

# Decentralized Model for Solid waste management in Urban Area- a perspective towards Sustainable Solid waste management.

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## Abstract:

The major issues of Solid wastes management in Urban Areas may be attributed to the partial source segregation of waste, poor waste collection & coverage, partial treatment of wastes and unscientific disposal of the huge amount of waste generated. In order to meet these challenges, the present paper recommends the “Decentralized solid waste management system (DSWM)”, a decentralized approach to solid waste management along with the appropriate managerial, technological and community support.

The Centralised Framework moves the emphasis away from waste generation and into waste disposal sites, and transportation contributes to the total cost. Communities must treat their wastes in their own locality/premises using low-cost mechanisms on a sustainable scale under the decentralised waste management framework. The current paper is an effort to provide a holistic approach to the issue of waste collection and disposal through the idea of decentralised waste management, and to see if it relates to other solid waste management solutions in terms of expense and technological viability, as well as how it assists in achieving efficiency in terms of solid waste management in urban environments, also outlines the key observations and benefits of the Decentralised framework. This paper also discusses case studies from Gandhinagar, Ahmedabad, Bhavnagar, and Mumbai, in which multiple institutions/communities/ULBs have used a decentralised method to effectively handle their waste.

**Keyword :** Decentralised Solid waste management, Centralized Solid waste management, Solid waste management, Urban Local Bodies, composting, transportation of solid wastes.

## 1. INTRODUCTION

Solid Waste Management is of growing importance across the Country. Inappropriate and unscientific disposal of solid waste in open areas and uncontrolled dump sites can have adverse consequences, on both human health and environments. It results in spread of communicable and non-communicable diseases among people and livestock, adversely impacting welfare, livelihood, and economic productivity.

Solid waste management is a vital component of Urban Areas, and as per the 74th Indian Constitutional Amendment, SWM is primary responsibility and obligation of the Municipal Authorities. It's one of the basic and essential services provided by Urban Local Authorities within the country to make the metropolitan territories clean.

With population growth, evolving lifestyles, and rapid economic change, Solid Waste management is worsening in urban areas. Today, the realisation of sustainable solid waste management is a greater challenge for Urban Local Authorities and unable to cope up with increasing issues of handling of Solid wastes.

Urban Local Bodies (ULBs) in charge of solid waste management seldom have enough funds, resources, or plans in place to boost SWM. It leads to low collection efficiency and uncontrolled disposal. Along these lines, it is critical to recognise failures and shortcomings of the ULBs since they are monetarily subject to the Center and State for their working. Yet, notwithstanding each one of those requirements, numerous ULBs have put forth critical attempts in accomplishing effective solid waste management.

There are likewise other various players who play a crucial role in managing such waste. Generally, the city interacts with all its stakeholders to manage the waste effectively. Many of these is done by informal sectors and now arising recyclers who are setting up processes for decentralised waste management. The interconnectedness of the government agencies, technology, recyclers, citizens/residents, waste pickers make the circle for compelling waste management of the city in a centralised and/or decentralised manner.

## 2. SOLID WASTE MANAGEMENT SCENARIO IN URBAN AREAS

As per Ministry of Housing and Urban Affairs Annual Report for the year 2016-17, it is estimated that the total generation of solid waste is approximately 1,50,000 T/day in India. Out of the total, approximately 90% (1,35,000 MT/day) is collected. Out of the collected waste, 20% (27,000 MT/day) is processed and the remaining 80% (10,80,000 MT/day) is going to the dump sites (Source MoHUA)

