



Field survey of existing garbage management system and their feasibility used for Jaipur municipal corporation

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Abstract: This research paper focuses on the assessment of the existing state of the garbage management system (GMS) in Jaipur city, with the objective of identifying the main challenges to its efficiency and exploring prospects for improvement. Jaipur, like many other cities, is grappling with inadequate garbage management, resulting in large heaps of garbage accumulating on open lands, around buildings, and in marketplaces. The study examines the impact of rapid population growth due to uncontrolled and unplanned urbanization, which has exacerbated the problem of GMS in Jaipur, Rajasthan. The findings reveal that designated and non-designated dumping sites on major streets and open spaces are often neglected, leading to rubbish heaps encroaching on roads, causing air and water pollution, and creating a significant nuisance. Moreover, the composition of waste in the city is diverse, comprising both biodegradable and non-biodegradable materials such as e-wastes, plastics, polythene, pathological wastes, and hair designer's waste, among others. The lack of a proper mechanism for waste treatment in Jaipur results in the dumping of waste in open areas, posing environmental hazards to both the ecosystem and the residents. This case study highlights the obstacles and prospects for effective garbage management in Jaipur and emphasizes the urgent need for comprehensive solutions to address this global concern.

Keywords: Garbage management system, waste treatment, challenges, environmental Pollution, uncontrolled urbanization,

1. Introduction

Garbage management is a pressing issue in Jaipur, a fast-urbanizing city in India. Large heaps of solid waste are scattered across open lands, buildings, and marketplaces, becoming an accepted part of daily life for the city's residents [1-7]. The generation of solid waste stems from domestic, commercial, and industrial activities, with agricultural and commercial waste being carelessly discarded. The low-income population, unable to afford waste management services, contributes to the problem by indiscriminately disposing of their waste. The lack of proper dustbin facilities and distant disposal sites further exacerbates the issue [8-10].

The agencies responsible for waste management in Jaipur face numerous challenges, including inadequate waste data, insufficient equipment, and poor public attitudes. As a result, solid waste accumulates, leading residents to pile it up on roads and set it on fire, causing pollution. Improperly dumped waste finds its way into drainage systems and water streams, resulting in severe environmental pollution. To address these problems, salient issues in

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the solid waste management sector must be addressed, ultimately improving the city's environmental conditions and the well-being of its inhabitants [11-13].

Jaipur, like many other Indian cities, is experiencing rapid development, leading to an exponential increase in waste generation. Waste minimization, including source reduction, recycling, and reuse, is crucial for effective waste management. Various factors, such as source reduction, onsite storage, collection and transfer, processing, and disposal, need to be considered in order to execute proper waste management. Municipal garbage (MG), which includes household and commercial waste, poses a significant challenge due to its diverse nature. However, effective management of MG sets a foundation for managing other types of solid waste [14-15].

Jaipur generates approximately 1150 metric tons of solid waste daily, with an 80% lifting efficiency. The per capita solid waste generation is around 450 grams, resulting in 1.75 kilograms per day for a family of five. Although specific data on waste composition in Jaipur is unavailable, the overall composition in India consists of approximately 50% biodegradable waste, 25% inert waste, 9% plastic, 8% paper, 4% scraps, and 1% glass. The composition may vary depending on the season, with more biodegradable waste during summer due to increased vegetation. Recent bans on plastic bags in Rajasthan may have influenced a decrease in the composition of plastic waste [16-17].

Table 1: Municipal garbage generation in different zones in Jaipur City

S. No.	Name of zone	Ward number	Municipal garbage (MT)
Jaipur Municipal Corporation Heritage (100 Wards)			
1	Amer	1 to 4	84,066.26
2	Hawa Mahal	5 to 30	1849,457.61
3	Civil Lines	31 to 54	1597,258.85
4	Kishanpole	55 to 75	1345060.08
5	Adarsh Nagar	75 to 100	1765391.36
Jaipur Municipal Corporation Greater (150 Wards)			
1	Vidhyadhar Nagar	1 to 42	31100451.44
2	Jhotwara	43 to 64	1429126.34
3	Sanganer	65 to 103	2858252.67

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4	Bagru	104 to 124	1325163,03
5	Malviya Nagar	125 to 150	1752472.25

This research paper focuses on the Municipal garbage management (MGM) practices in Jaipur, Rajasthan, India. It highlights the challenges associated with MGM management, including poor collection, transportation, and treatment practices, resulting in negative impacts on public health, the environment, and climate change. The paper reviews the existing MGM management strategies in Jaipur and emphasizes the need for improvement. Key challenges identified include uncontrolled landfilling, lack of public participation, and inadequate implementation of MGM legislation and waste conversion techniques. The paper provides recommendations such as public awareness campaigns, public-private partnerships, investment in lined landfills, and adoption of recycling and waste-to-energy technologies. It suggests the use of optimization models and life cycle assessment tools to minimize costs and environmental impact. The study aims to assist policymakers and private sector stakeholders in developing effective strategies for future planning, investment, and execution of improved MGM management in Indian cities. The objective of this study is to gain a comprehensive understanding of the city's garbage management practices. However, it is worth noting that open dumping practices are still common in many Indian cities, leading to environmental pollution and public health concerns.

