)	Nil

Worksheet: Glass waste (Non-bio-degradable)

Quantity	**1047 M.T.D.**
Residential	400 M.T.D.
Non- Residential	647 M.T.D.
Responsibility	
Residential	Citizens
Non- Residential	MCGM
Collection	
Residential	Citizens
Non- Residential	MCGM
The nature of the process	Give to the vendors and factoring units
Unit Rate	
Capital Expenditure for Residential waste	Rs. 4 L/M.T.D.
Capital expenditure for Non- Residential waste	Rs. 0.5 L/M.T.D.
Operation & Maintenance expenditure for residential waste	Rs. 0.5 L/M.T.D./year
Operation & Maintenance expenditure for non-residential waste	Rs. 1.0 L/M.T.D/year

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Capital Expenditure	
Residential	Rs. 1600L
Non- Residential	Rs. 324L
Operation & Maintenance Expenditure	
Residential	Rs. 200 L/year
Non- Residential	Rs. 647 L/year
Land Cost	
Residential	Nil
Non- Residential	Nil
Income Generated	
Residential	Rs. 12000 L/year
Non-residential	Rs. 19,410 L/year
Expenditure on Transport (accounted for in Operation & Maintenance costs)	Nil

Worksheet: Metal waste (Non-biodegradable)

Quantity	**1046 M.T.D.**
Residential	400 M.T.D.
Non- Residential	646 M.T.D.
Responsibility	
Residential	Citizens
Non- Residential	MCGM
Collection	
Residential	Citizens
Non- Residential	MCGM
The nature of the process	Give to vendors (Raddiwalas)
Unit Rate	
Capital Expenditure for Residential waste	Rs. 4 L/M.T.D.
Capital expenditure for Non- Residential waste	Rs. 0.5 L/M.T.D.
Operation & Maintenance expenditure for residential waste	Rs. 1.0 L/M.T.D/year
Operation & Maintenance expenditure for non-residential waste	Rs. 0.5 L/M.T.D/year

continued on next page

Capital Expenditure	
Residential	Rs. 1600 L
Non- Residential	Rs. 323 L
Operation & Maintenance Expenditure	
Residential	Rs. 200 L/year
Non- Residential	Rs. 646 L/year
Land Cost	
Residential	Nil
Non- Residential	Nil
Income Generated	
Residential	Rs. 24,000 L/year
Non-residential	Rs. 38,760 L/year
Expenditure on Transport (accounted for in Operation & Maintenance costs)	Nil

Worksheet for waste from roads and open spaces (bio-degradable and non-biodegradable)

Non-biodegradable waste from roads can be utilized for filling of low-lying plots as the nature of this solid waste is similar to construction debris.

On the other hand, bio-degradable waste from open spaces, gardens, etc can be transported to a centralised compost and biomethanation units treating bio-degradable waste from residential and commercial premises.

Worksheet for e-waste

325 M.T.D.

- E-waste, which is expected to increase drastically over the next few years, can be collected by the corporation by providing required collection centres & selling this waste to vendors and factory units.

Worksheet for medical waste

205 M.T.D.

- Medical waste can be dealt with through private agencies (205 MTD of medical waste can be disposed of through incineration & other suitable methods on PPP basis).

Summary of expenditure and income from various processes through decentralised system

Bio-degradable waste from **middle & high-income households** (Compost generation)

2418	1209	3627	1209

Bio-degradable waste from **low income households (slums)** (Compost generation)

2100	2800	2100	700

Non-residential bio-degradable waste (Compost generation)

240	1200	360	120

Biomethanation

40,150	24,090	2730	1606

Plastic waste (non-biodegradable)

Residential

945	615	1800	630

Non-Residential

313	625	18750	625

Glass waste (non-biodegradable)

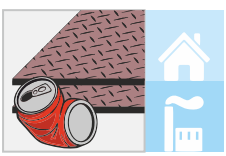
Residential

1600	200	12000	400

Non-Residential

304	647	19410	647

Metal waste (non-biodegradable)



Residential

1600	323	24000	400

Non-Residential

323	646	38760	646

Waste from Roads and Open Spaces

200
800
Nil
1267

(H) E-Waste

200
800
9750
325

(I) Hospitals & Medical

200
800
Nil
205

Capital Expenditure (Rs. Lakhs)
Operation & Maintenance Expenses (Rs. Lakhs/year)
Income in (Rs. Lakhs/year
Quantity (M.T.D)

