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# Review And Analysis of Existing Solid Waste Management System in Lahore

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## ABSTRACT

The continued increase in urbanization & industrialization has resulted in increased solid waste generation in Pakistan, impacting environment conservation, public health & aesthetic beauty. In this review paper, an effort is made to evaluate the Municipal Solid Waste (MSW) generation, storage, collection, transfer & transport, processing & recovery & landfill sites, in Lahore. The study concludes with identifying issues in the existing solid waste management system of Lahore along with recommendations.

## 1.0 Introduction

As the rates of industrialization & urbanization increase, consumption patterns change along with the wide range of products become available on market then this causes the increase in the average amount of municipal solid waste generated per person. Every year across the globe more than two billion tonnes of municipal solid waste (MSW) is generated. If packed into standard shipping containers and placed end-to-end, this waste would wrap around the Earth's equator 25 times, or further than traveling to the moon and back (UNEP, 2024). A significant amount of money is dedicated to managing huge volume of solid waste. The considerable

amount flow varies with income levels. In low -income countries waste management consumes ~20% of municipal budgets which is equivalent to $35/tonne, where in high-income countries it is equivalent to $100/tonne (Bank, 2022). Such figures indicate that the solid waste management has turned into gigantic & intricate & an expensive service.

Solid Waste Management is not just a technical issue, but also involves legal, environmental, socio-cultural, political and economic factors as well as the readiness of the resources. Furthermore, these factors possess the interrelationships which are challenging in solid waste management system (V. Kum & Harnpornchai, 2005). Therefore, it is necessary to adopt an integrated approach which aligns technical problems and other factors as well. Effective solid waste management (SWM) demands not jus a proper infrastructure but also involves the policy enforcement, public awareness & stakeholder association to clinch the sustainable outcomes (Carlos Afonso Teixeira, 2024).

Developing countries encounter many challenges, and mismanagement of Solid Waste Management (SWM) contributes to low collection efficiency and, consequently, environmental degradation impacts public health & aesthetics (Asif Iqbal, Abdul Sattar Nizami, & Sharif, 2022). Pakistan comes under the heading of developing countries with a rank of 5th largest country in the world. Pakistan produces 49.6 million tons of solid waste annually. On the daily basis, 60% of solid waste is collected whereas 40% remains in open drains, street corners, abandoned buildings, empty plots, and nullahs (Muhammad Fazal, 2024). Additionally, most of the collected solid waste in Pakistan is either dumped or burned within or outside the municipal limits (Bank, Pakistan: Sustainable Solid Waste Management in Mountain Areas, 2021).

Lahore is one of the largest cities of the Pakistan with population estimated at 14,407,100 & growth rate currently is 3.06% (Review, 2024).Lahore produces nearly 2.4 million tonnes of solid waste per year. It has 330 dumps which are spread across 52 hectares. (Bank, Pakistan: Sustainable Solid Waste Management in Mountain Areas, 2021). This paper analysis the solid waste management system from waste generation to disposal, in Lahore & identifying the issues as well as recommendations of suitable solution.

## 1.1 Waste Generation

Waste generation is the first functional element of solid waste management which involves both the quantities & qualities of the waste. Determining waste generation rate is essential for the development of solid waste management plan for any city (Prof.Shaukat Hayat, 2016). In

Lahore, waste generation rate is calculated as 0.54 kg/person/day based on historical data on tonnage collected by Lahore Waste Management Company (LWMC) from 2011 to 2022. Waste generation rate in Lahore is affected by several factors such as population, climate change & lifestyles as well as income levels. Composition of solid waste over the period is depicted in the Table 1. (Asif Iqbal e. a., 2023).

**Table 1**. Composition of solid waste over the period

| Components | 2011 Winter | 2011 Summer | 2012 Summer | 2014 Summer | 2014 Autumn | 2019 Autumn | 2022 Winter | Avg. % |
|---|---|---|---|---|---|---|---|---|
| Combustibles | 3.83 | 3.69 | 2.12 | 3.52 | 6.05 | 4.97 | 3.09 | 3.90 |
| Diaper | 5.35 | 6.76 | 3.11 | 2.88 | 5.06 | 5.42 | 15.78 | 6.34 |
| Elec.-electro. | 0.05 | 0.02 | 0.25 | 0.04 | 0.03 | 0.12 | 0.02 | 0.08 |
| Glass | 0.43 | 0.85 | 0.77 | 0.74 | 0.69 | 1.13 | 0.82 | 0.78 |
| Hazardous | 0.18 | 0.91 | 1.52 | 2.14 | 1.33 | 0.05 | 0.11 | 0.89 |
| Biodegradable | 72.76 | 63.46 | 64.85 | 66.49 | 56.32 | 50.95 | 54.32 | 61.31 |
| Metals | 0.04 | 0.04 | 0.13 | 0.08 | 0.06 | 0.23 | 0.06 | 0.09 |
| Non-Combust. | 3.42 | 1.82 | 2.26 | 5.39 | 6.4 | 14.57 | 7.63 | 5.93 |
| Paper-card. | 2.34 | 3.84 | 2.43 | 1.67 | 2.18 | 3.87 | 1.38 | 2.53 |
| PET | 0.08 | 0.18 | 0.17 | 0.15 | 0.09 | 0.88 | 0.04 | 0.23 |
| Nylon | 5.58 | 9.77 | 11.62 | 9.76 | 10.92 | 10.85 | 9.41 | 9.70 |
| Plastics | 0.45 | 0.66 | 0.72 | 0.59 | 0.63 | 1.44 | 0.68 | 0.74 |
| Tetrapak | 0.77 | 0.94 | 0.98 | 1.14 | 1.02 | 1.26 | 0.64 | 0.96 |
| Textile | 4.71 | 7.05 | 9.09 | 5.42 | 9.21 | 4.26 | 6.02 | 6.54 |
| TOTAL | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