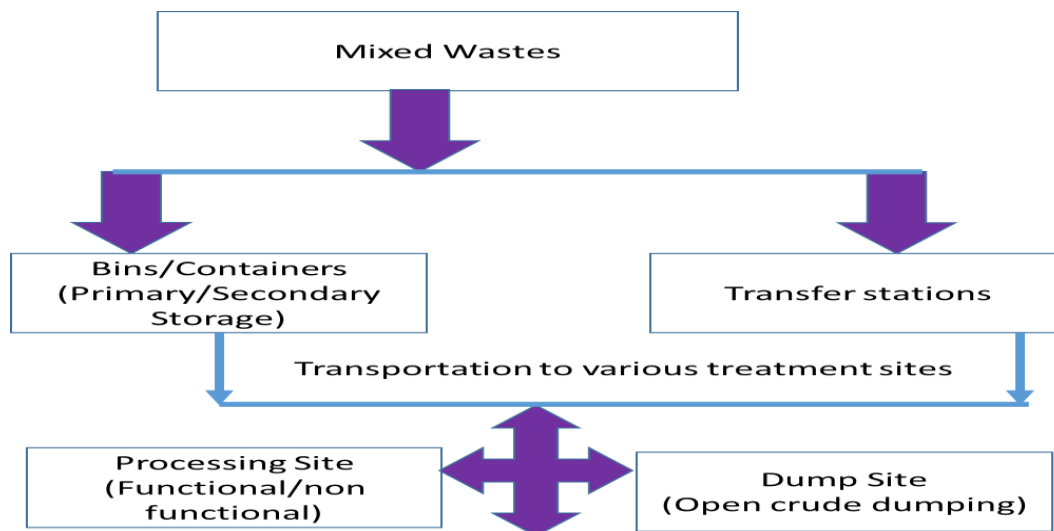
Despite numerous measures to treat waste, ULBs are reportedly unable to meet their general responsibilities satisfactorily. The condition is especially concerning in urban unauthorised settlements and slums, where the SWM is almost non-existent. This has resulted in widespread health issues among people. The standard of living has declined, and manpower has dwindled due to this increased disease frequency.

Solid waste is transported inefficiently as many cities lack proper transport facilities and its disposal is also not done in a scientific manner. The trucks used for transportation of waste are generally opened and uncovered which causes to leak the waste onto the road resulting in unsanitary conditions. In excess of 80 percent of waste is disposed of aimlessly at dump yards in an unhygienic way by the municipal authorities prompting the issues of wellbeing and environmental degradation.

The majority of cities dump their waste in low-lying areas outside of town, with no concern for protection or organisational control. Cities, especially large cities, are confronted with the problem of insufficient land availability for waste disposal. Finding new disposal sites is also a significant challenge.

In terms of finances of ULBs, There is a large financial gap between the revenue income and expenditure. Establishment costs, such as wages for conservancy workers and waste transportation, account for a large portion of income spending. A small portion of expenditure is incurred on the treatment and disposal of waste as compare to collection & transportation of the wastes. In most ULBs, revenue generation from user fees and waste recovery are nearly negligible. The expenditure & revenue profiles of most municipalities clearly shows that the internal finances are insufficient to meet need for SWM. This is all over common situations prevailing in most of the Cities. Figure 1 , 2, 3 & 4 shows the current situations and desirable approach towards sustainable solid waste management along with baseline scenario and Centralized SWM in Urban Areas.

