

SOLID WASTE MANAGEMENT

A Study Of : "Karachi's Garbage Crisis Turning
The City Of Lights Into City Of Trash"



INFONALYSIS



DECEMBER 2018



RESEARCH & DEVELOPMENT
DEPARTMENT



**KARACHI CHAMBER OF
COMMERCE & INDUSTRY**

The gateway to economic
prosperity...

Table of Contents

WASTE MANAGEMENT IN KARACHI	1
The Metropolis in the state of clutter	2
Karachi – dynamics of waste management	2
Waste disposal from collection to dumping	3
Multiple glitches hinders waste collection	8
No Waste Segregation Practice in Place	9
Dysfunctional Incineration Plants at Healthcare Facilities	10
Repercussions of Negligence towards Waste Disposal	11
Attempts to uplift outworn systems	12
WASTE MANAGEMENT IN WORLD	16
Sustainable SWM Practices in World	18
Recycling Technologies	21
E–waste Recycling as a Budding Industry	22
Incineration – The Conventional Waste Treatment	23
Rising Trend of Home Composting	24
Turning Waste to Energy	26
MOVES IMPERATIVE FOR CLEAN KARACHI!	28
Waste Segregation at Source via Colored Waste Boxes	28
Incentive Schemes for reducing or Recycling Waste	28
Minimizing the use of Plastic/Polythene Bags	29
Introducing Federal legislations for Garbage	29
Public Awareness Campaigns	30

EXECUTIVE SUMMARY

Solid waste management has emerged as a daunting task for the administrative and municipal authorities in many countries. Developing and underdeveloped countries usually lack proper and well developed solid waste management systems which adversely affect their public health and environment. This report attempts to shed some light on the sanitation crisis and analyze the dynamics of waste management system of Karachi. It also highlights the recommendations to overcome the problems related to waste management in one of the main urban agglomerations of Pakistan, 'Karachi'.

Being a megacity, Karachi ranks on top in producing solid waste among all other cities of Pakistan which has become a menace owing to the years of negligence towards its civic services and poor performance. Some parts of Karachi sadly display an image of an overly littered city with trash scattered everywhere and piles of garbage stacked on its roadsides, streets and alleys. Solid waste generation in Karachi hovers between 12,000 to 15,000 TPD and is expected to be doubled by the end of 2020 of which only up to 10,000 TPD of solid waste gets collected. The rest is dumped in the open spaces of roadside and pavements or sometimes even burned by the residents without realizing the risks involved in such practices.

Efficient waste management is also an important aspect of livability in any urban center. Unfortunately, Karachi has been ranked among least livable cities of the world due to improper management of civic facilities which are already inadequate where rapid urbanization has aggravated the challenges. According to EIU livability index 2017, Karachi has been

ranked 136th out of 140th amongst the world’s least livable cities of the world due to failing on various indicators like environment, health, livability, education and safety.

Since long waste management was the core responsibility of the Karachi and District Municipal Corporations. A few years back, a part of this responsibility was shifted to Sindh Solid Waste Management Board (SSWMB). Since then, the waste collection situation has improved to some extent but it is still much below par. To get the work done, SSWMB outsourced garbage collection system to Chinese Sanitation Companies and imported some machinery and equipment for the job. However, this setup was ~12 times costlier for Sindh government than the spending of the municipal corporation for the work. Still a lot of improvement needs to be brought in through concerted efforts to ensure a clean and healthy environment for the citizens. The unattended organic waste triggers growth of flies and other harmful pests and bacteria which cause host of diseases. Even the hazardous hospital waste does not get properly treated due to only two obsolete incineration plants.

Solid waste collection in Karachi comprises of straight forward steps where garbage is initially collected from household residents through door to door service and finally dumped at allocated sites without any treatment or segregation. In order to overcome the challenges and the abysmal state of Solid Waste management in Karachi, a systematic approach is required to minimize waste generation and at the same time putting the waste to best use through recycling or converting it into energy.

Developed countries like Germany, Sweden, and Luxembourg are utilizing modern techniques to recycle most of their waste to produce energy and other valuable materials. These innovative recycling methods can be implemented in Pakistan to effectively manage solid waste and foster a recycling based economy. However, in order to apply these international best practices of waste management, the at-source segregation of waste is indispensable that requires active participation of every household.

In order to engage public, initiation of Awareness Campaigns and participation programs are needed to educate people about the health hazards of improper waste management, merits of a clean neighborhood, proper sanitation and waste disposal techniques. Together, all garbage lifting authorities including KMC and DMCs can make joint efforts in promoting a clean healthy environment which we can preferably term as ‘Naya Karachi’ (New Karachi). It is, therefore inevitable for Karachi to not only improve the municipal solid waste management while adopting the global best practices but the citizens of Karachi should start using basic cleaning technique right from their homes. A clean, healthy and safe Karachi will transform this city to a major tourist attraction and a preferred investment destination.

WASTE MANAGEMENT IN KARACHI

The rapid urban migration and population growth have enlisted Karachi among the most populous megacities of the world. The population bulge has brought along numerous challenges with it where maintaining hygienic conditions and handling solid waste are currently one of the most pressing issues faced by the authorities. From communes of elite to the expansive municipal slums, the largest megacity of Pakistan – 'Karachi', sadly displays an image of an overly littered city with trash scattered everywhere and piles of garbage stacked on its roadsides, streets and alleys. The dire situation has ruined the aesthetics of the country's main financial hub and once a hustling bustling city now presents a look of trash bin. Although, the state of hygiene is relatively better in the posh localities and commercial centers, the congested old city and slum areas are in dire state posing serious hazards to health and environment.

Being a megacity, Karachi ranks on top in producing solid waste among all major cities of Pakistan.

This report attempts to shed some light on the sanitation crisis and analyze the dynamics of waste management system of Karachi. It also recommends different viable strategies to effectively manage solid waste and foster a recycling based economy. The main aim of this report is to identify ways to turn today's useless garbage burden into tomorrow's treasure with joint efforts of concerned authorities and the general public. It suggests suitable options to adopt global best practices of Solid Waste Management in the given unique socio-economic and political framework of Pakistan.

The Metropolis in the state of clutter

The amount and type of solid waste generated in any city or country depend upon the pace of its economic development, consumption pattern, individual preferences, rate of its urbanization and degree of industrialization. Being a megacity, Karachi ranks on top in producing solid waste among all major cities of Pakistan which has become a menace owing to the years of negligence towards its civic services and poor performance.

Efficient waste management is also an important aspect of livability in any urban center. In a report on Karachi titled "*Transforming Karachi into a Livable and Competitive Megacity: A City Diagnostic and Transformation Strategy*" published in Feb, 2018, World Bank highlighted that over 50% of the city's waste remains uncollected and simply dumped into open dumpsites without any treatment. It underscored institutional fragmentation and complex political economy in Karachi, as the main culprits for the dismal state. Likewise, in 2017, Economist Intelligence Unit (EIU) placed the metropolis at 136th out of the total 140 least livable cities of the world due to failing on various indicators; environment, health, livability, education and safety.

Karachi – dynamics of waste management

Around 20 years back, solid waste generation in Karachi was 6,450 Tons per Day (TPD) which increased to 9,000 TPD in 2005. As population increased manifolds, solid waste generation now hovers between 12,000 to 15,000 TPD and is expected to be doubled by the end of 2020. In contrast, Lahore produces just over 5,000 tons of garbage on daily basis.

