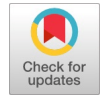


# Achieving Sustainable Development in Kanpur City through Efficient Planning and Management of Solid Waste



Arti Vishnoi, Akanksha Dwivedi

**Abstract:** This paper explores the current situation, challenges, and planning implications of municipal solid waste (MSWM) management in Kanpur City, with a focus on sustainable development. Based on up-to-date municipal reports, Central Pollution Control Board data, scholarly research and local news, the study combines hard data (population, daily waste) with soft data (institutional capacity, informal sector, technology and landfilling practices). Rapid urbanisation, population growth, and changes in consumption patterns have led to a significant increase in solid waste production in Kanpur, posing serious environmental, social, and public health problems. Poor waste collection, improper disposal practices, open dumping, and limited public awareness have negatively impacted the city's sustainable urban development. This article examines the contributions of effective planning and scientific solid waste management to sustainable development in Kanpur City. Waste segregation at source, recycling, composting, community participation, technological integration, and efficient municipal governance are key to reducing environmental degradation and improving urban living conditions. Further, the study highlights the need for policy implementation, public-private partnerships, and environmental education to reinforce waste management systems. By adopting sustainable practices through integrated planning strategies, Kanpur can convert waste from an environmental burden into a valuable resource, thereby contributing to the conservation of ecological balance, economic efficiency, and social well-being for the present and future generations. The paper finds essential planning deficiencies and argues for an integrated, decentralized approach with focus on source separation, reclaiming of materials, decentralized composting, sanitary landfill cleanup and governance changes to make Kanpur's MSWM compatible with the national SWM Rules and the sustainable development principles.

**Keywords:** Municipal Solid Waste, Sustainable Development Goals, Source Segregation, Decentralised Composting, Urban Governance, Landfill Remediation.

**Nomenclature:**

CPCB: Central Pollution Control Board

MSW: Municipal Solid Waste

ISWM: Integrated Solid Waste Management

## I. INTRODUCTION

Rapid urban expansion puts pressure on some Indian

cities to handle municipal solid waste sustainably. Kanpur — a commercial and industrial centre on the Ganges in Uttar Pradesh — is illustrated by this dilemma. With a growing urban population and industrial waste streams (chiefly from tanneries), combined with inadequate municipal treatment facilities, untreated waste has been reported at high levels, causing environmental destruction and public health hazards. It has been estimated that Kanpur's urban population is well in the multi-million range (local city figures usually show urban area estimates above 3 million), a demographic reality that is the source of much of their municipal waste and services. This paper's objectives are twofold: to provide a focused, fact-based analysis of Kanpur's MSW landscape; and to suggest methods for planning and development toward sustainability, circularity in waste management and enhanced environmental and social performance. As per the World Population Review (2023) [8], Kanpur is one of the most densely populated cities in Uttar Pradesh, and its continuously increasing population has significantly raised the generation of municipal solid waste. With rapid urbanization, industrial expansion, and shifting consumption patterns, the city faces major challenges for its waste collection, transportation, and disposal systems. Consequently, effective planning and scientific management of solid waste are necessary to maintain environmental sustainability and public health. Sustainable waste management would also help Kanpur achieve cleaner urban development and improve the overall quality of life for residents.

### A. Literature Review

Singh and Chauhan (2020). [1] conducted an extensive research-based assessment of waste generation and composition of municipal solid waste in Kanpur, indicating that the majority of urban waste in the city was organic, followed by plastics and inert materials. They concluded that, while door-to-door collection is significantly high in Kanpur as per the Swachh Bharat Mission, the absence of efficient source separation hinders the performance of composting units and material recovery services. They suggest that decentralised composting and segregation processes are important elements in increasing the overall efficiency of the system, particularly in high-density residential areas (Singh & Chauhan, 2020) [1]. Likewise, Gupta (2021) studied institutional and infrastructure limitations in the waste management system of Kanpur Nagar Nigam, including

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governance, financial sustainability, and technology issues. Gupta's research also noted that Kanpur's reliance on open dumping, low-end landfills, and the absence of a local network of informal recyclers has significantly impacted the environment. He argues that sustainable waste management in Kanpur will have to move toward an Integrated Solid Waste Management (ISWM) framework, focusing on public involvement, PPP-related processing technologies and stringent adherence to the Solid Waste Management Rules, 2016 (Gupta, 2021) [2] [4]. These studies collectively highlight the need for systematic planning, decentralisation, and institutional robustness in Kanpur to achieve sustainable MSWM outcomes, even as operational improvements have been made.