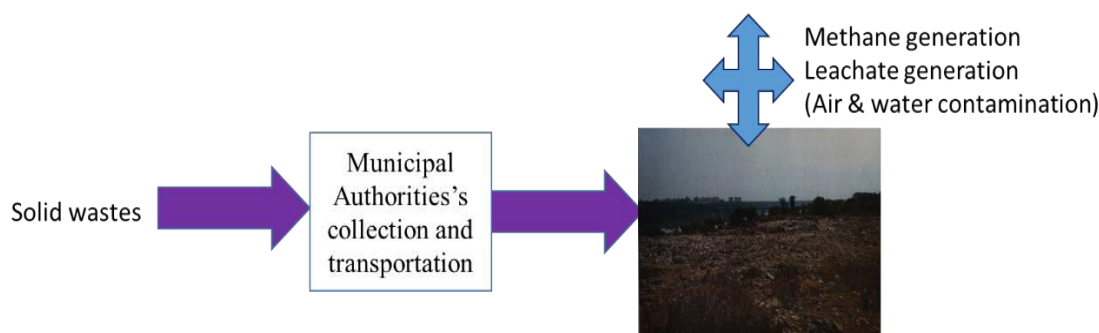
Existing Scenario



**Figure 1 :** Existing Scenario in almost all Cities(Source : Author's creation)

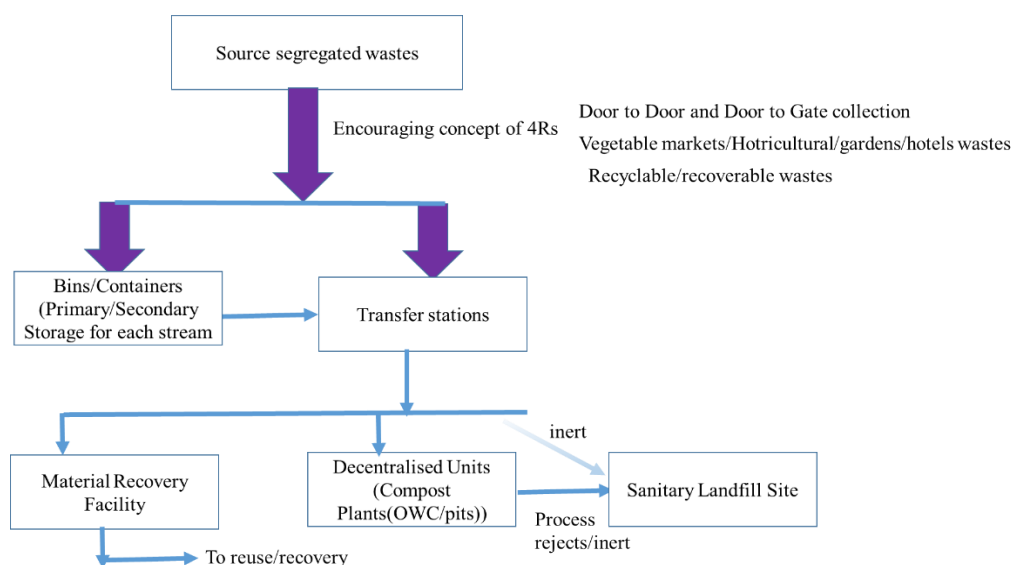
Problems : Unhygienic condition , Water Pollution, Spread of Disease Vectors, Air pollution, Odor Pollution, More Land Required for Landfill, Expensive collection and transportation

Current Baseline situations in Urban Areas



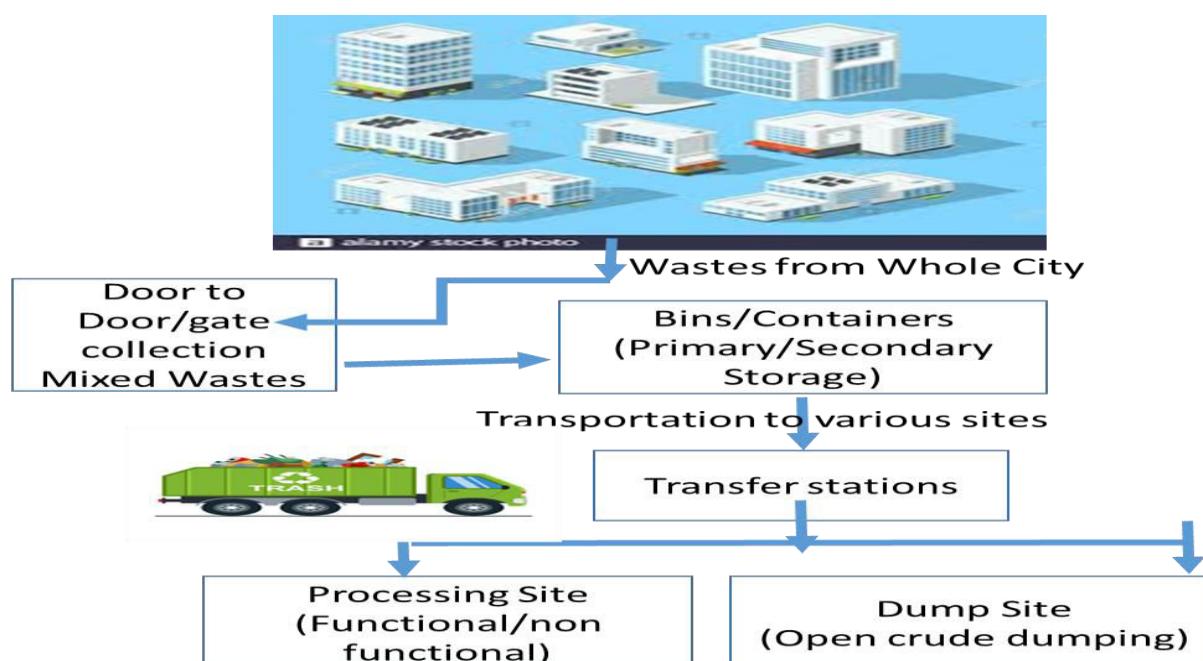
**Figure 2 :** Current baseline scenario (Source : Author's creation)