Comparison of centralised and decentralised waste management systems

The current system being employed by the MCGM is a centralised system, the features of which are;

- Dumping of waste at the Deonar, Mulund and Kanjurmarg dumping grounds in Mumbai is not being done in a scientific manner.
- This unscientific dumping of waste has not proved to be foolproof for the corporation, and has revealed little benefits over the years.
- The MCGM's approach towards Solid Waste Management is also in resulting defiance of the MSW rules of 2016 and directives underlined by the Central Government. This proves that the centralised method being adopted by the corporation has failed.The decentralised method, therefore, needs to be adopted in compliance of various rules and regulations.

Comparison of budgetary provisions

	Current Centralised method (in Rs. Crores)	Proposed decentralised method (in Rs. Crores)
 Budget Provision (Rs. Crores)	2500	2025
 Administrative Expenses	1625	1600
 Transport (per year)	500	100
 Other maintenance (per year)	125	125
 For Capital (5 years)	250	250
 Income	Nil	1100

Methodology followed by MCGM for SWM (Centralised System)	
General (Budget)	Rs. 2500 Crore
General Administration Expenses	Rs. 1625 Crore
Operation & Maintenance Expenses	Rs. 125 Crore
Proposed expenditure on treatment and disposal	Approximately Rs. 7000 crores over 5 years
Income for Corporation	The corporation does not earn anything at present, implementing composting and biomethanation can bring in revenue
Tax income	Nil
Recycling	Ragpickers help in segregation & earn by working in extremely unfavourable conditions
Environmental degradation 	Dangers of air pollution, environmental degradation occur due to air pollution. Moreover, the health of citizens is affected.

Service Level Benchmarking

To monitor the performance of Urban Local Bodies with respect to services offered to citizens, the Ministry of Urban Development (MoUD), Government of India has devised benchmarks along with ideal targets to be achieved for Civic Bodies. For solid waste management departments in local bodies, MoUD has set 8 such benchmarks. Following table illustrates these benchmarks, and also specifies the progress of the MCGM[10] with respect to these benchmarks

Description of service	Target	Achieved
Coverage of SWM services through Door to Door collection	100%	80%
Efficiency of Collection	100%	100%
Extent of Segregation of Municipal Solid Waste	100%	27%
Extent of Municipal Solid Waste Recovered	80%	3%
Extent of Scientific Disposal of Waste at Landfill site	100%	30%
Efficiency in Redressing Customer Complaints	85%	No separate tax/charge
Extent of Cost Recovery in SWM Services	100%	No separate tax/charge
Efficiency in Collection of SWM Charges	90%	100%

10 : http://www.mcgm.gov.in/irj/portal/anonymous/qlchfengswm

CHAPTER 4

F/S WARD IN MUMBAI: A SUCCESS STORY IN SWM

F/S Ward (Parel area) under the Municipal Corporation of Greater Mumbai (MCGM) has endeavoured to implement a 'Zero garbage' concept across the ward, converting wet waste into compost and recycling dry waste. The focus behind the initiative taken up by the ward is adding another 'R' to the existing three 'R's; Recovery. Two main projects are at the fore currently.

Project 1	

The Model

Step 1: House-to-house dustbin (wet and dry separate) distribution, widespread awareness programmes.

Step 2: Separate collection of wet and dry waste from each household and chawl.

Step 3: Transportation to one of five centres through mini-trucks with provision for waste to be collected and transporated separately.

Step 4: Garbage is checked once again to see if it is well segregated. If not, manual segregation is carried out at the centre itself.

Step 5: Wet waste is converted into compost/manure through composting. Dry waste is sold to a predetermined MCGM contractor, who recycles the waste.

F/S, why did it start?

Under the adoption scheme, the Swacch Mumbai Prabhodan, the MCGM encouraged adoption of areas in Mumbai for purposes of cleanliness, maintenance, and upgradation of sanitation services. In 2014, availing this scheme, Mumbai Councillor Mr. Sanjay Ambole (then constituency no. 198) adopted an area encompassing 14,500 households and 256 chawls for the duration of one year. After submitting a proposal to make the area garbage bin-free, the MCGM put out a tender to accept options not just limited to collecting garbage, but also cleaning public and community toilers, sweeping streets and housegullys, etc. The proposal was pitched to have the following benefits;

1. The adopted area would be completely dustbin-free, deterring unwanted pathogens.
2. Various health issues associated with open, untreated garbage, like malaria, dengue, diarrhoea, etc. would be eradicated.
3. The Corporation will benefit greatly monetarily as well, as the need to hire employees to clean, pickup and mainly transportation will be eliminated. Moreover, a revenue will also be generated from the dry as well as wet waste.