Solid waste generation now hovers between 12,000 to 15,000 TPD and is expected to be doubled by the end of 2020.

EIU placed the metropolis (Karachi) at 136th out of the total 140 least livable cities of the world.

The structure of solid management system is such that Karachi is divided into six zones (West, East, South, Central, Korangi and Malir), 10 towns and 178 Union Councils (UCs). Throughout the years, Karachi Metropolitan Corporation (KMC) along with the District Municipal Councils (DMCs) have remained responsible for providing municipal services in the Karachi Division. Initially, an individual DMC was responsible for managing the solid waste in each of the six zones. Recently, a part of this responsibility has been shifted to Sindh Solid Waste Management Board (SSWMB). Since then, the waste collection situation has somewhat improved but it is still much below par.

Against the huge waste generation, the handling capacity of DMCs and KMC had remained limited to only one third of it. It has been reported, out of 12,000 TPD generated, only 4,000 TPD were being collected on daily basis by the waste pickers whilst the remaining garbage was being dumped in the open spaces of roadside and pavements by the residents.

Karachi is divided into six zones (West, East, South, Central, Korangi and Malir), 10 towns and 178 Union Councils.

Waste disposal from collection to dumping

When we compare the local garbage collection system with the international best practices, there exists wide disparity in both operational efficiencies as well as technological advancement and quality of administration.

Unlike the modern chain flow of solid waste management followed in the other parts of the world, solid waste collection in Karachi comprises of fewer straight forward steps where garbage is initially collected from household residents through door to door service and finally dumped at allocated sites without any treatment or segregation.

Garbage collection in Karachi involves the following stages:

Stage 1: Picking garbage from household and taking it to the dustbin sites (kachra kundi).

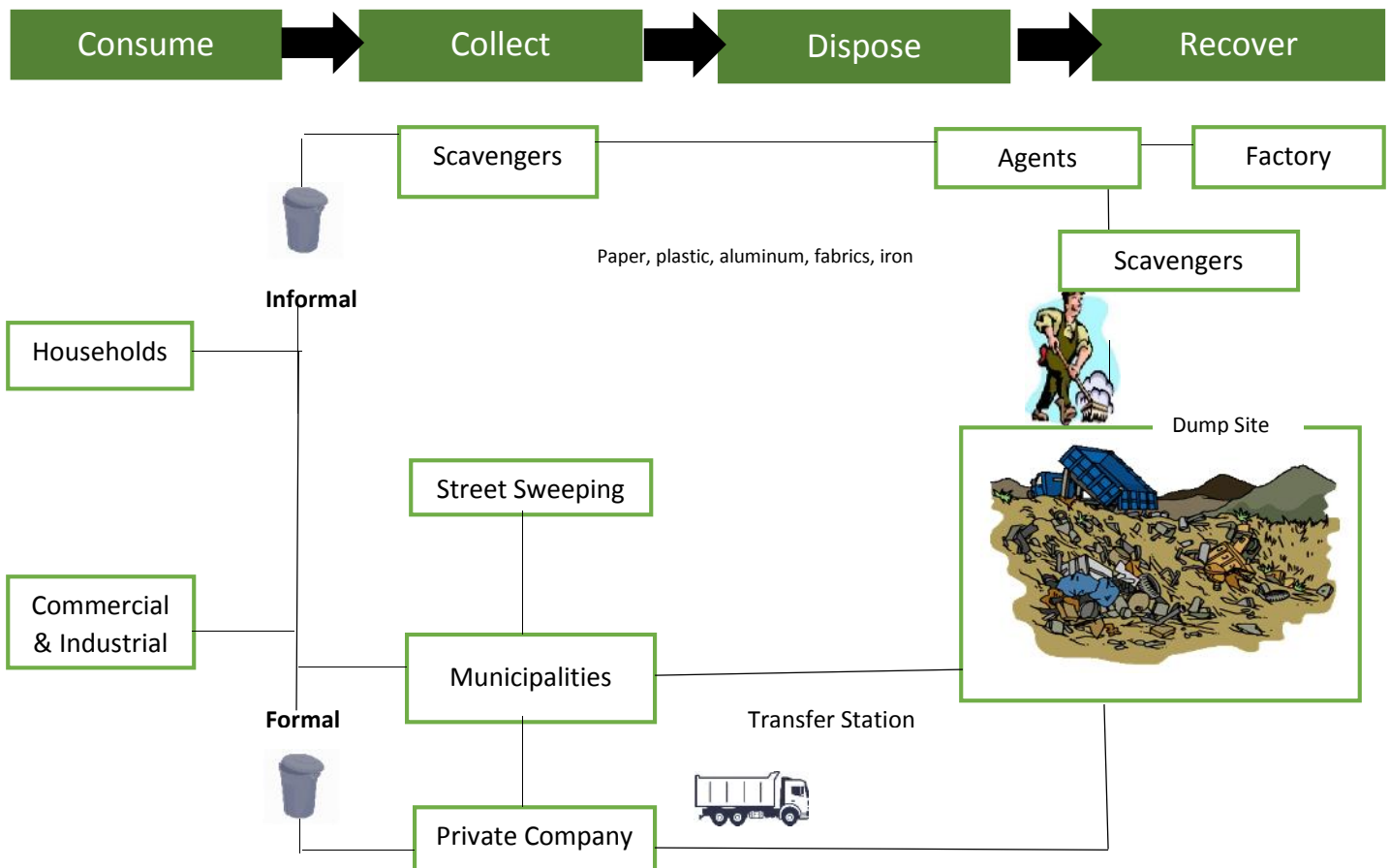
Stage 2: Lifting garbage from dustbin sites and moving it to Garbage Transfer Stations (GTS). In Karachi, these GTSs do not possess any waste treatment plants although, there is an incineration plant at one of the GTS at Mewa Shah. However, it has also been dysfunctional for a long period of time.

Stage 3: From the GTS, garbage is finally taken to the landfill sites and is simply dumped there.

Due to the inability of DMCs to lift garbage from their respective jurisdictions, there had been a backlog of around 1.1 million tons of garbage that was piled up on the GTSs. These GTSs include Sharafi Goth, Sohrab Goth, Mewa Shah, 100 Qtr. Korangi, Murtaza Chowrangi, Rehri, and Ibrahim Hyderi near Korangi Creek, Hawksbay and Malir River bed. The heaps of garbage that remain on these GTSs are required to be lifted and sent to the landfill sites as per outsourcing SSPRA Rules, 2010. Some of the waste got decomposed naturally over time while some of it was burned to create space but polluting the environment around.

Garbage Transfer Stations (GTS) include Sharafi Goth, Sohrab Goth, Mewa Shah, 100 Qtr. Korangi, Murtaza Chowrangi, Rehri, and Ibrahim Hyderi near Korangi Creek, Hawksbay and Malir River bed.