Recommended approach to manage the wastes



**Figure 3:**Recommended approach (Source : Author's creation)

Opportunities: Efficient processing and Improving Recycling/Recovery ,Reducing air pollution &possible Carbon Trading, Reducing Cost of SWM, Creating Job opportunities, Improving Health and Environment, Improving Soil and ground water Condition



**Figure 4:** Centralized Solid waste management (Source : Author's creation)

Centralised Solid waste management System

### 3.CONCEPT OF DECENTRALIZED SOLID WASTE MANAGEMENT SYSTEM

Various small/medium local waste management facilities by within the locality & premises of Buildings/complex is known as the Decentralized solid waste management system (DSWM). It necessitates that societies/communities process their waste locally using low-cost mechanisms in their own locality. For example, cluster of Flats/Apartments, Commercial buildings, Educational Institutes etc can create their own processing/Recycling/Recovering /disposal mechanism for solid wastes generated in their premises.



**Figure 5:** Decentralized Solid waste management-DSWM (Source: Author's creation)

The decentralized mechanism is not only manageable, sustainable and financially feasible, but yet in addition assists with improving the quality of life and working conditions of the waste pickers. Decentralized or at source segregation and treatment of waste has become the most down to earth and acceptable solution for danger of garbage.

Many bulk waste generators such as large industries, hotels, IT companies, educational Institutions, Govt.Complexes & Offices and few Municipal Corporations have begun embracing various decentralized waste management solutions as a part of their overall waste management strategies. Decentralised systems anyway run on more modest, however reasonable scales. This system is easy to manage, monitor and update/rectify. Decentralised model permits the communities to address their issues & needs and micromanage their solid waste at institution level resulting in a simple, long-term approach that prevents waste winding up in landfills. Swachh Bharat, Smart Cities, and AMRUT, among other initiatives of the Indian government focused on public health and sanitation, emphasise efficient decentralised urban waste management activities. The communities could be get legitimate support for decentralized model for SWM through the provisions of SWM Rules 2016 and EP Act 86, the legal framework of the Country.

### 4.CENTRALISE VS DECENTRALISED WASTE MANAGEMENT SYSTEMS

Existing centralized framework is not appropriate for waste with high organic content and is additionally not cost effective. Integration of informal waste workers is also poor in this system. Wastes are not collected from every corner of the Cities in

efficient manner under this system. As a result, overflowing garbage bins at the public collection sites, scattered garbage all over is common scenario prevailing in most colonies in the city. It is very expensive.

Centralised system have a history of failing at scale, owing to the static system's difficulty. From door-to-door collection to transportation, treatment and crude dumping of waste in over-flowing dump sites is not the effective management of mixed waste. In layman's words, the linear waste dumping scheme reveals the waste is still mismanaged.

Floating of Tenders for collection and transportation at increased cost and high spent are both the prominent features of this Centralised mechanism. Most of the Urban Local Bodies manage their Solid wastes in consolidated way by centralized mechanism, which is eventually dumped after storage, collection, transportation, partial treatment at open dump sites. Tenders are issued to complete this tasks, though some contractors want to deal with a Centralised solid waste system as they found it more profitable than Decentralised one.