A one-year pilot was started in the year 2015-16 after NGOs Shiv Sneh Samajik Pratishtan and Prateek won the tender. At the end of the first year, 5 centres were proposed for segregation and composting of waste, and land would be provided by the MCGM to the NGOs. In 2017, post municipal elections, constituency 198 got delimited into 203, which was now represented by Ms. Sindhu Masurkar. Under Ms. Masurkar's leadership, the project got a further extension to 2017-18.

The tender has proposed decentralised disposal of garbage from 256 chawls and 14,500 houses of the aforementioned area. The NGOs involved will be employing a total of 252 volunteers, who will be paid an honorarium of Rs. 6000 per month per person from the MCGM. These 252 volunteers are proposed to pick up garbage from all the individual households and slums, transfer this waste to a segregation facility in an area which is given by the MCGM, and segregate the waste. The ratio of volunteers to houses will be aimed at approximately 2:200. The dry waste will be sold and/or recycle to pre-determined vendors. The wet waste will be composted and the resulting compost will be used in green spaces and/or sold to generate revenue. The goal is to made 14,500 households and 256 chawls in F/S are entirely garbage free and make revenue from waste. The need for garbage bins will also completely eradicated, which will also destroy prevalent diseases. Currently, approximately 20% of the garbage is getting composted and the area is inching towards its green goals.

Project 2	

Apart from the aforementioned project, F/S is undertaking another small-scale project, wherein food waste from the F/S ward office canteen is being sent to a bio-gas plant set-up locally in the ward. The gas obtained from the plant is then used in the canteen itself. The system is an epitome of sustainability, where the canteen is entirely self-sufficient.

Note: Bio-gas is a non-conventional energy source, which can be used for;

a) Combustion in canteens/used as a replacement for LPG
b) Used in gas crematoriums
c) Conversion into bio-CNG; used in gas buses and transportation. Conversion is done by compressing biogas after it is formed.

CHAPTER 5

CONCLUSION & RECOMMENDATIONS

- Mumbai produces about 8780 Metric Tonnes Daily (MTD) of waste, of which approximately 3000 MTD is wet waste. It is said that 5kgs of wet waste roughly converts into 1 m3 of biogas. By this calculation, Mumbai has the potential to produce 1,50,000 kgs of biogas on a daily basis. This is sufficient to run all the BEST buses in Mumbai, if they were all bio-CNG buses.
- The MCGM should sincerely try to adopt a decentralised methodology for solid waste managemet, as is expected in various provisions of the Municipal Solid Waste Rules of 2016, court orders, etc.
- The present method of centralised dumping should be discontinued in phases taking the following specific actions;
  - Reduce transportation cost for unsegregated dumping at Denoar, Mulund, and Kanjurmarg
  - The proposal of transportation to the dumping site of Taloje for MMR should not be implemented.
- Make provisions in the budget for administrative expenses to be at par with present allocations.
- The residential premises & slums should be supported for their Capital expenditure as well as Operation & Maintenance expenditure whenever so needed. This may be continued for about 5-10 years.
- The responsibility of the treatment processes executed in residential premises can subsequently taken by the MCGM by providing decentralised plants in the reserved plots of the Solid Waste Management department. The Development Plan (DP) of 2014-34 contemplated locations earmarked for the use of reserved plots by the Solid Waste Management department.
- These plots thus can be utilised in each ward for the treatment of bio-degradable solid waste, presently from markets and restaurants & subsequently in phases from residential premises'.
- On reserved plots earmarked in DP 2014-34, dry waste collection centres should be developed and a system is to be created for handing over dry waste to respective vendors & generating relevant income from such methods.
- The compost & bio-gas from the treatment processes of bio-degradable waste from residents can also be systemised to generate income from said decentralised plants in each ward, which is provided in the reserved plots of the DP of 2014-34.
- Ultimately, it is expected that with this decentralised method, only 10% of solid waste has to reach the dumping sites at Kanjurmarg and Deonar.
- The present quantity of solid waste dumped at the 3 dumping grounds has to be dealt with in a suitable manner; of composting, leachate management, and heat energy from biomethanation process or electricity generation.