WASTE COLLECTION MECHANISM



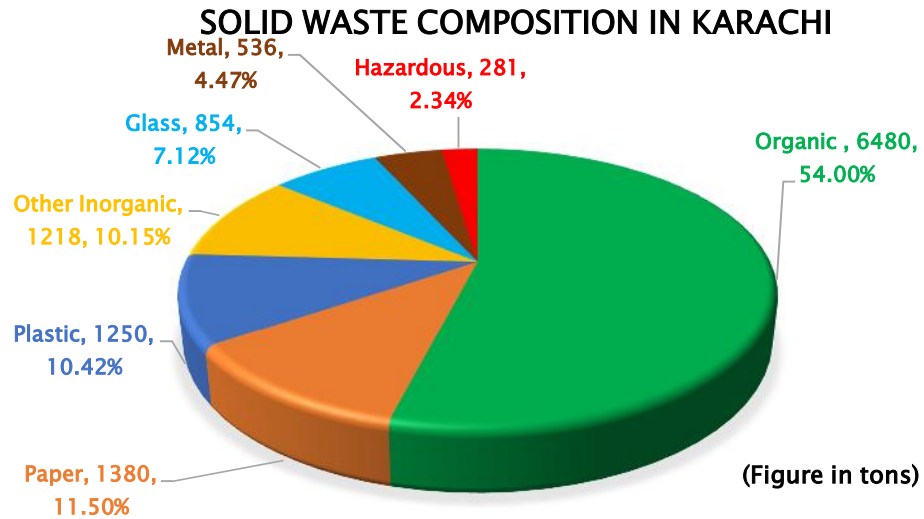
The city possesses only two landfill sites; Gond pass and Jam Chakro, having a waste storing capacity of only 9,500 tons against the generation of 12,000 TPD. Each of the landfills has land area of 500 acres. However, these landfill sites are located in the far flung areas of North West of Karachi which put off transporters to skip dumping on daily basis.

The need for the construction of new landfill sites has been felt many times. However, only one new land site has been selected in this regard and no further steps have been taken lately.

SOLID WASTE DUMPED AT KARACHI'S LANDFILL SITES		
S. No.	Name of Landfill Site	Waste handling capacity (tons/day)
1	Jam Chakro, near surjani Town	Around 8,000 tons
2	Gondpass	Around 1,500 tons
3	Dhabeji (under progress)	Not commissioned

Source: KCCI Research, SSWMB

Solid wastes are broadly categorized as organic, inorganic and hazardous waste. According to the estimates of SSWMB, indigenous waste lying open at the landfill sites of Karachi comprises of 54% organic in nature which can be used for composting and planting nurseries by the farmers. While, the remaining waste comprises of recyclable waste including paper (11.5%), plastic (10%), glass (7%), metal (4.5%) and other inorganic waste (10%). Such waste can be used by the recycling industry to produce new items while hazardous waste constitutes just 2% of Karachi's solid waste.



Source: *KCCI Research, SSWMB*

The solid waste is further classified into domestic, industrial, construction or municipal waste. Various kinds of solid waste are supposed to be disposed of in different manner. For example, paper, glass, bottles, cans are recyclable waste and therefore can be put to better use by adopting recycling techniques. The organic pile can be composted to be used as organic fertilizer which gets decomposed with the scorching heat, moisture, oxygen and bacteria. Proper treatment of waste according to its type is critical to avoid damage to health and environment. In Karachi, much efforts have not been made to manage waste systematically where everything is mixed randomly and left untreated at the discretion of nature to play its part.



Organic Waste

Vegetable, fruit debris, paper and cardboard, food, green and garden waste, human and animal waste, bio-solids.



Hazardous Waste

Paints, aerosols, old medicines, chemical, electronics, auto parts, mercury waste, batteries, amunition, polishes, pesticides etc.



Recyclable Waste

Paper, glass, cans, bottles, metals, fabrics, clothes, bulbs, batteries, boxes, appliances, scraps, some plastics, etc.

Multiple glitches hinders waste collection

On primary level, problems being faced at door-to-door waste collection service include short attendance of garbage collectors, lack of proper trainings, dearth of garbage containers and difficulty in collecting garbage piles from roadsides, streets, open spaces and drains. This megacity of Pakistan not only suffers from poor waste collection services but poor waste handling capacity is another loophole that has failed the whole process of solid waste management in Karachi.

The landfill sites have already reached their saturation point long time ago and are clogged restraining further garbage collection. Furthermore, there is an issue of encroachments as well that have been built up on these GTSS and are even used for living which is very hazardous for the health of the dwellers. These encroachments have to be removed in order to free up the space for garbage collection.

The burgeoning population in the metropolitan area, lack of awareness, unavailability of proper waste disposal systems

The landfill sites have already reached their saturation point long time ago and are clogged restraining further garbage collection.

and rampant corruption prevailing at the local and provincial levels have further added to the woes of the city and needs immediate attention of the concerned authorities. Furthermore, loopholes existing in the institutional framework indicate poor governance which makes it difficult for all the stakeholders to stand at one platform and devise a proper mechanism for waste management.

Likewise, not much record has been maintained on solid waste generation in the past regarding its origin, characteristic and composition. As a result, all waste management operations are being conducted on the basis of assumptions and inferences which lead to inefficiencies mishandling of waste collection.

All waste management operations being conducted on the basis of assumption and inferences which leads to mishandling of waste collection.

No Waste Segregation Practice in Place

As the world resources are depleting fast, waste disposal techniques such as recycling, composting and incineration are becoming more preferable over burning and landfilling. However, in the absence of waste segregation exercise at the collection stage, all these technically viable and sound disposal techniques become futile. Hence, segregation of solid waste is the first step in the chain and is pivotal for effective solid waste disposal system of Pakistan. Unfortunately, no such procedure is being practiced in Karachi through formal channel at any stage regardless of its high significance which indicates sheer casualness of the municipality.

In the absence of formal waste segregation practice in Karachi, the untreated waste is usually sorted up by scavengers. These scavengers first sort out the waste and then sell it to the respective industry where it could be used as raw materials, thus forming an informal ecosystem of solid waste. Sorting waste in the middle of kachra kundis is dangerous as it could

potentially transmit several diseases to these scavengers which are sometimes poor children. Due to the absence of formal system of segregation at the time of waste collection, only 25% of the garbage is re-utilized that too only by way of the scavengers.

Dysfunctional Incineration Plants at Healthcare Facilities

Karachi has over 50 hospitals that produce more than 100 TPD of solid waste. Only two incineration plants were established for treating medical waste which are almost dysfunctional.

Another major lacuna that persists in safely managing the hazardous solid waste is from the healthcare facilities. Karachi has over 50 hospitals that produce more than 100 tons of solid waste on daily basis. Only two incineration plants were established for treating medical waste. One such treatment plant was set up at Mewa Shah GTS in 1998 which later became nonoperational. Similarly, another incineration plant, established in the year 2000, at Karachi's largest healthcare facility Jinnah Post Medical College (JPMC), has also been almost dysfunctional since long due to being very old and outdated. However, the healthcare facility is still dependent on it owing to the lack of alternate disposal mechanism. Last year, it was planned to be upgraded while a new incinerator was also planned to be purchased as an alternative which remains pending till date.

Pakistan is amongst the countries having one of the highest ratios of TB patients.

The unsafe disposal of syringes, drips, urine or blood bags, needles, fluids and other used wastage are a serious health hazard. Pakistan is amongst the countries having one of the highest ratios of TB patients. The case is easily relatable with the fact that TB bacteria spread through droplets in saliva. As the hospital waste possessing all sort of communicable bacteria, viruses, including sputum culture test, is dumped in

A major portion of trash comprises of plastic bags, wrappers and pet bottles.

the landfill sites, it gets mixed with the domestic waste which later spreads TB and other such diseases.

In the absence of proper waste disposal mechanism, this hospital waste contaminated with all sorts of viruses and bacteria is dumped in the open spaces while some of it gets picked up by the poor scavengers. This is a very alarming situation that needs to be addressed on priority for the safety of the citizens who are mostly unaware of the repercussions of this negligence.