## II. METHODS AND DATA SOURCES

This study relies on secondary data and document analysis. Main sources include:

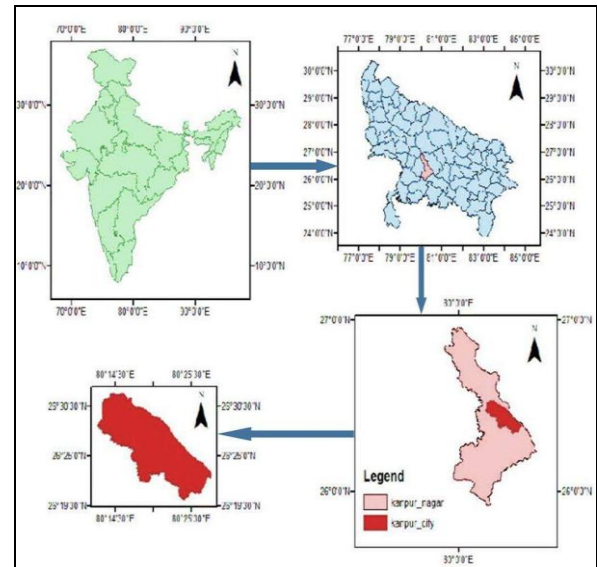
- Official Kanpur Nagar Nigam materials and municipal web pages describing programmes and institutional roles.
- Central Pollution Control Board (CPCB) technical summaries and state-wise MSW reports providing city-level waste-generation figures and disposal practices [6].
- Recent peer-reviewed and conference papers, technical reports and assessments focusing on Kanpur's waste management practices and waste composition studies.
- Media and local news reporting on municipal initiatives (e.g., smart-city activities, Swachh Bharat-related inspections).
- National policy documents that frame urban MSWM (Solid Waste Management Rules, 2016).

Analysis consisted of synthesizing these sources to extract: (a) population and urban growth context; (b) current estimates of daily waste generation and composition; (c) existing infrastructure (collection, transfer stations, processing units, landfill sites); and (d) governance and policy gaps. Where multiple numeric estimates exist (for example, daily waste tonnage), the paper reports the authoritative CPCB value and notes alternate recent academic estimates for comparison.

### A. City Profile and Waste Quantities

City profile and volume of waste. Kanpur is among the largest urban agglomerations in Uttar Pradesh. New urban population estimates (urban agglomerations/estimates of towns and cities) typically include cities with populations exceeding three million inhabitants, indicating a significant need for municipal services.

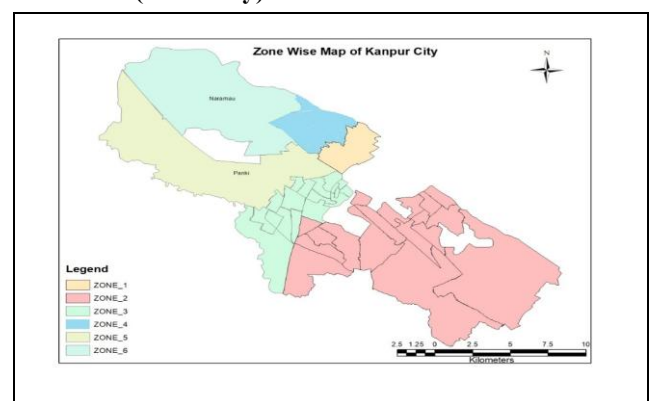
With respect to waste generation, as reported by CPCB and as part of its official records, Kanpur generates about 1,100 tonnes of municipal solid waste (MSW)/day.



[Fig.1: Location Map]

Some of these recent academic and municipal-level reports include higher estimates (~1,400–1,500 TPD), reflecting differences in measurement scope (city limits vs urban agglomeration) and the inclusion of commercial/industrial (non-MSW) streams. During planning, MSW generation should be assumed to be at least 1,100 TPD, with a growth trend aligned with population and per-capita waste generation. For Kanpur, waste composition studies reveal a considerable organic portion (food/green waste), along with recoverable recyclables (paper, plastic, metal, glass) and inert fractions (construction & demolition debris). Reported composition data from municipal sampling and academic studies indicate that organics routinely constitute the largest share, making decentralised composting and biogasification promising technologies if source segregation is maintained.