## 1.2 Waste Storage

Waste storage refers to the temporary retaining of waste items. Solid waste materials are stored in an organized & well-planned storage system until collected to avoid contamination & clinch safety (Andales, 2024). For the solid waste storage in Lahore, containers of several sizes are

*Figure 1 View of 5 m3container that is being lifted mechanically by Mazda arm roll.*

placed such as sized 5m^3 & 10m^3. Storage containers have different capacity values. Capacity values vary from 3 tons for 5m^3 (Figure 1) to 6 tons for 10m^3. The Solid Waste Management Department has positioned 698 skips of 2.5$m^3$ (Syeda Adila Batool, 2009). About 8000 waste storage containers sized 0.8m placed in the city to store the waste (Asif Iqbal e. a., 2023). Additionally, to prevent waste disposal inside drains by public, about 500 waste drums have been installed along six primary drains of waste in the city ((LWMC), 2024).


*Figure 2 View of skip*

## 1.3 Waste Collection System

Well developed waste collection system ensures environmental quality, public health & safety. This functional element of solid waste is responsible for about three-quarters of solid waste management. Waste collection is made by both formal & informal sectors in Lahore. The collection of waste is done in two modes such as primary collection & secondary collection. Primary collection involves the door-to-door collection. Door to Door collection is one of the important activities of the contract with Turkish companies. Ozpak and Albayrak in their respective areas carry out the door-to-door waste collection. Wheeled ploughs & donkey carts are most used to collect waste by an informal waste collector. Informal waste collectors for their service are paid by households & municipalities themselves. Such combination of formal & informal collection produces about 68% collection rate for the city (Dr. Saima Shafique, 2022).

Turkish companies on contract manages the door-to-door collection of waste. Residents are provided with shopping bags to put the waste into these bags. As soon as bags get filled, residents put the bags outside of the house on announced time & then these bags are collected by workers in handcarts to dump it into the waste storage area or communal containers.

Additionally, during secondary collection waste is transported to dumpsite through he several types of vehicles. Waste transportation to dumpsite in two shifts is carried out. Two trips are made by the compactor to collect the waste from a specific area in 1st shift (06:00 am to 02:00 pm). One trip to a specific union council is managed by one compactor, in 2nd shift. For the collection of vehicles Albayrak utilizes different vehicle types and capacity. These vehicles include arms roll, $8m^3$ and $5m^3$ compactors, tractor trolley and dumpers. Owing to the narrow roads, sometimes space for vehicle routing is also considered (Usman Ashraf, 2016).

## 1.4 Waste Transfer & Transport

Transfer and transport refer to the tools, services and accessories used to impact the transfer of waste from one location to another (usually to large distant location) (Municipal Solid Waste Engineering Principles & Management (2nd Edition), 2016).

According to Texas administration code (TAC), transfer station is defined as "a facility used for transferring solid waste from collection vehicles to long-haul vehicles (one transportation unit to another transportation unit)." A transfer station may involve operations to recover recyclable materials from the waste stream (Quality, 2024). In Lahore, incomplete data is available regarding the number of total transfer stations. Only two transfer stations found while having literature review. Valencia town transfer station which covers an area of about 15 kanal and 1,000 tons of waste on the daily basis is managed by this station whereas Saghian bridge transfer station comprising of an area of 10 kanal and is equipped to manage 1,400 tons of waste everyday. It is serving its operational practices in forty-six union councils of Lahore. (Sana Hafeez1 & Shahid Sher, 2020). Additionally, in Lahore open transfer station is built near river Ravi and residential areas which is creating air and land pollution. Such transfer statin goes against USEPA (Anam Maqsooda & Zafarb, 2021). At these transfer stations different activities are carried out such as Transportation activities, sorting, loading and unloading of waste material. Workshop activities for maintaining vehicles. In the absence of electricity generator works. Household solid waste, organic waste, cow dung, metal and glass waste, demolition debris are the different types of wastes hold by these transfer stations. (Sana Hafeez & Zaheer Ahmad Nasir, 2021).

