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## Case Study of Mumbai: Decentralised Solid Waste Management

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### Abstract

Mumbai Metropolitan Region (MMR), spread over 4,355sq. km is home to seven municipal corporations. All Municipal Corporations in India are mandated to look into solid waste management in their functional domains under the 74th Constitutional Amendment. At present, all the seven municipal corporations depend upon centralised means of managing waste which is dumped at assigned landfills post collection. Apart from the 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.

This paper explores the scale at which different institutions/communities have taken efforts to successfully manage their waste. Most people are unable to achieve 100% decentralized 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. By means of different examples and a technology provider for bio-medical waste, we are able to make an impact towards creating greener, sustainable communities.

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### 1. Introduction

The city of Mumbai is split into two parts- Greater Mumbai and the region surrounding it. The entire region-called the Mumbai Metropolitan Region (MMR) is governed by a group of Municipal Corporations. The various

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municipal corporations in MMR are Municipal Corporation of Greater Mumbai (MCGM), Thane Municipal Corporation (TMC), Navi Mumbai Municipal Corporation, Ulhas Nagar Municipal Corporation, Kalyan - Dombivili Municipal Corporation, Bhiwandi-Nizampur Municipal Corporation and Vasai-Virar Municipal Corporation. All municipal corporations look after the basic sanitation facilities provided to the citizens under the 74th Constitutional Amendment that gives municipal corporations these powers. This paper looks at examples from MCGM and TMC. The city interacts with all its stakeholders to manage the waste effectively. The nexus between the government agencies, technology, recyclers, citizens/residents, waste pickers create the circle for effective waste management of the city in a centralised and/or decentralised manner.

Centralised mechanisms have known to fail at scale, largely because of the complexity that this linear system poses. From door-to-door collection to mere dumping of waste in over-flooded landfills leaves very little space for effective management of mixed waste. In simpler terms, the linear system of waste dumping highlights that waste is in fact, mismanaged. This system is also largely characterised by tenders floated for collection and the rising price spent on transportation. MCGM budgets INR 2232 Cr. for waste management in the current FY 2015-2016.

Decentralised systems however run on smaller, but manageable scales. The concept of YIMB enables processing and storage of waste thereby increasing its value. The link of such high value waste is noticed with the waste traders or 'Raddiwallahs' who are seen almost in every nook and corner of our cities. The existing network of such traders and informal workers create an unofficial knowledge pool that assesses the worth of waste.



Fig. 1. Stakeholder Map

## 2. Methodology:

In this paper, we explore the case study of Mumbai and adjoining area of Thane, where various attempts are made by citizens and organisations to make an effort to manage their waste in a decentralised manner. The sampling of the report has case studies of one active citizen; two housing complexes (that have 25 and 210 flats respectively); a 50 flat apartment complex (that has flourished to growing their own food); an industrial colony (with their own residential space); a college (that efficiently segregates examination papers); and a Bio-Medical Waste Management Plant (that funds sustainability projects). Each of them are lessons to prove that the notion of decentralised waste

management is not just a thought of academia but of practice.

### 3. Case Studies

#### 3.1 An Active Citizen: Mr. Subhash Rane, Ward 41, Malad

Subhash Rane, a retired professional from Siemens India took up to changing the face of his locality after he noticed garbage on the streets during his morning walk. He requested the local authorities to collect the garbage. Over subsequent months, he kept repeating this exercise and coordinated with the ward officials ensuring waste pick-ups in his ward (Budget). He noticed that there was no coordination of citizens with the ward officers to manage effective pick up. Soon, he became the factotum for the community in regards to waste pick-ups.

According to the Bye-Laws of the Municipal Corporation of Greater Mumbai, if the area has door to door collection, then there is no need for a common community bin (MCGM, 2006). So he eliminated them streetwise and at the same time ensured regular pick up. Over time, he has strategically killed the dumping spots with the help of shop owners, residents and other proactive citizens. By adhering to these rules, Subhash Rane bridged the gap between the Municipal Corporation and the citizens. As a nodal contact for Ward 41, Mr. Rane is now trying to make it a zero waste ward by requesting separate trucks for collecting wet and dry waste.

#### 3.2 Sathaye College, Vile Parle

The Microbiology Department at Sathaye College has been managing its bio-degradable waste for the last seven years. When the experiment started, Prof. Kudva (Professor in charge) gathered little information about setting up a vermi-composting system for the leaf litter of their college. So this quest of setting up the vermi-composting bin, included a lot of trial and error for its functioning. The end result of this process was a 6 x 3 pit, designed using scrap material that was readily available in their backyards. The cover of the pit is made from old windows that close the compost pit while aerating it from above.