2. Methodology

Sources of garbage

Household waste, hotels, commercials waste, horticulture, clinics and dispensaries waste, sludges, construction and demolition waste

Garbage management in Jaipur

In 2007-2008, the Central Pollution Control Board conducted a study on the state of municipal garbage collection, treatment, and disposal in and around Jaipur City. The study revealed that a significant portion of the city's population did not store waste at the source but instead disposed of it in garbage bins, on roads, in open spaces, and even in drainage pipes.

The practice of isolating recyclable waste was also not common, resulting in recyclable materials being mixed with regular waste. Consequently, the streets, garbage bins, and dumping zones were often filled with a combination of recyclable waste and general rubbish, with only a portion of it being picked up by street sweepers [6, 7, 18].

While there was a door-to-door waste collection system in place, it suffered from poor management and irregularities. Over the past few decades, Jaipur has experienced a significant increase in garbage production. The daily predicted generation of municipal garbage in Jaipur is estimated to be between 1050 to 1150 tonnes per day (TPD). Currently, approximately 900 TPD, or about 85% of the waste generated, is collected through street sweepers and the door-to-door collection system using vehicles. The remaining solid waste is transported through special drives that occur on a weekly basis [6, 19].

The primary system for waste collection in Jaipur relies on street sweeping and door-to-door collection. There are approximately 6700 street sweepers in the city responsible for cleaning the streets. While some roads are cleaned daily, others are cleaned periodically, either twice a week or once a week. The transportation of waste is carried out using various vehicles such as three-wheelers, tractors, and trucks. These vehicles are loaded manually with the help of laborers and operate for 2-3 shifts per day. Insufficient numbers of transport vehicles are also a significant concern [20-22]. Furthermore, the transportation system is not synchronized with the primary collection system and waste storage facilities, creating further challenges. The existing municipal garbage management system (MGMS) is shown in figure 1.

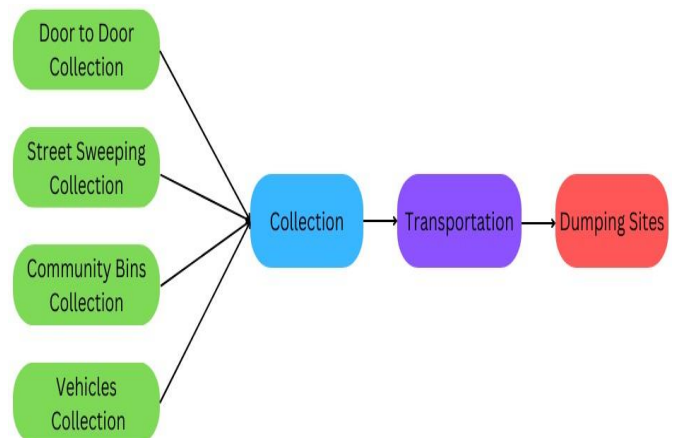


Figure 1: MGMS in Jaipur

Status of GM in Jaipur city

During the study, it was evident that there was a lack of community garbage collection facilities in slums, resulting in slum dwellers dumping their garbage near their living areas. The refuse bins in the old Jaipur area were in a deplorable state, being dirty and overflowing. As a result, people often resorted to throwing garbage outside the bins. This led to the inconvenience of having large amounts of garbage on the streets, which had to be sorted by sweepers or attracted stray animals, creating an unsightly and unpleasant scene [6].

In the mornings, thick black smoke could be observed over significant areas of the roads due to the burning of fallen leaves, plastics, and other waste materials. Indiscriminate dumping of garbage had resulted in the blockage of many drains along the roads, as well as main sewer lines near locations such as Mother Dairy, Bais Godam, Durgapura, and Pratapnagar etc [7].

The common method of garbage transportation in Jaipur involved the use of commercial trucks, both with and without hydraulic systems, with a carrying capacity of 3.5 to 8.0 tons of waste at a time. Manual labor was employed to lift and throw the garbage from roadside bins into these trucks. Additionally, tractors, dumper placers, and mobile compactors were also utilized to transport waste to the dumping site. The Jaipur Municipal Corporation (JMC) possessed one mechanized sweeping machine, which was primarily used on highways and in traffic-congested areas to pick up garbage from hard-to-reach places [6,7]. Garbage generation rate from the year 2000 to 2022 in Jaipur is shown in figure 2.