#### 4.1 ADVANTAGES OF DECENTRALISED SYSTEM

There are several benefits of a Decentralised initiative. It offers a long-term and sustainable waste management approach with many direct and indirect economic, social, health, and environmental benefits. Few of them are listed below.

- The Decentralised collection and processing of wastes, preventing waste from being transported too far from the dumping sites. It lowers the cost of fuel, consequent traffic congestions, air pollution, noise pollution and road & Vehicles maintenance costs etc.
- It also prevents the contamination of ground water through the seepage of leachate, which would otherwise end up at the dump site.
- The increased aesthetic state of the locality is one of the most apparent benefits of a decentralised system.
- This method eliminates the need for the ULBs to provide a primary/secondary collection service, resulting in substantial cost savings.
- Decentralized schemes offer the poorer people of society more opportunities for income and jobs. Rather than being a labor-intensive, it is capital intensive with livelihood option.
- There are economic advantages of Decentralised Recycling as well, as it would become easier to carry out proper and skilled segregation of recyclable materials at manageable scale, which fetches higher costs. As a result, the quality of finished goods produced from these recyclables increases dramatically, resulting in higher costs and aiding in the preservation and promotion of dedicated consumers' trust in these recyclable products, as well as giving the recycling industry a new impetus.
- The provision of formalising the working practices of waste collectors at small scale, allows them to operate in a safe environment. Gloves, uniforms, and other protective supplies are provided, which improves their working conditions. The neighborhood's tidy and clean appearance leaves it less resistant to illness. There can be drastic reduction in number of vehicles used for primary & secondary waste transportation. Which can result in reduction in air & noise pollution, which can benefit the Citizen's health of the city, indirectly.
- There are many Social benefits too. The waste pickers might be replaced as waste collectors and their job can be more formalized. Serving as a formal waste collector earns them more respect and dignity than working as a waste picker. Composting is second benefit. Producing compost not only provides an additional means of income for the scheme, but it also aids in reclaiming the soil's lost fertility. Chemical fertiliser misuse is well-known, and compost promotion as a natural manure is a pressing need of the moment.
- Decentralized solid waste management system focused on local people's management and ownership have a lot to add to the strengthening of public society which will result in the growth of a much more aware and motivated citizenry, which will take these modern skills forward in many other walks of life.
- The Government should recognise the benefits of local decentralized system and include community services to make this a common practise. Municipalities' financial funding for community-based integrated waste disposal systems would offer the necessary impetus.

Why are cities still adopting a Centralised waste management process, which has a high transportation cost and adds to emissions, at a time when everyone is transitioning to decentralised waste management systems to mitigate the effects of factors that contribute to climate change. Such Centralised mechanism has never worked successfully in the past.

#### 4.2 LIMITATIONS:

However, owing to a shortage of adequate channels for handling rejects and sanitary waste, many units are unable to reach 100 percent decentralised control. Decentralized waste management models are undeniably successful. However, there may be a flaw in fully doing it.



### 4.3 VARIOUS TECHNOLOGICAL OPTIONS FOR DECENTRALISED SOLID WASTE MANAGEMENT

Decentralized SWM also uses the same technologies for processing/recycling/recovering of the wastes as Centralised one, but on small/medium scale. However, few technological options which are not feasible for Centralised one, can also be explored in case of DSWM. The analysis and survey is required to match with the specific requirement of DSWM. Many of them can have pros & cons as well. Source segregation is a must, in selecting any technology. And, in case of DSWM it becomes easy for particular selection of technological options, as source segregation is not the problem in case of DSWM, just like Centralised one. In case of DSWM, appropriate segregation of wastes can be implemented effectively and that can improve the quality of the compost and recycled materials that can be either used for captive use or it can be sold in the market.