The worms were bought from a local nursery with an initial investment of INR 300. The campus' horticulture waste and the vegetable peels from their canteen kick-started the process. The only other expense apart from worms, was the construction of the pit which at a cost of INR 30,000. The compost generated from the pit, is consumed on campus as manure for its green cover.

The campus generates a lot of paper waste from examination answer sheets that are stored up to three years as per the University norms. That left them thinking how to discard this paper waste discreetly. That's when a student

alumni- Laxmikanth Deshpande approached them with his new venture called Recyclekaro.com. For the past three years, Recyclekaro.com picks up the paper and E-waste. High value waste – bottles, other plastic waste and waste cardboard are picked up by the local waste-pickers. At the same time, the science labs also send their equipment for recycling with a local informal vendor. In addition to this, there is a push against bottled water on campus. Water filters are installed on every floor and regularly maintained. The college's Principal Smt. Kavita Rege asserts, "Students are constantly changing in our college. If we do not constantly provide the guidance that they need, the students will never be encouraged to think and take measures to be eco-friendly in their daily lives." This strong leadership from the Principal and her staff keep the systems in place.

### 3.3 Godrej Society

For the campus of Godrej spread across on both the eastern and western parts of Vikhroli- waste management has been a goal for the last 5 years. Since 2010, the company has been focusing on sustainable initiatives under the aegis of their '*Good and Green Policy*'. The policy mandated to look into two goals- Environmental and Social Sustainability making their entire campus (industrial and residential) water and carbon neutral.

Of the entire 12 MT produced, 6 MT is that of the industrial waste. As a specific strategy, the company focuses on going zero waste by the year 2020. The hazardous waste has been consistently managed along with any effluents through their STPs and ETPs as mandated by the law. However, packaging waste and other scrap was not handled and is now being streamlined. Every division is provided with a shed with separate compartments for scrap, corrugated boxes, packaging material and biodegradable waste. The Environment Engineering office looks into managing all of this from these division ensuring appropriate vendors are contacted for pick-ups of these specific wastes. For example, thermocol is collected separately and handed over to a vendor who resells it. The entire industrial arm manages to recycle about 98% of their waste. All the organic waste from the different departments go to a mobile OWC (Organic Waste Converter) operator who picks it up and sells the compost at a cost.

Some of the organic waste is composted through a vermi-composting pits across the campus. The system of vermi-composting has existed for over 7 years now. The industrial complex has extended its management of waste to the residential colony that houses its employees in 4500 apartments. This concept of managing waste is not restricted to just the industrial area. The residential area has an approximate of 4500 tenements (two colonies in Vikhroli east and one in Vikhroli West). So any waste- plastic, corrugated boxes, polythene bags all have vendors who collect from both the industrial and residential area. In addition, about 45 waste pickers from Deonar Dumping Ground have been employed to manage the waste of the residential colonies. All these 45 women are part of a self-help group (SHG) that ensures that they get their minimum wages and other employment benefits such as ESIC, EPF (Employee Provident Fund), and safety gear (gloves, jackets and closed shoes). Previous enthusiasm on segregation went down when people saw the Municipal truck mix their waste. As of now, segregation at source is not working for the residents since they were used to the municipal truck that mixed the waste during pick up. But the SHG does help with the segregation and manages to segregate the organic from the inorganic. Recyclekaro.com comes to pick up the recyclables and electronic waste is also collected periodically (not as often as the recyclables). The organisation gains financially by making sure that their wastes are managed well. For example, thermocol and mixed paper earns them a revenue of INR. 9/kg when segregated vs. INR 2/kg. Similarly, they save a huge expense incurred from the in-house compost rather than purchase elsewhere. The entire task is managed by the Environment Engineering Department by 8 people and the women from the SHG.

### 3.4 Devangini Society, Vile Parle

Satish Kolvankar, an active resident in Vile Parle has not sent out any kitchen waste to the Municipal Corporation for the last 20 years. An architect by profession, Kolvankar was intrigued by the waste management in his housing society. In 2013, he along with a few more people began to chalk out a waste management plan for the society of 30 flats. A little know-how on vermi-composting enabled the team of 5 people to build the system. The team identified three spots for vermi-composting; each plot serves the society for 4 months of the year. The system for collection of different types of waste is mentioned clearly and adhered to. Dry waste (Dirty Plastic, Glass, Metal, Dust, etc.) is to be handed to the housekeeping on Tuesday and Friday only. Wet waste (Kitchen waste, residual waste food, etc.) is stored in the respective floor bins that is handed over to the staff every day which goes to the vermi-compost pit.

Any unwanted stems, leaves, peels (fruits and vegetables) is to be disposed in a stair case bin which is allotted one per six flats.