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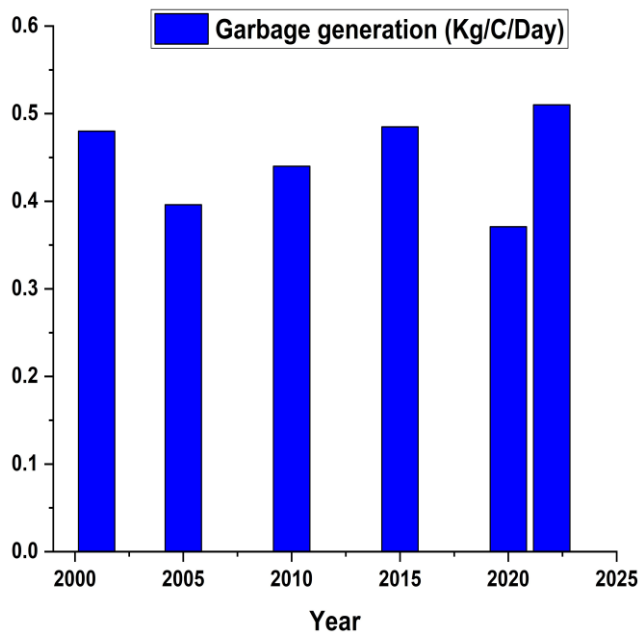


Figure 2: Garbage generation rate in Jaipur city

Quantities of garbage generated and its characteristics in Jaipur city

- Waste Quantity- 1050 to 1150 TPD
- Waste Generation Rate-0.51 kg/c/day
- Compostables-45.50%
- Recyclables-12.10 %
- Moisture Present-23%

Disposal sites in Jaipur

The landfill sites in the Jaipur city are shown in the figure 3. There are mostly three sites as given below [6,7, 12]:

Mathura Das Pura: This site is located in the east of the city. Total area for the site was 176 Bighas. This site is the old most site and is about 17 Km from the main city. Approximately 300-400 TPD of garbage is being dumped every day at this site.

Langariyawas: This site is located in the east direction of the city, 3-4 Km from the Mathura-Das-Pura. The area of this landfill site is 483 bigha.

Sewapura: This site is located at a distance of 20 Km from the main city on Jaipur-Delhi highway. Its total area is 200 bigha. Approximately, 200-300 TPD of garbage was being gone every day to this site.



Figure 3: The landfill sites in Jaipur city [1,11,12].

3. System Implementation

The management of solid waste in Jaipur is handled by the Jaipur Municipal Corporation (JMC). Sweepers play a crucial role in this process by collecting waste and bringing it to municipal bins. Typically, two to three sweepers are assigned to one container. To improve waste disposal infrastructure, the JMC has purchased around 800 waste disposal bins to be distributed throughout the city [2].

In theory, these waste disposal bins, with a storage capacity of half a ton of waste, are placed every 250 meters along the streets, ensuring easy access for residents. Currently, 55 out of the 77 wards have containers installed. However, the wards in the Old City area remain non-containerized, likely due to past objections, potentially related to space constraints. Unfortunately, the condition of many of the containers currently in use is quite poor, with large holes that result in waste spilling out from the sides. For example, in Civil Lines alone, approximately 40 bins are reported to have such issues, according to a permanent garbage worker assigned to that area [1,7].

In the morning, around 7:30 AM, JMC lorries arrive in locations such as Civil Lines to remove the waste. These lorries can accommodate two large bins of 2.5 to 3.5 cubic meters each. The bins are mechanically hoisted onto the back of the lorry, and in their place, empty bins are left for further use. In other areas, like along JLN Marg, residents dispose of their waste in community bins shared by around 20 to 25 homes. A municipal van visits these areas daily to collect the waste from these community bins. The Current practice and recommendation for Jaipur municipal corporation is shown in figure 4.

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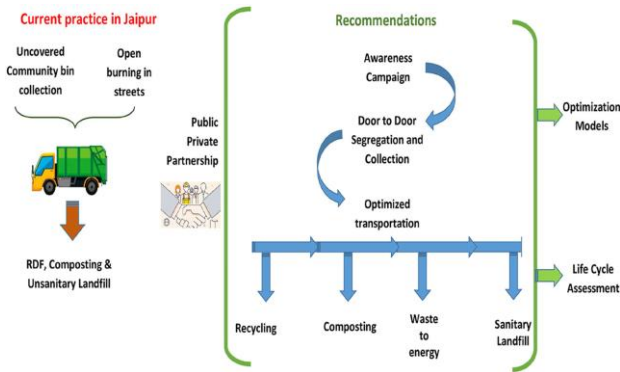


Figure 4: Current practice and recommendation for Jaipur municipal corporation [1]

4. Issues in Waste Management in Jaipur

At the workplace, there is a notable absenteeism rate of 10-20%. In some cases, instead of showing up for work, employees may send someone else to take their place. This results in a significant number of days off, approximately 100 days a year, including Sundays, where formal sector workers do not collect garbage, leading to accumulation on the streets. However, the percentage of Jaipur's budget spent on staff salaries seems disproportionately high. This could be attributed to the practice of hiring more employees each year without adequately increasing their workload, resulting in more people covering the same amount of work [7, 15].