### B. Current Status of Waste Generation, Collection and Treatment (Summary)



[Fig.2: Kanpur City Map (Zone-wise)]

### C. Generation & Collection

Recent city-level reports also cite very high door-to-door collection rates (reported at ~96%) and improved sorting rates, indicative of aggressive municipal efforts and citizen participation initiatives. Collection is not the same as scientific Processing.

**Table I: Sanitary Zone-Wise Solid Waste Generation in Kanpur City**

Sanitary Zone	No. of Wards	Population (Census, 2011)	No. of Households (Census, 2011)	Total Waste (MT/day)	Generation Rate (kg/capita/day)
Zone 1	19	399,238	80,013	605.5404	1.51
Zone 2	18	568,483	113,862	341.5704	0.60
Zone 3	18	467,488	93,663	347.5526	0.74
Zone 4	19	331,728	66,511	556.8197	1.67
Zone 5	19	490,852	98,336	317.513	0.65
Zone 6	17	509,242	102,014	339.3982	0.67
<b>Total</b>	<b>110</b>	<b>2,767,031</b>	<b>554,399</b>	<b>2,508.3943</b>	<b>0.90</b>

Source: Kanpur Nagar Nigam 2016 [3]

A tabular presentation of waste generation from six sanitary zones of Kanpur is given in Table A, using data from the 2011 Census. Waste generation levels per capita (waste production per capita) are highest in Zones 1 and 4, with values of 1.51 and 1.67 kg/day, respectively, suggesting increased Commercial activity or higher consumption rates. Zone 2 has relatively low per-person waste (0.60 kg/day), despite having the largest population. In total, these six zones produce around 2,508 MT of waste per day with an overall mean production rate of 0.90 kg per capita. These differences among zones reflect distinct socioeconomic, demographic, and land-use characteristics that affect waste generation levels across the city.

**Table II: Generation of Municipal Solid Waste in Kanpur City**

Source of Solid Waste	Solid Waste Generated (TPD)	Percentage of Share (%)
Households	200	21.77
Street Sweepings	140	15.24
Hotels and Restaurants	83	9.03
Markets (vegetable markets, mandis, etc.)	107	11.64
Commercial Establishments (Institutions, etc.)	103	11.20
Other Sources (Construction Debris, Horticulture Waste)	286	31.12
<b>Total</b>	<b>919</b>	<b>100</b>

Source: Kanpur Nagar Nigam 2016 (Integrated Solid Waste Management Plan for Kanpur Municipal Corporation. New Delhi CSE India, 2019) [5].

According to the table on total solid waste in the city, the contribution of various sources was estimated at 919 TPD. Household waste makes up 21.77% of the total waste, street sweepings a further 15.24%. Markets, hotels and businesses account for roughly a third of the litter overall. By far the greatest proportion originates from “Other Sources” (construction debris or horticultural waste), at 31.12 per cent, suggesting that a considerable portion of the problem stems from non-domestic causes. In general, the information indicates that although residential activities are important contributors, urban development activities create the largest level of solid waste. In many wards, Kanpur Nagar Nigam

offers door-to-door collection (with community bins and transfer stations). However, service coverage and frequency vary by ward and neighbourhood; informal settlements and peri-urban pockets receive less reliable services. The municipal smart-city and Swachh Bharat initiatives have added mechanical sweepers and vehicles, but operational gaps remain.

**Table III: Coverage of Door-To-Door Collection Services in Kanpur City**

Property Category	Number
Households	2,17,827
Hotels and Restaurants	1,215
Commercial Establishments (institutions, offices)	4,568
Any other establishments (including markets)	414
<b>Total</b>	<b>2,24,024</b>