Benefits to the environment

a If biogas is used in crematoriums, it can save wood (conventional cremation) and electricity (electrical crematoriums).

b Reduces dependency on conventional fuels; petrol and diesel, promotes eco-friendly public transport.

c There will be a considerable reduction in the amount of waste being unscientifically dumped into the land, which is lead to a reduction in land and air pollution.

d decentralised composting and bio-gas plants eliminates the need for transportation of garbage to landfills, which leads to decrease in air pollution.

Economic benefits

a Cost for gas cremation is half of cost of electric cremation.
b It is economically straining to transport large quantities of waste to landfills, setting up biogas or composting plants in close proximity to major collection points/refuse transfer stations drastically reduces cost of transportation and processing.
c Dependency on petrol and diesel will reduce significantly, making fuel cheaper.
d It is estimated that BEST will save Rs. 225 crores per year on fuel if they switch to biogas cars.
e In a biogas plant, all cost will be recovered in 3.5-4 years, following the plant will reap profits. The life if the biogas plant will be atleast 15 years.
f Additionally, the corporation can sell composted/liquid fertilizer, which can act as a potential source of revenue from essentially waste.

Mumbai has a long way to go in the field of solid waste management. By taking inspiration from its own F/S ward, it has the potential to become a model for the zero-garbage phenomenon, especially considering its size and the scale at which waste is generated. A co-ordinated citizen awareness program coupled with deliberative and administrative will power can change the abysmal state of Waste Management in India, and can even act as a source of revenue for the corporation.

Circular Economy

What is a circular economy?

- The current world order operates majorly on a linear economy; one which is based on a 'Buy', 'Consume', and 'Dispose' model.
- Such a system assumes that there are infinite resources on the planet.
- A circular economy, on the other hand, treats resources as finite; it uses a 'Buy', 'Consume', 'Return' model, which is not necessarily constrained to recycling.
- The circular economy also changes the way that products are designed and produced, often using leasing and sharing resources for production.

Implementing the concept of a circular economy in tackling solid waste

- Incorporating a circular economy will reduce consumption, and hence, reduce waste generation.
- It will encourage a fundamental shift in our approach towards garbage, nurturing a culture of conservation of resources. It will also nudge populations towards being responsible.
- Following the concept of a circular economy will lead to innovation in tackling waste management.
- A circular economy is inherently sustainable, which will lead to greater benefits to the environment.
- Simple but effective techniques like composting and bio-methanation and be greatly enhanced and promoted with the implementation of circular economy models.
- A circular economy also aligns with the concept of decentralised waste management.

CHAPTER 6

ANNEXURE

Solid Waste Management Rules, 2016

The Government has revamped the Municipal Solid Wastes (Management and Handling) Rules 2000 and notified the new Solid Waste Management Rules, 2016 on April 8, 2016. The salient features of the SWM Rules, 2016 are as under;

1. Areas Cover: These rules are applicable to

i. Every urban local body (Mega city to Panchayat level),
ii. outgrowths in urban agglomerations,
iii. census towns as declared by the Registrar General and Census Commissioner of India,
iv. notified areas,
v. notified industrial townships,
vi. areas under the control of Indian Railways,
vii. airports/ airbases,
viii. Ports and harbours,
ix. defence establishments,
x. special economic zones,
xi. State and Central government organisations,
xii. places of pilgrims,
xiii. religious and historical importance as may be notified by respective State government from time to time and
xiv. every domestic, institutional, commercial and any other non residential solid waste generator situated in the areas.

2. The Waste Generators are

- Every household
- Event organizers
- Street Vendors
- RWAs & Market Associations
- Gated Community having more than area 5000 sq.m.
- Hotels & restaurants, etc.