The C/N (Carbon to Nitrogen) ratio of the waste ranges from 20 to 30, while the calorific value ranges between 800-1000 Kcal/kg. In cities, compostable materials constitute a major fraction of 40-60%, while inert materials make up 30-50% of the waste. The organic fraction tends to increase as one moves from rural to urban areas. However, the percentage of recyclable waste is quite low since these materials are often collected by street sweepers directly from households [1, 6].

In India, the prevalent methods for the treatment and disposal of municipal solid waste (MSW) include landfilling, composting, and a limited number of waste-to-energy initiatives such as incineration, refuse-derived fuel (RDF), and biomethane. Unfortunately, Jaipur faces a similar situation where open, uncontrolled, and poorly managed landfills are common for waste disposal.

5. Results and Discussion

Shortcomings have been identified in the implementation of new waste management methods in all selected wards. The adoption of door-to-door collection in one ward has led to effective waste collection, waste reduction, elimination of foul odors, and improved aesthetics of dustbins. However, in commercial areas where community bins are absent, traders often dump waste in the streets, particularly during odd hours. Some waste heaps were observed on roadsides throughout the city.

While all trucks used for waste transportation have meshes to prevent littering, 30% of the trucks only have partial polythene covers, and 25% have no polythene covers at all. This results in the scattering of waste and foul odors during transport. The recycling process is mainly carried out by informal sector workers, who exhibit high efficiency in recovering recyclable waste. However, there are no other prominent methods implemented for the overall disposal of waste.

Significant amounts of waste, including organic waste from markets, are generated in the wards. Unfortunately, this waste is disposed of in the Mathuradaspora dump yard, which leads to foul odors, waste scattering, leachate formation, air pollution from burning, and methane emissions from decomposing organic waste.

6. Conclusions

This study aimed to assess the solid waste management system in Jaipur, focusing on implementation, successes, challenges, and public-private partnerships. The formal sector performs well, but improvements are needed in law enforcement, corruption reduction, technology, staff training, manpower, education, and funding. With a growing population and economy, proper waste collection, segregation, processing, and disposal are crucial. Key challenges include inadequate waste segregation, limited community bins, lack of transfer stations, and insufficient polythene covering on trucks. The informal sector plays a significant role in recycling, but more attention is needed for waste processing and disposal. Priority areas include establishing sanitary landfills, increasing waste processing plants, improving waste segregation, training workers, and raising public awareness. Challenges include

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unregulated landfilling, weak waste management enforcement, and limited public involvement. Composting and unsanitary landfilling are common due to poor waste segregation and inefficient conversion facilities.

7. Suggestions

Key Conclusions and Recommendations for MGM system in Jaipur:

Improving Collection Mechanism:

- Waste should be collected at pre-informed timings with announcements to residents.
- Different bins for different types of waste should be provided for effective waste segregation.

Improving Storage of Solid Waste:

- Design transfer stations for direct transfer of waste into large vehicles or containers.
- Consider the quantity of waste and types of vehicles used for primary and secondary waste in designing storage facilities.

Improving Transportation of Solid Waste:

- Ensure transport vehicles are covered to comply with regulations.
- Centralize or decentralize transport services, coordinating with secondary waste storage to minimize manual handling.

Improving Disposal of Solid Waste:

- Treat organic waste through methods like composting, anaerobic digestion, or incineration to reduce environmental impact.
- Emphasize recycling as the primary treatment method for inorganic waste.

Disposal in Landfills:

- Development authorities should identify landfill sites and hand them over to the municipal authority.
- Select landfill sites near waste processing facilities and ensure they can accommodate waste for 20 to 25 years.

Collaboration and Stakeholder Engagement:

- Encourage collaboration between municipality, private sector, public sector, and informal sector to maximize material and energy recovery from MSW.

- Raise awareness among local communities for waste segregation processes.

Technological and Environmental Considerations:

- Develop recycling plants, feasible waste-to-energy technologies, and scientific landfills that comply with environmental standards.
- Apply mathematical or optimization models to optimize resource utilization and minimize management facilities, time, and expenditure.
- Conduct Life Cycle Assessment (LCA) studies to identify environmentally favorable MSWM scenarios and prioritize technology or treatment processes with the least impact.
- Conduct further research on economic and environmental benefits of recycling and energy generation facilities in Jaipur.

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