Source: Kanpur Nagar Nigam, 2016

**Table IV: Details of Waste Collection Depots and Vehicles**

Depot	No. of Vehicles	Category of Vehicles	Administrative Zones Served
<b>Bhagwat Das</b>	42	Bulldozer – 1, Dozer – 1, JCB – 2, Bobcats – 2, Loaders – 6, Leyland Trucks – 22, DCM – 1, Dumper Placers (big) – 2, Dumper Placers (small) – 2, Tractors – 3	2
<b>Jajmau</b>	18	Bobcat – 1, Loader – 3, Leyland Trucks – 3, DCM – 5, Dumper Placers (big) – 1, Dumper Placers (small) – 4, RC (Mini) – 1	1, 3, 6
<b>Panki</b>	18	Bobcat – 1, Loader – 3, Leyland Trucks – 7, DCM – 4, Dumper Placers (big) – 1, Dumper Placers (small) – 2	5, 3
<b>Fazal Ganj</b>	35	JCB – 1, Bobcat – 1, Loaders – 6, Leyland Trucks – 13, DCM – 1, Dumper Placers (big) – 2, Dumper Placers (small) – 8, RC (Mini) – 3	5, 6, 4

Source: Kanpur Nagar Nigam, 2016

**D. Transportation Processing infrastructure**

Transportation Processing infrastructure. In numerous wards of Kanpur Nagar Nigam, door-to-door collection is available alongside community bins and transfer stations. However, service coverage and frequency differ from ward to ward and neighbourhood to neighbourhood, with informal settlements and peri-urban pockets having less reliable coverage. Kanpur has embarked on decentralised MRFs and composting units—often under the auspices of Smart City and state programmes—but the combined installed processing capacity is insufficient to meet daily generation. Decentralized MRFs at transfer stations have been suggested in academic and municipal assessments to improve resource recovery and reduce landfill loads.



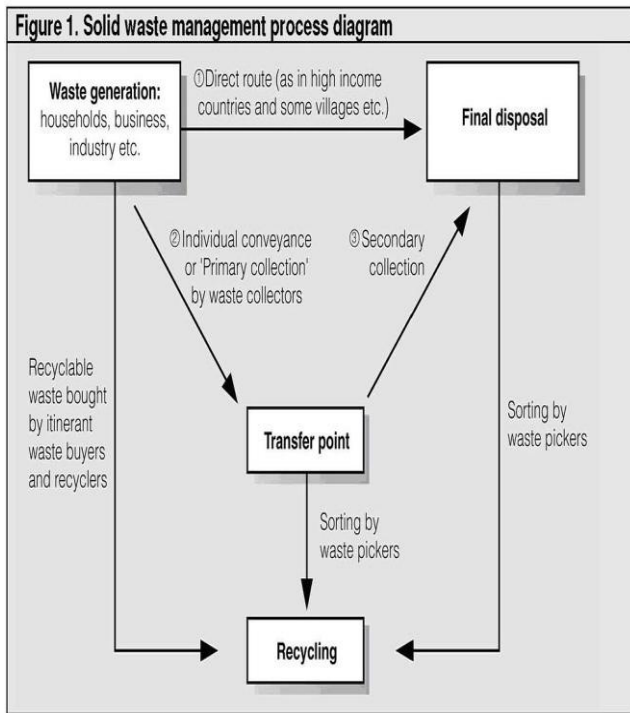


Figure: 3

**E. Spatial Distribution of Waste-Related Problems in Kanpur**

Waste-related problems are spatially distributed in Kanpur. The spatial distribution of waste-related problems in Kanpur shows that different parts of the city face distinct challenges. Areas with congestion and high population density, like Beconganj and Chaman Ganj, known for high levels of waste accumulation due to very narrow lanes, also have very large populations. Both riverbank areas near Bithoor and Jajmau are at risk of dumping or leachate, endangering the Ganga’s water quality. Areas within the industrial regions of Jajmau and Panki handle mixed waste from industry and municipal sources, but are experiencing greater environmental pressures. This pattern illustrates the extent to which Kanpur’s diverse urban structure influences both the magnitude and character of its waste-management challenges. Different neighbourhoods illustrate different kinds of waste-management failures.

- Landfill Pressure Zones: Bithoor Road–Kuberpur
- Low Segregation Zones: Beconganj, Chaman Ganj, Nayaganj
- Industrial Waste Burden: Jajmau, Panki
- High-risk Riverbank Zones: Bithoor, Shukla Ganj, Jajmau riverfront

**III. KEY CHALLENGES AND PLANNING GAPS IN KANPUR’S SWM SYSTEM**

**A. Scale Mismatch**

The daily generation of waste far surpasses the capacity of the existing composting plants, MRFs, and the Kuberpur landfill. Overflowing waste from Kidwai Nagar, Govind Nagar, Beconganj, and other areas underscores the demand-infrastructure gap.