3. Duties of Waste generators and Authorities

i. Every Waste Generators shall segregate waste and store separately and hand over to Municipal workers or authorized waste pickers.
ii. Ministry of Environment, Forest & Climate Change shall constitute 'Central Monitoring Committee' to monitor and review every year.
iii. MoUD shall frame National Policy on SWM and coordinate with States/UTs, provide technical guidelines, financial support, training to local bodies, etc.

iv. Departments of Fertilizers & Chemicals shall assist in market development for city compost and make available to companies (3/4 bags compost: 6/7 bags Fertilizers).
v. Ministry of Agriculture shall make flexible Fertilizer Control Order, promote utilization of compost, testing facility for compost and issue guidelines.
vi. Ministry of Power shall fix tariff of power generation from W-T-E project and ensure distribution through companies.
vii. MNRE shall facilitate infrastructure for waste-to-Energy plants and provide subsidy.
viii. Secy- Incharge, UD (sate/UT) shall prepare State Policy/Strategy, adopt 3- Rs, coordinate for state planning, identification of common/regional landfills, notify guidelines of buffer zones.
ix. District Collector/Magistrate shall facilitate identification of landfill site, quarterly review the performance of local bodies.
x. Secretary, Panchayats: same as Secy. UD at Panchayat level.
xi. CPCB shall coordinate with SPCBs/PCCs for monitoring and Annual Reports, formulation of standards, review new technologies, prepare guidelines for buffer zones restricting from residential, commercial and construction activities areas; and inter-state movement of waste.
xii. Local Authority/Panchayats shall prepare SWM plan with time line and its implementation, segregate, adopt 3-Rs, material recovery, processing/ disposal of Waste, user fee and levy spot fine.
xiii. SPCBs/PCCs shall monitor, issue authorization and regulate.
xiv. Manufacturers/Brand owners shall facilitate collect back wastes of their products and provide pouch for packaging sanitary wastes, etc.
xv. Industry (cement, power plant, etc.) shall use RDF within 100 km.
xvi. Operator of facilities shall follow guidelines/standards

4. Criteria for Hilly Region: Avoid landfill, make waste transfer stations, strict action for littering and construct landfill at plain areas.

5. Waste to Energy plant for waste with 1500 Kcal/kg and above for co- incineration in cement and power plants.

6. Time Frame for Implementation of SWM Rules:

a. Landfill Identification: 1 year
b. Procurement of waste processing facilities: 2 years
c. Ensure segregation of waste: 2 years
d. Cities up to 1 million population: 2 Years
e. Million plus cities: 3 years
f. Setting up sanitary landfills: 3 years
g. Bioremediation/capping of old landfills : 5 years

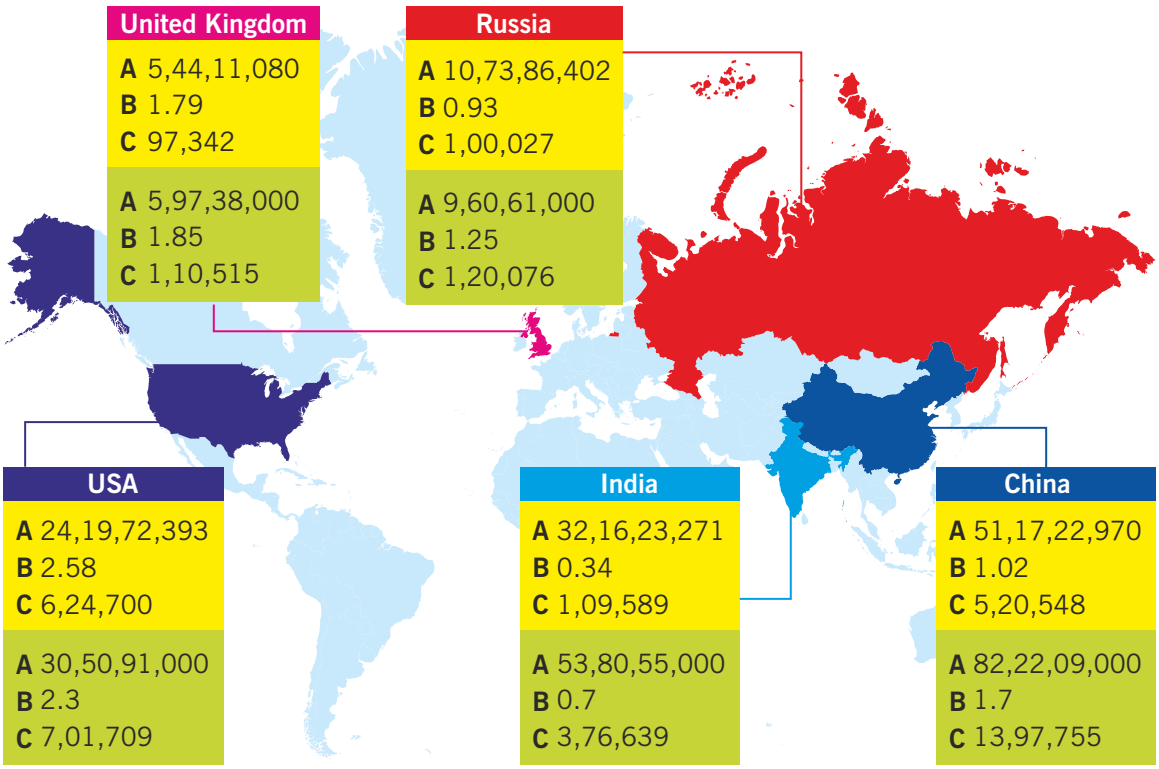
7. Review of implementation of rules at Various levels;