Repercussions of Negligence towards Waste Disposal

The ineffective management of solid waste is harming the citizens in many different ways. In fact, it has even taken many lives of the innocent people in Karachi.

The Sindh government, imposed a ban on the manufacture, sale and purchase of non-biodegradable polythene bags and plastic products in the province on 21st March, 2018.

A major portion of trash comprises of plastic bags, wrappers and pet bottles. The polythene bags are a major menace as these are non-biodegradable, non-recyclable and spread out more by getting air borne. They appear littered across the streets, clogging the sewerage/drainage systems and eventually landing in the ocean harming the marine life. Burning of plastics releases toxic gases which pollutes the air, damages lungs and causes many different diseases including cancers.

The Sindh government, imposed a ban on the manufacture, sale and purchase of non-biodegradable polythene bags and plastic products in the province on 21st March, 2018, complying with the order of the Supreme Court. However, it is just on paper, this ban could not be implemented in practice.

In some cases, when the piles of garbage is intentionally burned or catches fire accidentally, the fire spreads to the

adjacent areas and engulfs houses and Kuchi Abaadis nearby instigating severe loss to lives and property. The smoke from burning trash containing all sort of material and plastics is also quite hazardous for health.

Unattended organic waste triggers growth of flies and other harmful pests which cause host of diseases like cholera, and dysentery which often cause deaths among children.

Unattended organic waste triggers growth of flies and other harmful pests which cause host of diseases like cholera, and dysentery which often cause deaths among children. During rainy and moist seasons, these open dumpsites also become breeding grounds of mosquitoes propagating many diseases like Malaria, Dengue Fever and Chikungunya. Such diseases burden the poor citizens with additional cost of medical care and sometimes become fatal. The health care is quite expensive a proposition for lower and middle class to bear where the unhygienic environment fuels up the instances of sickness adding a great deal to the miseries of Karachites.

Moreover, a city failing to manage its solid waste efficiently also fails to provide complex services of education, health and transportation. It is an example which holds completely true in case of Karachi.

A city failing to manage its solid waste efficiently also fails to provide complex services of education, health and transportation, like in case of Karachi.

Attempts to uplift outworn systems

Due to the lack of interest of concerned local authorities and deteriorating hygiene conditions of the city, Sindh government established Sindh Solid Waste Management Board (SSWMB) in 2015 under Sindh Local Government Act, 2013 and gave the task of collection and disposing off waste in the urban areas of the province to the Board. The board was provided with access to sufficient funds, and was handed over a portion assets and liabilities of the KMC and DMCs that were previously responsible for these tasks.

In the budget for 2018-19, a total of PKR 1.7 billion has been allocated to SSWMB compared with PKR 2.9 billion assigned in the budget for 2017-18.

Sindh government imported many garbage lifting machineries which included large number of plastic steel dustbins, 77 refuse collection vehicles and 200 small garbage collection vehicles.

Subsequently, the board awarded a \$ 25 million contract to a private Chinese Changyi Kangjie Sanitation Engineering Company for period of 2 years to lift garbage in two districts, South and East, out of six districts in Karachi in 2017. Later, two more districts namely; District Malir and District West were also awarded to another Chinese firm for front-end waste collection. For this purpose, SSWMB signed a 7 year agreement with Hangzhor Jinjiang Group Environment Sanitation Service Company Limited, China¹ for lifting and dumping of garbage from limits of West and Malir DMCs in August 2017. However, Korangi and Central DMCs and federal government institutions declined to work with SSWMB; while Cantonment Boards also did not come under the umbrella of SSWMB for waste collection.

In an effort to make the city cleaner, Sindh government imported many garbage lifting machineries which included large number of plastic steel dustbins, 77 refuse collection vehicles and 200 small garbage collection vehicles. Moreover, many mechanical sweepings, vehicles for showering trees and road washing vehicles were also imported. In the budget for 2018-19, a total of PKR 1.7 billion has been allocated to SSWMB compared with PKR 2.9 billion assigned in the budget for 2017-18 for development expenditures on different projects related to solid waste of Sindh.

As the garbage lifting responsibilities were gradually taken away from local municipal authorities and outsourced to Chinese companies along with the addition of new equipment and machinery, the situation of garbage collection improved

¹ <https://dailytimes.com.pk/119005/sswmb-inks-accord-with-chinese-firm-to-dump-garbage/>

considerably. By now, up to 10,000 TPD of solid waste is being collected against earlier collection of just 4,000 TPD. It is still not optimal which means that still 20% to 30% waste still remains uncollected.

The Sindh government committed to pay Chinese company around \$ 29 per ton which translates into ~PKR 3,700 making garbage collection way too costly.

Though, recently, Sindh Solid Waste Management Board (SSWMB) itself criticized the performance of the Chinese contractors for front end collection and disposal of municipal solid waste. In a report submitted to the Judicial Commission overseeing the issue of negligence in waste disposal, SSWMB pointed out that the Chinese contractor was not performing the requisite functions according to the terms of contract agreement. Operation for the collection of garbage was not being carried out twice a day while repair and maintenance of vehicles and waste bins were also not being done at all. Containers/bins for garbage were not being cleaned, similarly monitoring and complaint centers were not properly functional. In spite of formation of independent waste management body and hiring professional services of a Chinese company, the government continued to struggle to comprehensively address the sanitation problem that has afflicted the whole city.

Although, the efforts of solid waste management have not yielded optimal results, at least the new setup did introduce the concept of dustbins to the public across the city which was non-existent before.

Initially, garbage collection cost was mere around PKR 320 per ton when the responsibility was resting with local municipalities. However, with the contract being awarded to Chinese Garbage Company, the Sindh government committed to pay around \$ 29 per ton which translates into ~PKR 3,700

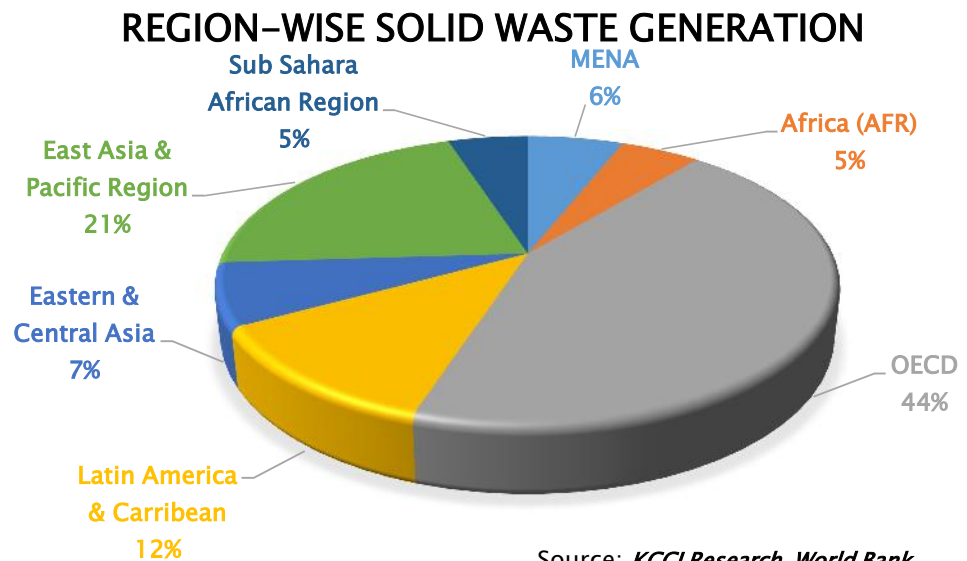
making garbage collection way too costly. If it collects 10,000 TPD of waste, this amount translates in to a hefty PKR 1.1billion on monthly basis and PKR 13 billion per annum. Despite being so expensive the Chinese firms still failed to fulfill their tasks optimally for one reason or the other.