Commonly used technologies for decentralized solid waste management, such as ;

- Recycling/reuse of waste, (co ordination with local kabaddiwala, pastiwala)
- Pitcomposting, (easy to practice at small and local level )
- Vermi-composting (easy to practice at small and local level )
- Organic Waste Converter (OWC) and Shredder –(available in the market in various capacity)
- Small scale anaerobic digestion (Bio-Gas) –(can be adopted , if high organic wastes)
- Bhatti or Burner (made out of sand) for Sanitary wastes (authorized and environment friendly)
- Handover of domestic hazardous wastes to ULB or sale out to authorized dealer of HZWM.

This selection of suitable technologies depends on various factors including techno-economic viability and size of the locality. The inert, and process rejects (non-biodegradable residue left after composting/processing) could be disposed through ULB to Sanitary landfill and finished compost can be utilized for captive use within premises, i.e. in own gardens.

Residents/Occupants themselves can do the recycling of waste or they can approach local kabaddiwala, pastiwala or scrap dealer. Even , it can be done centrally through the association of informal sectors. voluntary agencies.

### 4.4 METHODOLOGY FOR DECENTRALISATION MECHANISM

The general methodology for setting up of Decentralised System are ;

- Baseline Survey and quantification & Characterization of the wastes to decide treatment options.
- Door to door waste collection of collection from central area of each block of whole establishments, depending on area and quantification of the wastes. It can be manual and/or lifting (though in built belt systems in high rise buildings)
- Segregation of biodegradable and non-biodegradable wastes at sources by individual generator/flat.
- Secondary/correction segregation at secondary storage for recyclable, organic and inert wastes.
- Selling of Recyclables through co ordination of Informal Sectors
- Processing of organic wastes as per above technologies options
- Disposal of inert wastes and process rejects wastes to City's authorized landfill Site through Municipal Corporation/ULBs
- Periodical meetings, interactions, training/awareness programmes in association of ULBs.
- Periodical repair/maintenance of the functional elements of Decentralised System.

### 5. CASE STUDIES

Few success stories of DECENTRALISED SYSTEM are explained below.

1. Gandhinagar Municipal Corporation (GMC), Gandhinagar, Gujarat : GMC has decentralized facilities for processing of biodegradable wastes generated from City's main Vegetable markets (#2) and other horticultural wastes. Such Processing plants are situated in Sector 21 and Sector 24 of Gandhinagar, which comprises Pit Compost units, Vermi Compost Units and OWC- 500 Kg & 1000 Kg with Shredder. This Decentralized Facilities successfully process the wastes of about 42 MT/day, and finished Compost is utilised for captive use of GMC.
2. Decentralised Collection System, integrating waste-pickers into AMC's waste collection system, Ahmedabad, Gujarat (Source : What Works in Water & Sanitation, Case studies in Urban Gujarat, UMC, 2013) : Ramapir-no-Tekro, located in Vadaj area of Ahmedabad, is the largest slum in Ahmedabad. About 1.5 lakh families reside there. The slum comprises of numerous chawls and has very narrow lanes. Most of the slums in Ahmedabad do not have any door-to-door collection system. Likewise, there were no waste collectors visiting the entire settlement of Ramapir-no- Tekro. Self Employed Women's Association (SEWA), a membership organization, supports and organizes women workers of informal sector within 12 states of India. The Ahmedabad Municipal Corporation (AMC) joined hands with SEWA to initiate a pilot for door-to-door waste collection work from slum

settlements of Ramapir-no-Tekro in Vadaj area. Waste-picker members of SEWA from the area were assigned the task for the pilot project. The slum area produces about 2.5 to 3 tons of waste everyday. Each member earns a minimum of about Rs. 2,500 per month through regular door-to-door waste collection. Besides, they segregate paper and plastic waste from the collected trash and sell it to scrap-dealers to fetch some extra money.