a. MoEF&CC, Central Monitoring Committee: Every year
b. District Collector review performance of Local authorities: Quarterly
c. SPCBs/PCCs review implementation of Rules with DMA: half yearly
d. Secretary In-charge, UD- State level Advisory Committee: half yearly

Timeline of Solid Waste Management Policies in India

Year Rules	Policies/Schemes
1989	The Hazardous Waste (Management and Handling) Rules
1994–95	MSW Management – Strategy Paper by NEERI J.L. Bajaj Committee
1998	Bio-medical Waste Handling Rules Supreme Court-appointed Barman Committee
2000	MSW (Management and Handling) Rules, 2000 Central Public Health and Environmental Engineering Organisation Manual on MSW
2005	Report of the Technology Advisory Group on Solid Waste Management
2006	Strategy and Action Plan-Use of Compost in Cities
2008	National Urban Sanitation Policy
2009	Draft Document on E-Waste Handling Rules
2010	National Mission on Sustainable Habitat
2011	Plastic Waste (Management and Handling) Rules The E-Waste (Management and Handling) Rules
2013	Draft MSW (Management and Handling) Rules
2015	Draft MSW Rules
2016	Solid Waste Management Rules, 2016

Quantity of Solid Waste Generated, by Country[11]



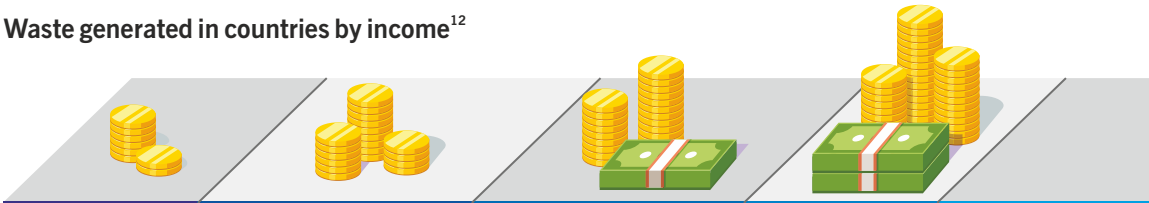
Managing solid waste is an extensive and collaborative service. Municipalities require capacity buiding, skill management, and professional expertise to manage solid waste effectively, especially considering the scale at which waste is beginning to get generated.

Waste generation is generally a function of affluence of a region, and country-to-country variations are vast. For example, waste generation in sub-Saharan Africa, which is historically an economically impoverished continent, is 62 million tonnes annually. On the other hand, annual waste generation in East Asia in 270 million tonnes, 70% of which comprises of waste generated by China.

Similarly, it can also be inferred that high-income countries produce the most waste per capita, whereas low-income countries produce the least waste per capita.

11: http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1334852610766/AnnexJ.pdf

Waste generated in countries by income[12]



Lower Income	Lower Middle Income	Upper Middle Income	High Income	Total
A 343 **B** 0.6 **C** 2,04,802	**A** 1293 **B** 0.78 **C** 10,12,321	**A** 572 **B** 1.16 **C** 6,65,586	**A** 774 **B** 2.13 **C** 16,49,547	**A** 2982 **B** 1.19 **C** 35,32,256
A 676 **B** 0.86 **C** 5,84,272	**A** 2080 **B** 1.3 **C** 26,18,804	**A** 619 **B** 1.6 **C** 9,87,039	**A** 912 **B** 2.1 **C** 18,79,590	**A** 4287 **B** 1.4 **C** 60,69,705