As earlier, KMC and DMCs were responsible for overall Karachi’s garbage collection, disposal, staff budgeting, machinery and vehicles, they put the blame of their low performance on lack of funds and capacity building in the past. It is still questionable whether KMC management could have performed better than the Chinese contractors provided they had been given sufficient funds, trainings and resources. KMC has also filed a case against SSWMB for its dissolution to get back the authority to clean the city. Ever since its establishment, the board has been influenced with ‘power politics’. Till the case concludes, the fate of the SSWM board hangs in the balance.

WASTE MANAGEMENT IN WORLD

According to a report of World Bank, municipal solid waste generation stood at around 2.01 billion tons in 2016 globally which is projected to increase around 3.4 billion tons by the end of 2050. In comparison to the developed countries, people residing in urban settlements of developing countries are more exposed and affected by poorly managed solid waste. Owing to the expensive techniques adopted for the safe disposal which usually caters around 20% to 50% of the municipal budget, management of solid waste has remained a challenge for developing cities and countries. For serving this critical municipal service, a sustainable, efficient and socially supportable integrated system is required. ²

According to a report of World Bank, municipal solid waste generation stood at around 2.01 billion tons in 2016 globally which is projected to increase around 3.4 billion tons by the end of 2050.



The rapid non-biodegradable waste accumulation poses serious threat to the environment and human health. In this regard, United Nation Framework Convention on Climate Change (UNFCCC) was established in 1992 which enforces

² <http://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management>

environmentally sound management of solid waste which involves safe disposal of garbage, encouraging recycling of solid waste for industrial processes, reusing and recycling techniques.

World Bank's engagement in terms of solid waste management consists of 340 SWM programs which are over \$ 4.7 billion in all six regions of World Bank.

The World Bank also plays a vital role for taking initiative for an efficient solid waste management system in different countries around the globe. World Bank's engagement in terms of solid waste management consists of 340 SWM programs which are over \$ 4.7 billion in all six regions of World Bank. Under this program, a \$ 5.5 million project of establishing a composting facility has been undertaken in Pakistan under collaboration of Kyoto Protocol of the UNFCCC in Lahore. It resulted in reduction of 150,000 tonnes of carbon dioxide equivalents and increased the daily compost production volume to 1000 TPD from 300 TPD.³ Such a program can be extended to Karachi also.

In developed countries like US, U.K, Europe, waste is segregated on domestic level by the household in various garbage bins. The recyclable items are generally put in green box, garbage (kitchen items) is thrown in blue box while inert garden items are separated in grey boxes. According to the European Environment Agency (EEA), Austria possesses the highest recycling rate where 63% of all its waste is recycled along with having the world's most advanced recycling industry. This is closely followed by Germany where 62% of all its waste is collected from landfill sites to be recycled and composted afterwards. The country's bottle deposit system has drawn its citizen attention and offers good incentive to

³ <http://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management>

Container deposit system—the individual depositing the empty bottles or cans gets some reward for depositing the container at the nearby shop or container deposit machine (reverse vending machine).

sort out plastic and glass bottles through the municipal waste.⁴

Container deposit system has been initiated by many different countries like Iceland, Scotland, China etc. in which the individual depositing the empty bottles or cans gets some reward for depositing the container at the nearby shop or container deposit machine (reverse vending machine). The



reward may include discounts on bus tickets, travel coupons, redemption coins or money back on the next purchase etc. to incentivize the scheme which is covered through proper legislations by the government.

Sustainable SWM Practices in World

Green colored box collects the organic waste while orange box is meant for putting recyclable waste.

The standard practice of waste collection which is followed globally comprises of various steps. The household segregates their garbage in different colored boxes according to the type of waste. In some countries, green colored box collects the organic waste while orange box is meant for putting recyclable waste. At times, more colored boxes are used to further segregate – glass, plastic, metal and paper.

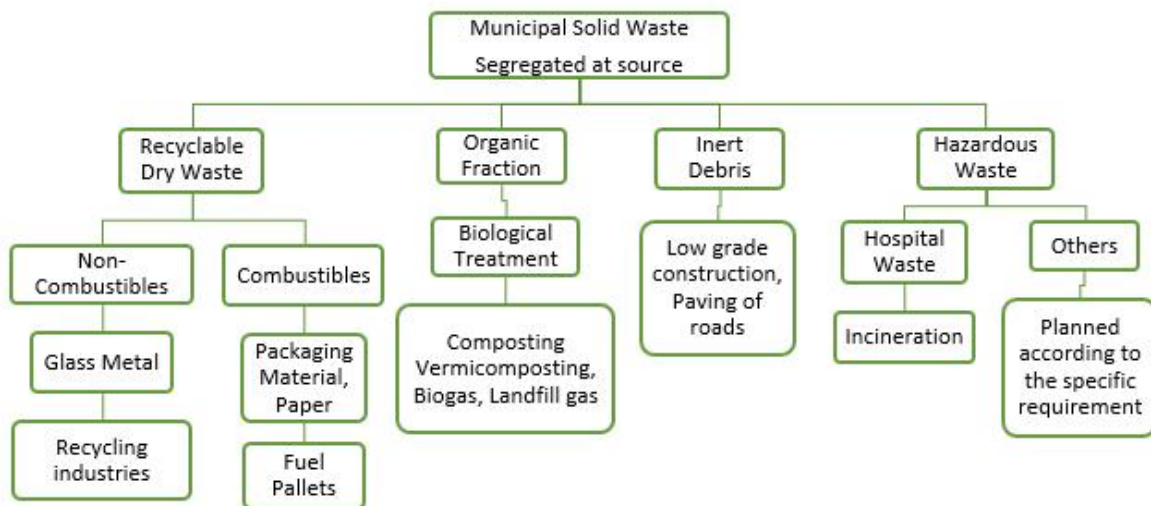
The primary garbage collection includes picking garbage from these boxes and taking it to the garbage collection point which is known as "Temporary Storage". From these Temporary Storages, waste is taken to the Garbage Transfer Stations

⁴ <https://www.eea.europa.eu/media/newsreleases/highest-recycling-rates-in-austria>

(GTSs). At this stage, recycling companies pick already segregated waste which usually contain items such like paper, glass, electronic and electrical items etc. Afterwards, the leftover useless waste, which cannot be further utilized in any form, is transferred to the respective landfill sites where it is dumped and disposed-off using certain technical method.

With the passage of time, diverse options of waste handling have emerged through technological advancements where the useless waste is turned into a formal money making industry.