Type of garbage	To be handed on
<b>DRY GARBAGE:</b> dirty plastic, dirty paper, glass, metal, dust, etc.	<b>Tuesday &amp; Friday</b>
<b>WET GARBAGE:</b> kitchen waste, residual waste food, etc	<b>Mon, Wed, Thursday, Sat, Sun</b>
<b>Unwanted stems, leaves, peels, etc. of raw vegetables and fruits</b>	<b>To be placed everyday in the stair-case bin</b>

Fig. 2.

The different collection system enables easy and effective management of waste. The wet waste goes to the vermi-composting pit and the dry waste is kept aside. There is only one janitor who sweeps the open spaces of the complex. His job has been made easy, since he collects all the high-value waste without having to sort it. The electronic waste is also disposed by him. He earns a marginal profit from these sales to a local kabadiwallah. The entire system is showcased at the entrance for everyone to see. The team updates the scoreboard on how many kilos of dry waste it has managed to store separately. This constantly motivates everyone on the project. Highlighting the entire system by means of a pollution chart in the building reaffirms everyone’s faith in their waste management system. This system needs very minimal supervision after the initial set-up in addition to the little infrastructural set up. The entire system of composting is based on natural processes with no extra energy/inoculum costs. Only the one time investment on dustbins is the added cost of the system.



Fig. 3. From Left to Right - Vermi-composting bin, Notice put for the bin on each floor, bin on every floor, pollution chart maintained

### 3.5 Runwal Nagar Plot No. 1, Thane.

Pratik Walawalkar, a student of Environment Science, University of Mumbai, was keen on managing the waste of his society. He started with the horticulture waste (Dried twigs and leaves) in his compound. After speaking with several experts such as Paryavaran Dakshata Manch (PDM), a local solution providing NGO, he took up vermi-composting. He setup the vermi-composting pit in the open area of the complex where all the dried leaves and twigs are dumped. All the 210 flats existing in his residential complex agreed to his experiment and there was no looking back. The vermi-composting bin was constructed at a cost of INR 30,000 and thereafter all the housekeeping staff started piling the horticulture waste in one corner.

The twigs and leaves are watered in an open area next to the vermi-compost bin for them to accelerate the process of decomposition. After about 10 days, this is put in the vermi-compost bin. About a kilo of earthworms were brought from PDM to initiate the process. Walawalkar says, the number of earthworms would have increased at least 3-4 times. Since worms are sensitive towards strong smelling foods such as onions and are averse to citrus fruits, there is a separate system in place for vegetable peels. The complex also has a small temple that generates some Nirmalya (flowers offered to divine idols). This Nirmalya and vegetable peels are added in along with dry leaves to a 'Magic Bucket'- a concept adopted from PDM. Two magic buckets of 100 L capacity, cater to the wilful residents of Runwal estate Plot No. 1. The support from all the flats ensured that Pratik could take the project ahead. The technical support from PDM that was crucial to setting up of the vermi-composting and Bucket-based composting system.

### 3.6 Fortune Heights, Mahim.

One of the residents in Fortune Heights, Monisha Narke got thinking about the waste she generates. Her journey started with managing the waste produced at home for her family of six. She soon realised that when there was a get-together or when there would be a binge on seasonal fruits such as mango- her home composting system would not hold good. She ended up sending the excess waste to the Municipal truck. Soon, this frustration led to the quest of setting up the system for her building consisting of 25 apartments through her start up- RUR (Are you Reducing, reusing and recycling?) The proposal was set forth to the General Body and after discussions and debates, the resolution was passed. That got RUR's solution to manage the building's biodegradable waste. A set of drums that have perforations on the bottom and side allow the drums to aerate the waste that is placed inside. By collecting the entire building's biodegradable waste (not including non-veg waste), the building achieves 90% reduction in their waste going to the landfill. At the same time, the society has also managed to recycle over 80% of their waste by means of composting and handing over their recyclables (paper, plastic, tin, etc.) to FORCE (a dry waste recycler). Every day, 15 kilos of wet waste is composted, 10 kg is recycled and less than 5 kg is dumped. The only rejects that they send to the landfill are wrappers, soiled containers, Styrofoam. Apart from that, there is horticulture waste that ideally needs to be shredded, but since there isn't any capacity to manage that- the society pays MCGM to pick up the horticulture waste.



Over the last three years, her project has progressed to setting up a terrace garden (14 x 12 sq. ft), which has been around for a year now. The compost that is generated by the building is largely consumed by the garden and by some of the residents who have some plants at home. The edible terrace garden completely nurtures herbs and seasonal vegetables. The produce is shared in a random fashion, where each family gets substantial amount of food that they can cook one meal. The linkage between the terrace garden and the composting activity has been ingrained so well that the kids have a fun time comprehending the link between nature and their day to day lives.