Current

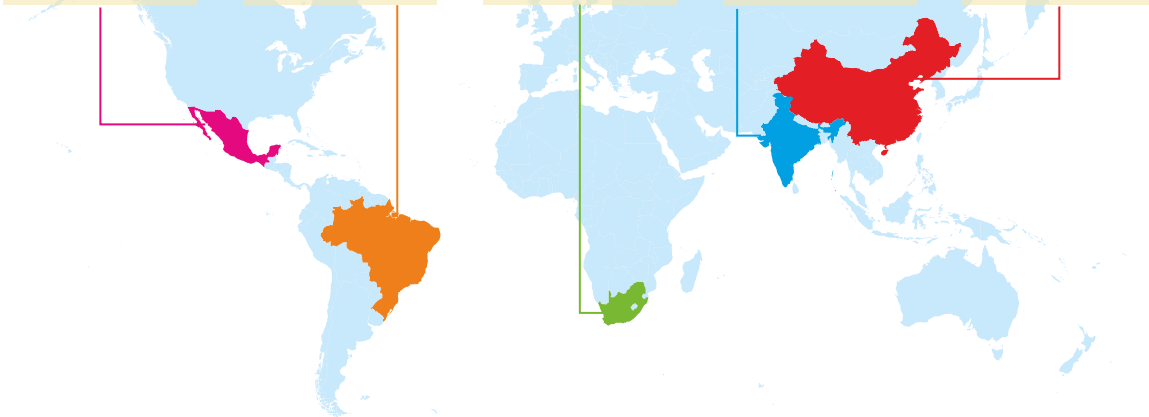
Projected (by 2025)

A Total Urban Population (in millions)
B MSW generation per capita (kg/capita/day)
C Total MSW generation (tonnes/day)

Qualitative aspect of waste generation, by country[13]

A Methane Emissions from post-consumer Municipal Waste (MtCO2e)
B Greenhouse gas emissions
C % methane from disposal sites (relative to total GHG emissions)

Mexico	Brazil	South Africa	India	China
A 31 **B** 383 **C** 8.1%	**A** 16 **B** 659 **C** 2.4%	**A** 16 **B** 380 **C** 4.3%	**A** 14 **B** 1210 **C** 1.1%	**A** 45 **B** 3650 **C** 1.2%



12 : http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1334852610766/AnnexJ.pdf

13 : http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1334852610766/AnnexJ.pdf

References

- Hita Unnikrishnan, Brunda Gowrav and Sabrina Jathanha [1] have studied to assess the various factors that govern the sustenance of a decentralised solid waste management system in urban India. V.K. Garg[2] has studied Aristotle called worms the “intestines of the earth” and stated that there may not be any other creature that has played so important a role in the history of life on earth.
- Satpal Singh, decentralised Solid Waste Management in India: A Perspective on Technological Options (Cities - The 21st Century India)
- Joshi & Ahmed (2016), Cogent Environmental Science, Status and challenges of municipal solid waste management in India: A review
- Slesha N. Desai and Mitali A. Shah (2017), decentralised Solid Waste Management in Urban Areas: A Review, International Journal of Current Engineering and Technology, 2018
- Hita Unnikrishnan, Brunda Gowrav and Sabrina Jathanha, Sustainable decentralised Model for Solid Waste Management in Urban India

Forums for raising complaints on Solid Waste Management

Citizens have the following methods for lodging complaints related to Solid Waste Management, which include Garbage not getting lifted, removal of debris, lifting of tree cutting, providing/replacing dustbins, collection point related issues, or other miscellaneous issues.

1916

1. 1916 Central Complaint Registration System of MCGM

a. Citizens can utilise the central complaint number, 1916 to register complaints on the official complaint redressal system of Mumbai's local body.
b. The complainant is given a unique complaint number, which can be used to track the status of respective complaints.
c. The administration is also bound to solve these issues within a stipulated time, failing which the complaint gets escalated.

2. The MCGM website (www.mcgm.gov.in)

a. Citizens can also register complaints on the MCGM's website, where the complaint is registered on the Central Complaint Registration System as well.
b. The same rules apply are applicable as the 1916 system.

3. MCGM official app

a. Citizens can choose to register complaints through the official MCGM app, from which complaints are also registered on the Central Complaint Registration System.

4. Swachhata App

a. Citizens can lodge complaints through the Swachhata app, which is created by the Ministry of Housing & Urban Affairs.
b. An analysis of complaints is also uploaded on a dashboard (www.swachh.city), where citizens can visit and view the administration's ranking based on their response to complaints, along with an analysis of type of complaints registered on the app.