MUNICIPAL SOLID WASTE USAGE



Recycling – Most Viable SWM Solution

Recycling is one of the most technically viable method of disposing off waste which turns it into new useful materials and objects, making less waste to end up in the landfills. Reducing waste through recycling is beneficial for the environment while it also generates employment. The recycling activity is driving a whole industry where 1.6 million

people are actively working handling over 600 tons of recyclable waste in the world.⁵

The global market revenue is likely to surge from \$266 billion in 2017 to \$282 billion in 2018 excluding revenue from plastic recycling industry. The market size of plastic recycling is estimated to be at \$ 37.6 billion in 2018.⁶ With the longstanding recycling techniques in place, it is believed that about 40% of world's raw material needs are fulfilled through recycled materials. Several household items used in routine are also being recycled. These include steel cans, aluminum, newspapers, paper towels, plastic laundry detergent bottles, container glass of soft drinks etc. Metal recycling is one of the best way of saving energy. Making cans through recycled aluminum scraps takes 95% less energy than bauxite ore which is used for producing aluminum. Similarly, using recycled steel would save 75% energy than is used for producing new steel through its raw material iron ore.

Japan, where almost 77% waste is reduced, reused and recycled has developed various policies in this regard.

Germany has also opened the world's most advanced and largest recycling development center which has the reprocessing capacity to recycle everything from daily consumer items to industrial waste. Japan, where almost 77% waste is reduced, reused and recycled has developed various policies in this regard. State of the art technologies have been developed in order to recycle waste.

Austria is the best example among all the countries engaged in recycling its waste where most of its Municipal Solid Waste is treated either through recycling or through incineration. It

⁵ <http://www.bir.org/industry/>

⁶ <https://www.prnewswire.com/news-releases/global-waste-recycling-market-outlook-report-2017-2018-37-6-billion-opportunities-in-plastic-recycling-300650956.html>

China has been importing recycled electronic, plastic, paper and other such materials from the United States and turned them into finished goods.

Materials Recovery Facilities (MRFs) is the most useful one through which waste is converted into usable materials.

implemented strict regulation on waste management including a landfill ban on certain waste types, landfill / incineration tax and a remediation contribution in case of landfilling and incineration.⁷

In case of Vienna, the heat from burning the waste in the incinerator is used to provide heating and hot water to its citizens by channeling it to its central heating system. Furthermore, an Electronic Data Management system has been deployed for waste management for information gathering and to optimize waste management planning.⁸

For very long time, China has been importing recycled electronic, plastic, paper and other such materials from the United States and turning them into finished goods. This means that Pakistan could have developed a profitable industry or could have exported its waste to China by properly segregating and managing its waste.

Recycling Technologies

Globally, various new technologies have been introduced for recycling solid waste. Among these technologies, **Materials Recovery Facilities (MRFs)** is the most useful one through which waste is converted into usable materials. However, with the advancement in waste recycling technology, MRF has successfully evolved into integrated **Mixed Waste Processing Facilities (MWPFs)**. Both technologies help divert waste from landfill sites and recover marketable commodities. However MRFs require solid waste to be segregated before being recycled. While, MWPFs, on the other hand, can extract

⁷ <http://www.assises-dechets.org/IMG/pdf/ItwAustrianMinisterBerlakovich.pdf>

⁸ <https://www.citylab.com/solutions/2017/06/the-viennese-make-peace-with-their-trash/531639/>

recyclable items right through solid waste without requiring segregation at source.

The process of converting solid waste into usable items undergoes several stages after which it is being shipped to the respective industries for adding further value to these items which is later being sold in the markets. These stages include sorting, compressing, baling, storing and then finally shipping to the respective industries for manufacturing into new items.

E-waste Recycling as a Budding Industry

Advancement in technology has surged the production of electronic items for satisfying the unlimited wants of continuously increasing number of customers due to which a large amount of e-wastes emanates each year. E-wastes are also hazardous to the environment and adversely affects the ecological system. The European Union estimates that e-waste will grow every year by 3-5% approximately and according to the Silicon Valley Toxics Coalition and the Basel Action Network, e-waste now constitutes a larger portion of municipal waste than diapers or drink containers.

In 2016, a report on e-waste by the UN's International Telecommunication Union, the International Solid Waste Association revealed an alarming situation faced by the world where 44.7 million tons of e-waste was generated all around the globe. The e-waste also includes the worn out and damaged solar panels which are difficult to recycle.

On the other hand, some of the e-waste continue to remain economically valuable and are subsequently exported to third world countries including Pakistan. In fact, Pakistan is one of the top importer of e-waste products. However, the e-waste

The European Union estimates that e-waste will grow every year by 3-5% approximately.

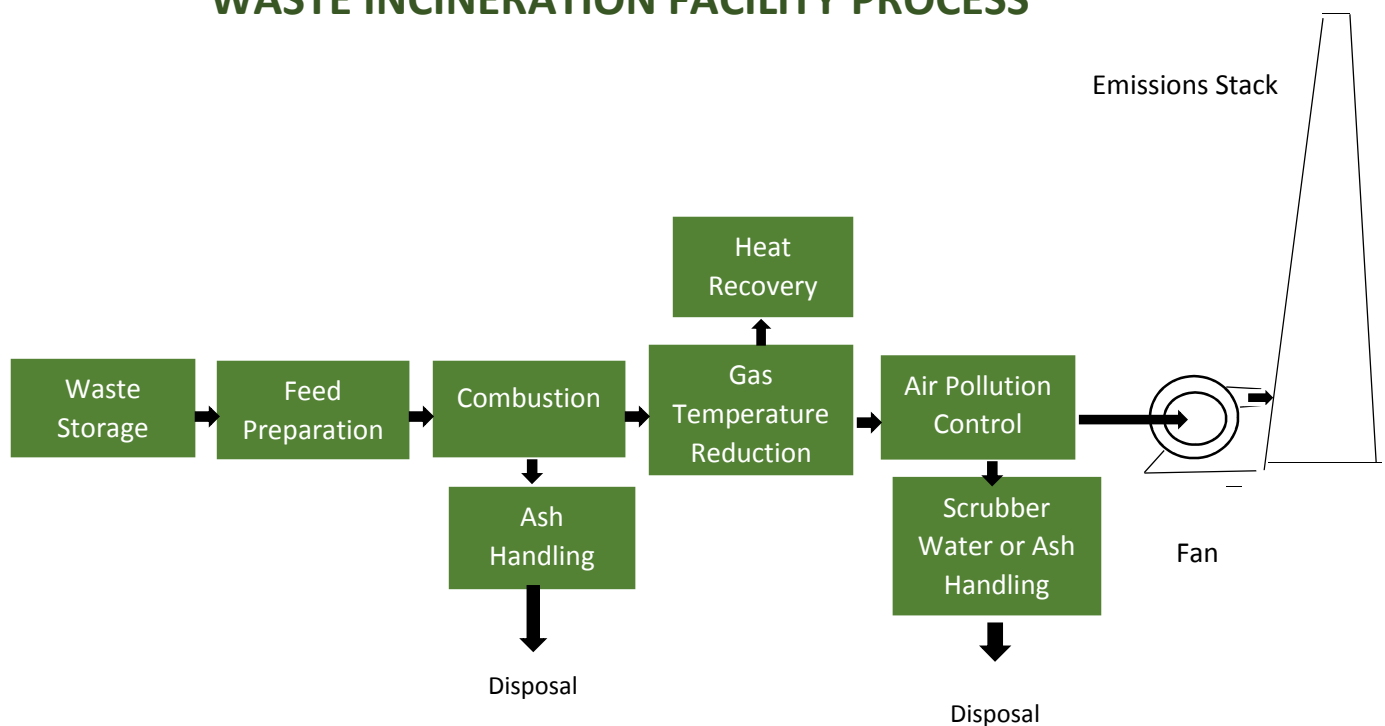
Pakistan is one of the top importer of e-waste products.

management system is still in its nascent state in the country without any formal mechanism to cater to e-waste as a specific category.