3. Law Garden and Khanipini Bazar (Food Stalls) of Ahmedabad (Source : What Works in Water & Sanitation, Case studies in Urban Gujarat, UMC, 2013) : AMC installed OWC installed a 200 kg/day capacity OWC machine with a shredder machine to make compost out of wet waste. Garden wastes and food stalls wastes are composed in OWC daily. Garden waste generated from Law Garden was also brought here. The owners of fast-food joints from nearby 'Khani-Pini Bazaar' (food stalls) who earlier dumped their food waste in a community bin every night now sent it to the OWC.
4. The Gangajaliya-Talav market, Bhavnagar, Gujarat (Source : What Works in Water & Sanitation, Case studies in Urban Gujarat, UMC, 2013).: It is the main vegetable market in Bhavnagar and it generates 15 tons of organic waste every day. Bhavnagar Municipal Corporation (BMC) set up the required infrastructure—land, electricity, water connections, and a shed to house the OWC machine behind the vegetable market. The converter can process approximately 300 kg organic waste per hour and it produces 7 tons of organic manure daily. The product is packed in bags of 50 kg. The final product is called 'soil enricher', and is sold to farmers for Rs 3 per kg. Initially, BMC operated the OWC. It later handed over the operating of the OWC to a trained women group (Sakhi Mandal—who are monitored by the Mahatma Gandhi Khadi Gram Udhog Trust, Ahmedabad). The trust pays Rs 10,000 to BMC every month as revenue. The soil enricher is in demand by the farmers from nearby fields.
5. TCS, Gandhinagar has its own Decentralised waste facility” for the treatment of wastes generated in its premises : OWC (Organic Waste Converter) installed as part of DSWM.
6. Godrej Group, Godrej Society, Mumbai :Of the entire 12 MT produced, 6 MT is that of the industrial waste. Every division is provided with a shed with separate compartments for scrap, corrugated boxes, packaging material and biodegradable waste. 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. (Source : HamsaIyer-2016)

## 5. CONCLUSION AND RECOMMENDATIONS

In India, solid waste disposal is of a major concern. The majority of solid waste management and environmental sustainability issues remain unsolved. It is important to note here is that improving solid waste management is the most significant challenge facing by most ULBs. In this case, it is critical to develop a model for decentralized and cost effective solid waste management that includes local people's participation and resource recovery of wastes into wealth and prevention of raw/partially treated waste accumulation.

The decentralised solution may be one of the most successful ways to address all of waste management issues because it has the ability to decrease waste volume by improving people's mindsets, as well as minimise transit costs, traffic congestion, air pollution, road repair costs, and degradation of ground water due to leachate seepage.

More importantly, it reduces the volume of garbage that must be disposed of in dump site/landfills, since land is a significant bottleneck in the solid waste management scheme. Decentralised approach has the potential to increase civic engagement while also promoting environmental protection and economic efficiency.

Community based decentralized solid waste management system with ULB' support should be promoted and Govt should encourage it. Policy framework and Action plan should be prepared in compliance with Regulatory requirements to promote DSWM. ULBs can approach individuals Institutions/Office Complexes/Govt. Offices/Chairman of Buildings/Apartments/Societies to promote DSWM and can also organize awareness programs to encourage them to go for DSWM. ULBs and State Government can also consider financial incentives for setting up of DSWM in order to encourage innovation and adoption of DSWM.

Given the severity of the SWM issues, it is imperative to implement the decentralized solid waste management system as the Decentralized plants, i.e. Composting, Organic waste converters, W-T-E plants are easy to operate and maintain and foster green development, lower GHG emissions, also reduces transportation cost, increase aesthetic state of the locality, create employment opportunities, wellbeing the people and environment.

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## REFERENCES

1. Case Study of Mumbai: Decentralised Solid Waste Management ,International Conference on Solid Waste Management, 5IconSWM 2015, HamsaIyer
2. Decentralized solid waste management In india: a perspective on Technological options by SatpalSingh, National institute of urban affairs, new delhi, cities - the 21st century india,2016
3. Detailed Project Report of GMC, draft version 1.1
4. Gandhinagar municipal Corporation, Official website, [www.gandhinagarmunicipal.com](http://www.gandhinagarmunicipal.com)
5. Solid Waste Management Rules 2016 , S.O.1357(E) , dated 8 april,2016 notified by MoEF, GoI,
6. What Works in Water & Sanitation, Case studies in Urban Gujarat, UMC, 2013