### 3.7 Enviro-Vigil, Thane (Bio - Medical Waste Processors)

Enviro-Vigil processes bio-medical waste for the regions of Thane Municipal Corporation and adjacent districts of Thane. Round the clock collection, crucial to the nature of bio-medical waste caters to over 3500 customers (Pathology Labs, Dispensaries, Clinics and Veterinary labs) and goes up to 2000 kgs per day. The first step is to separate the anatomical waste from the non-infectious waste. Of their entire collection, 1200 kg is anatomical and contaminated waste which is incinerated at 850<sup>0</sup>C at the first stage. The second stage that involves burning of the gases at 1000<sup>0</sup>C, ensures that the gases are combusted to eliminate any kind of hazardous gas in the atmosphere. The Wet Ventury scrubber which consists of alkali+water neutralises the effluent gas and reduces the existing temperature. The water in the Effluent Treatment Plant (ETP) contains polypropylene bags for arresting carbon particles from water. The water goes to the ETP for processing neutralising the water. The same water is reused for scrubbing purposes. The remaining gas is passed through a droplet separator and then exhaust air is released. The rest of the 800 kg consists of plastic waste that consists of IV bottles, syringes, etc. which is autoclaved at 120<sup>0</sup>C. The sterilised plastic is then shredded at their plant in Murbad where it gets converted into granules. Colour can be injected at this level, if needed, and these granules are sold to manufacturers of medical products who make new syringes, bottles, etc. Any leftover product due to chemical disinfection, is sent for scientific landfilling.

There are many problems faced in the treatment of such wastes. The biggest issue is that all this waste is unsegregated. Universally, there are three colour codes which are observed in Medical waste- Yellow stands for anatomical/infectious waste; Red stands for plastic; Blue stands for glass/puncture proof containers. Hospital staff often mix up surgical instruments with infectious waste. This job is bombarded to an overburdened doctor, does not facilitate capacity building due to time constraints. The job comes down to temporary labours who do not comprehend the issue. So by the time new staff starts working, they need to be trained again. Only a few hospitals segregate waste. Despite Preventive and Social Medicine course in medical colleges, doctors do not correlate the safe disposal of such wastes and good health. Old medicines which are a part of the waste, need to be incinerated but since companies do not disclose their medical compounds, their incineration is not standardised and multiple checks on the gas effluent is carried out.

The entire machinery at the Kalwa Municipal Hospital was purchased in 2003 and is about to be replaced in the coming year. The operational and maintenance costs for such plants vary between INR 30,000 to 3 Lakh for 60 employees. The cost for collection in hospitals is INR 4-6 per day per bed and a fixed cost is levied upon General Practitioners at about INR 1000-5000 per month. The profits that come from the Enviro - Vigil plant goes to fund student ventures that work on green concepts and innovative projects. These projects vary from technical research to applied research with the core idea of encouraging the students.

#### 4. Conclusion:

There is no doubt that decentralised waste management models work. However, there is a lacuna in managing it completely. All of the cases mentioned in this study do not have any process in place for their sanitary waste and rejects. Thus, both the categories end up going to the landfill. Particularly for sanitary waste, Enviro-Vigil does claim that the sanitary pads can be incinerated safely but they are not mandated by law since they are permitted to *only* pick up bio-medical waste. This brings attention to the need for making categorisation of different kinds of waste. By categorisation/classification, the concept of segregation will become clear and this can lead to zero-waste colonies. That said, there is very little done on incorporating, or even encouraging such colonies that are managing their waste effectively. While the Thane Municipal Corporation offers a 5% rebate to those housing complexes, the other Municipal Corporations aren't thinking on these lines.

Bangalore came up with the classifications, it would be important to scale up this classification and work on solutions based on them. Without that, our waste will continue to lie in dumping grounds.

Under the 74th Constitutional Amendment, the role of sanitation has been assigned to Municipal Corporations among 17 other functional domains. To be able to complete this task, tenders are floated and the garbage mafia work against decentralised solid waste management since it is not profitable. The actual incentive is needed at the trade level – that of *Kabadiwalahs* and waste pickers, since they meticulously work on adding or creating value in waste. A conversation with industry on bridging this knowledge gap is the need of the hour. But our Municipal Corporations have very little finance and man-power assigned to do this. With the limited resources and a huge task lying ahead of them, rethinking the system of work indicate administrative reforms will be required to bring in a crucial impact.

In retrospect, consumerism is also linked to waste management. Never ending needless purchase soften leave you with loads of trash behind. The concept of 3Rs need to be rethought and 5Rs need to come in place- Refuse, Reduce, Reuse, Replenish, Recharge and Recycle. That way, energy and material recovery will be taken very seriously. With that motto, producers will be forced to acknowledge the materials they use in their products and the packaging of their products. Without relevant and precise knowledge, expediting solutions would not be realistic. But to all this, people must come together to persistently work on the issue.

That will bring adaptable solutions to their doorsteps. Margaret Mead once said, "Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has."

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