Incineration – The Conventional Waste Treatment

Incineration is the conventional waste treatment process under which solid waste is burned within an incinerator on high temperature in the presence of oxygen. It is also called a Thermal Treatment where heat that is generated on high temperature is later on used for creating energy. The process reduces the volume by 60% to 70% and the remaining solid waste is disposed of through land filling. This technique does not dispose of the waste completely and it is a highly debatable technology due to the fact that it raises objections on safe and clean environment.

WASTE INCINERATION FACILITY PROCESS



Source: KCCI Research, www.nap.edu/read/5803

Rising Trend of Home Composting

In Karachi, solid waste comprises of 30% kitchen and food waste which is simply dumped into the sewerage and landfill sites; adding to the city's burden.

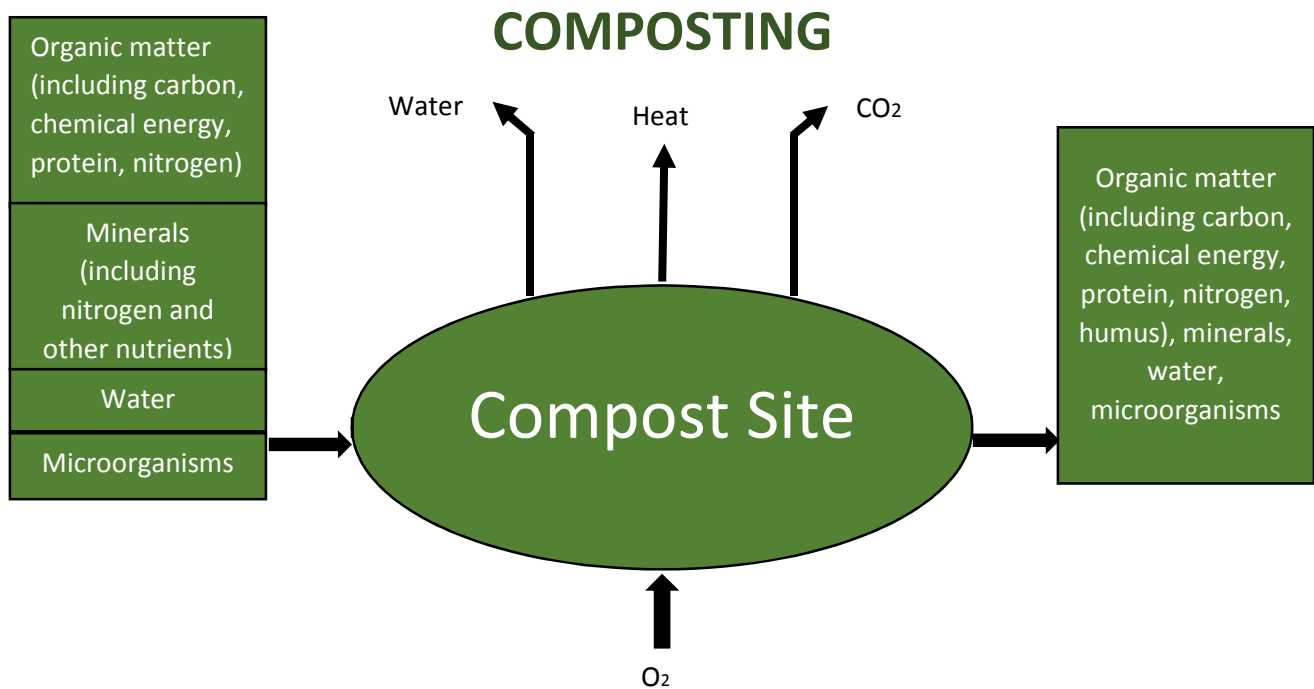
As organic food waste makes the largest portion of solid waste, composting is a natural phenomenon of turning this organic waste into nutrient rich soil. In Karachi, solid waste comprises of 30% kitchen and food waste which is simply dumped into the sewerage and landfill sites; adding to the city's burden. However, if used effectively, composting this organic waste through natural process can greatly help municipal and local governments to undertake environment friendly and practical recycling method.

When solid waste, which is organic in nature, is decomposed by micro-organisms in warm environment, organic fertilizer is formed which reduces the quantum of waste.

Composting not only contributes to effective waste management practices but also generates employment through preparing and selling compost while creating entrepreneurial opportunities for youth in related fields like organic gardening. The recycling of organic waste along with urban agriculture is a good option for making use of organic waste.

The recycling of organic waste along with urban agriculture is the best possible options available for making use of organic waste.

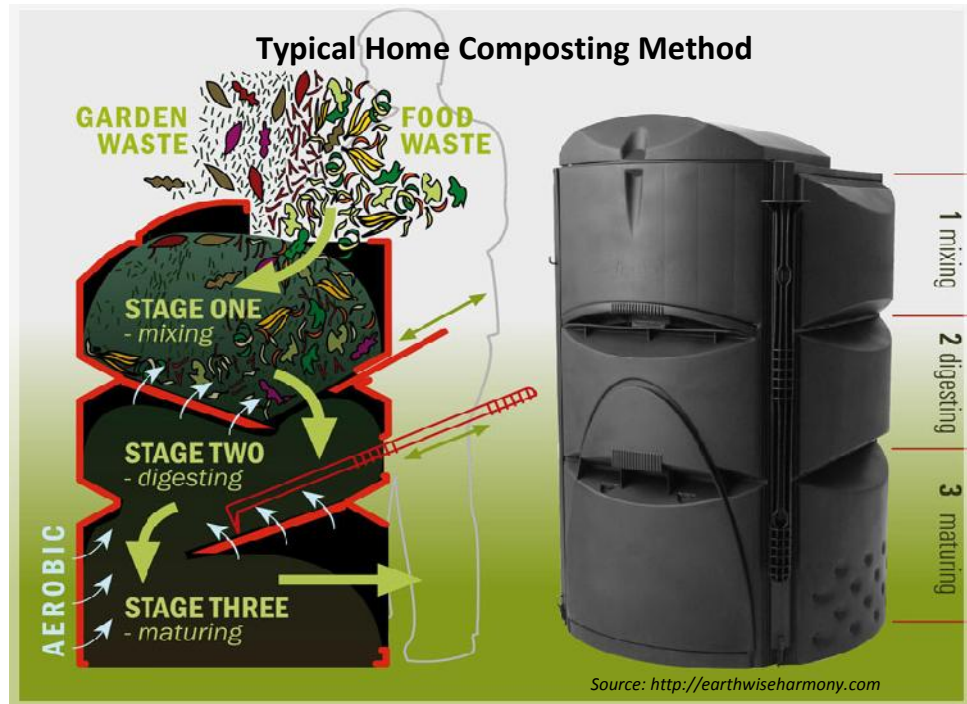
Lately, the concept of having a composting bin at each house is gaining popularity. The composting process involves decomposing organic matter or kitchen waste to nutrient rich fertilizer in the presence of heat, moisture, oxygen, and bacteria. This compost can be directly applied to the gardens or crops to provide nourishment to plants. This type of fertilizer is cost effective and healthier than the chemical fertilizers.



Source: *KCCI Research, climatetechwiki.org*

Typically, there are two types of composters available in the market. One is a simple plastic bin-type container while there are also available electronic composters which are equipped with mixing, heating, and added with bulking agent to accelerate composting reaction rate.