## 1.4 Processing

Processing is carried out to serve the three purpose such as to improve the efficiency of solid waste collection, recovery of materials which possess potential market value or reusing & combusting the several components to obtain the energy through number of ways (Municipal Solid Waste Engineering Principles & Management (2nd Edition), 2016). Currently Lahore has one of the largest composting facilities in Pakistan. The Lahore Compost (Private) limited is utilizing the municipal solid waste collected & transported to Mehmood Booti dumpsite & operating the compost plant. It has potential of processing 300 tonnes of waste per day converting it into compost & is operational since 2006. The compost at this plant reaches at its stable state in around 60-70 days (Bank, Environmental And Social Impact Assessment (Esia) And Environmental Management Plan (Emp) For The Composting Plant Of The Lahore

Compost Ltd., 2008). The windrow composing technology is being utilized. Aerobic composting plant installed by Menart Company (Belgium) purchased by Lahore composting limited & is now being operated by LCL (Shahid Raza, 2017).

Additionally, gas flaring project was launched by Lahore Waste Management Company at the closed Mehmood Booti dumpsite in 2018 when the site reached at its dumping capacity (International, 2018). The dumpsite emits a significant amount of methane & other gases. Global warming potential of methane gas is 56 times higher than carbon dioxide for 20 years whereas 21 times for 100 years. Every 24 hours, the installed gas vents releases 1cubic meter gas, equivalent to eight kg carbon dioxide per day & 2,920 kg per year. Such project protects environment same as done by 138 trees in one year (Reporter, 2018).

Furthermore, to promote sustainability & promote waste utilization Lahore Waste Management Company in 2011 signed an agreement with the DG Khan cement for sale of waste. D G Khan cement has established a Refuse Derived Fuel (RDF) plant for processing of 1000 tons of municipal waste. Refuse derived fuel consist of the municipal solid waste components which are combustible such as plastics & biodegradable waste. By blending RDF with coal as a substitute fuel source, DG Khan Cement uses it in its cement plants. This initiative is contributing towards sustainable energy use & reduction in solid waste volume dumped (Development, 2016).

Lahore is contributing only 20% in waste processing & recovery either through formal or informal, whereas huge amount of solid waste is being dumped at several established dumping sites.

## 1.5 Disposal/Landfill

The materials which are rejected from composting & material recovery facility are then disposed because these cannot be recycled. This is the final disposal of solid waste & is achieved in two ways such as open dumping & sanitary landfills (Municipal Solid Waste Engineering Principles & Management (2nd Edition), 2016).

In Lahore, there are number of open dumping lots with certain number of major landfill sites such as Mehmood Booti, Saggian, Baggrian & Lakhodair landfills.

The Mahmood Booti Landfill is located north of Bund Road, about 5 km away from River Ravi. This is the major site which contains Lahore Compost Plant on about 15 hectares. This site receives solid waste from the Shalimar Town, Aziz Bhatti Town, Data Town and a part of

Gulberg Town area. The site received solid waste since 1995 & currently the site is not operational & is closed. Saggian is the largest dumping site in the city comprising of an area of 81 hectares. Every day more than 1800 to 2200 tons of waste is hauled to this site. This site covers towns of Ravi, Samanabad, Data GunjBux and Gulberg. The small site named as Baggrian Landfill is in Nishtar consisting of only 5 acres with a 30m depression. About 300-350 tons of waste is disposed daily at this site from the towns of Gulberg, Allama Iqbal & Nishtar (Tang Zhonghua, 2013).

First ever Sanitary Landfill Site in Pakistan started in 2013 with its actual completion on 15th May 2015. The site receives 5000 tonnes of solid waste & its remaining life is going to end in two years. This site comprises of over 200 acres including 70 acres sanitary landfill (Hasnain, 2024).

## 2.0 Problems in Existing Solid Waste Management in Lahore

- Increased Waste Generation without Long-term Planning
- Insufficient Public Infrastructure and Facilities
- Lack of Waste Segregation at Source
- Reliance on informal sector which contribute to irregular waste collection
- Inadequate Waste Processing Infrastructure
- Limited Number of Waste Transfer Stations
- Overburdened and Near-capacity Landfills
- Limited Use of Advanced Waste Processing Technology
- Uncontrolled Methane Emissions from Dumpsites
- Inadequate Use of Data and Technology
- Inadequate Disposal of Hazardous Waste
- Unenforced Waste Management Regulations
- Limited Public Awareness and Participation

## 3.0 Recommendations

- Implement a Pay-As-You-Throw (PAYT) System
- Formalize the Informal Waste Sector
- Implement Waste Segregation at Source
- Optimize Waste Collection Routes
- Expand Waste Collection Frequency

- Develop Additional Transfer Stations
- Regularly Monitor and Maintain Transfer Stations
- Develop Hazardous Waste Handling Systems
- Promote Composting for Organic Waste
- Encourage Recycling through Incentive Programs
- Enhance Public-Private Partnerships (PPPs) to sufficient levels
- Utilize Methane for Energy Production
- Increase Landfill Capacity
- Increase Public Awareness and Education
- Strengthen Waste Management Regulations
- Establish a Comprehensive Waste Data System

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