Some governments even have a subsidy system in place to promote the use of composters at each home with the objective to reduce the amount of garbage disposed from each house.



Turning Waste to Energy

Waste to energy is an entire industry would reach around \$ 35.5 billion by the end of 2024.

With each passing year, generation of solid waste is mounting. This rapid growth in waste generation has driven the technological advancements in turning solid waste into energy. Waste to energy is an entire industry would reach around \$ 35.5 billion by the end of 2024⁹.

Number of countries like Germany, Sweden, and Luxembourg are engaged in producing electricity through this alternate means of waste disposal technique.

In view of homogenous solid waste generation on daily basis, National Electric Power Regulatory Authority, in Pakistan has also approved upfront tariff for waste to energy plants at \$ 10 cents which is quite low in comparison to what other regional countries charge for such plants like India which charges

⁹ <http://global-recycling.info/archives/1020>

upfront tariff of \$ 11.5 cents, China charges \$ 12 cents while Turkey has upfront tariff of \$ 13 cents for waste to energy plants.

The SSWM board is also in the process of conducting feasibility study on “Waste to Energy” projects. Such projects have been worked on all over the world due to their technological and economic benefits.

MOVES IMPERATIVE FOR CLEAN KARACHI!

Segregation of waste is the most important step that should be employed in the waste management process of the city.

All these above mentioned waste management methods are only effective when citizens of Karachi start adopting basic cleaning techniques right from their home. The change in Karachi's troublesome situation can also be brought when concerned authorities resume their responsibility actively and address the root cause by using all the suitable options that are in place in the other mega cities of the world. By doing so, not only the health and sanitation problems will be resolved; employment opportunities and revenues would also be created.

Waste Segregation at Source via Colored Waste Boxes

Incentives schemes for at home segregation of garbage can be initiated like offering monthly giveaways to households actively participating in such schemes.

Segregation of waste is the most important step that should be employed in the waste management process of the city. Once it is started, this waste can be effectively used and can become an opportunity for the government to recycle it and/or convert it into energy through various methods. Karachi's electricity demand can be partially fulfilled by generating energy from waste. It can include different colored boxes for specific type of waste.

Incentive Schemes for reducing or Recycling Waste

Incentives schemes for at home segregation of garbage can be initiated like offering monthly giveaways to households actively participating in such schemes. This concept is similar to an old popular scheme of getting new items in exchange of old utensils and used clothes which still exists in the low income areas.

The scavengers can be formally trained, registered and authorized to lift the recyclable material. Likewise, the already available pushcart vendors who buy paper, certain plastics and other used items and sell them at higher rates to industries can be further mobilized to reap greater results.

Garbage pickers from home can also be groomed to manage and segregate the trash themselves offering them some incentive to do so.

Garbage pickers from home can also be groomed to manage and segregate the trash themselves by offering them some incentive to do so. These garbage pickers usually arrive on donkey carts to collect waste from door to door service. Their only objective is to charge money for collecting garbage which is not properly disposed off in most cases and at time either burned or thrown away on any nearest open place. They can be effectively channelized to create awareness among residents and get them to segregate garbage at source.

Minimizing the use of Plastic/Polythene Bags

The plastic bags are used in great abundance which create havoc in the city. Strategies should be developed to minimize the use of plastic bags restricting it to carry liquid items only. The trend of carrying a reusable bag for shopping needs to be instilled by creating public awareness and discouraging use of plastic bags.

Introducing garbage penalties, rules and laws pertaining to rampant consumption of plastic bags.

Introducing Federal legislations for Garbage

Introducing garbage penalties, rules and laws pertaining to restricting rampant consumption of plastic bags are other viable solutions that can help in reducing the problem of waste management. This may include reward schemes on bottle depositing or recycling reusable materials.

Public Awareness Campaigns

A good solid waste management awareness campaign is the first step that is vital for maintaining a healthy environment, as technical solutions are not enough to build and sustain a livable city. Changing the behavior of the society and people is equally important. In this regard, educating people about ways to curb extensive consumption of plastic and disposable products can also make a huge difference.

Campaigns are the best way to engage peers and take necessary representative actions which showcase their efforts on SWM in promoting a clean healthy environment. Such international campaigns like 'Paperless Day campaign' and 'Recycle Day' should be actively organized in Karachi particularly engaging slum areas, different organizations, schools and colleges to raise public awareness about significance of cleanliness and different techniques which could be adopted for a greener and healthier Karachi. Furthermore, a 'recycle' based economy concept will conserve resources and also reduce the adverse effects on environment.

Karachi has many heritage buildings, Museums, sunny beaches and European styled architectural marvels. By cleaning the city in real manner, this hustling bustling city can be transformed into a prominent tourist attraction. A clean healthy environment will improve the productivity of the city and enhance the standard of living of its citizens.

International campaigns are 'Paperless Day campaign' and 'Recycle Day' should be organized particularly engaging slum areas, organizations, schools, and colleges

Disclaimer

This report produced by KCCI Research & Development Department (KCCI Research) contains information from sources believed to be trustworthy; it is not guaranteed that the matter is accurate or complete. This report may not be reproduced, distributed or published by any person for any purpose whatsoever, without the prior written permission/approval of KCCI and/or KCCI Research. It is not intended as professional and/or financial advice nor does any information contained herein constitute a comprehensive or complete statement of the matters discussed or the law relating thereto. The information in this report is not intended as an offer or recommendation to buy, sell or call on any commodity, security, currency, product, service or investment.

Analyst Certification:

The views expressed in this report accurately reflect the personal views of the Analyst(s). The Analyst(s) involved in the preparation of this report certify that (1) the views expressed in this report accurately reflect his/her/their personal views about all of the subject sectors and topics and (2) no part of their compensations were, are or will be directly or indirectly related to the specific recommendations or views expressed in this report.*

The Analyst(s) compile this document based on opinions and judgments, which may vary and be revised at any time without notice. KCCI Research makes no exemplification as to its exactitude or completeness and it should not be relied upon as such. This report is provided only for the information of members of KCCI and business community representatives who are expected to make their own corporate decisions and investment without undue reliance on this report and KCCI Research accepts no responsibility whatsoever for any direct or indirect consequential loss arising from any use of this report or its contents. The views expressed in this document are those of KCCI Research and do not necessarily reflect those of KCCI or its management.

The information contained in any research report does not constitute an offer to sell commodities / securities / currencies or the solicitation of an offer to buy, or recommendation for investment within any jurisdiction. Moreover, none of the research reports is intended as a prospectus within the meaning of the applicable laws of any jurisdiction and none of the research reports is directed to any person in any country in which the distribution of such research report is unlawful. The information and opinions in each research report constitute a judgment as at the date indicated and are subject to change without notice. The information may therefore not be accurate or current. The information and opinions contained in research reports have been compiled or arrived at from sources believed to be reliable in good faith, but no representation or warranty, express or implied, is made by KCCI as to their accuracy, completeness or correctness and KCCI also does not warrant that the information is up to date. Moreover, the reader should be aware of the fact that investments in commodities, currencies, undertakings, securities or other financial instruments involve risks. Past results do not guarantee future performance.

*** Analysts:** Uzma Taslim – Director, Shehzad Mubashsher – Deputy Director, Wajeeha Mehtab – Research Analyst, Asad Bilal Sheikh – Research Analyst, Natiq Nizar – Research Database Officer