**B. Weak Source Segregation**

Despite SWM Rules (2016), segregation at source remains low, particularly in densely populated old-city areas (Beconganj, Colonelganj, Nayaganj) and low-income settlements (Yashodanagar, Pehelwanpurwa). Mixed waste reduces the efficiency of recycling and composting facilities.

**C. Institutional Fragmentation**

Multiple agencies—Kanpur Nagar Nigam, Smart City SPV, private operators, and informal waste workers—often operate with overlapping responsibilities, reducing operational efficiency.

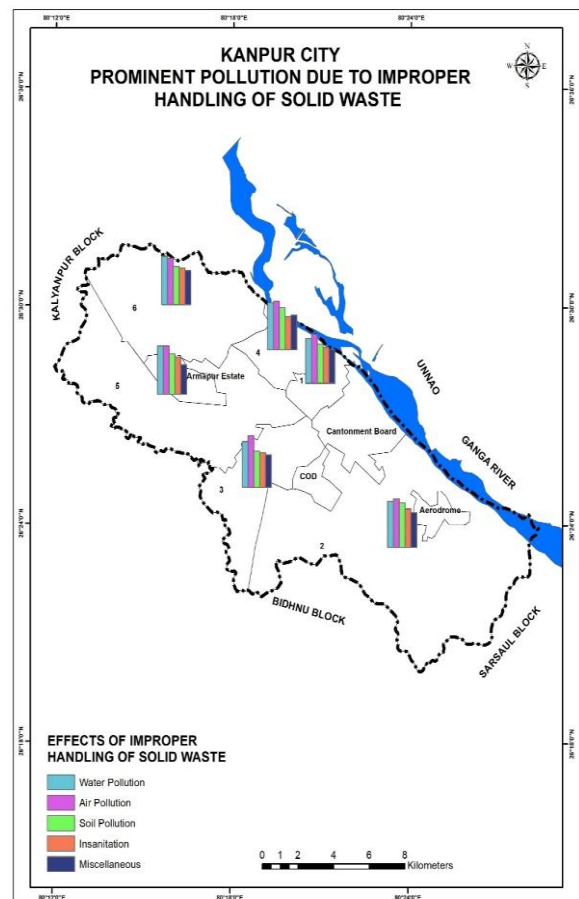
**D. Environmental Sensitivities**

Proximity to the Ganga River and major drainage corridors (Sisamau Nala, Golaghat Nala) makes the city highly vulnerable to leachate infiltration, illegal dumping, and water pollution.

**E. Financial Unsustainability**

Low user-fee recovery and dependence on government grants make long-term operation and maintenance of waste facilities vulnerable.

**IV. PROMINENT POLLUTION PERCEPTION INDEX IN DIFFERENT ZONES OF KANPUR CITY**



[Fig.4: Effects of Improper Handling of Solid Waste]

Source: Primary Data Source

This map of Kanpur City highlights the prominent pollution arising from improper handling of solid waste across six



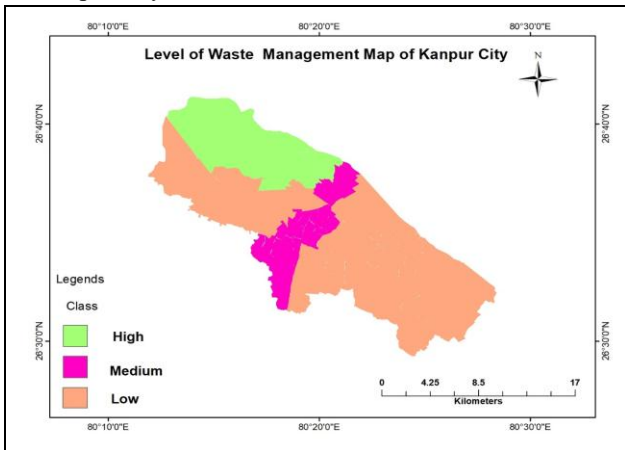
administrative zones. Each zone is marked with a multi-colored bar graph showing the intensity of five pollution effects: water pollution, air pollution, soil pollution, insanitation, and miscellaneous impacts. Zones 1 and 4 near the Ganga River are severely affected by water and soil pollution, putting the river's health and ecological integrity at risk. Similarly, the Solid Waste Management Rules 2016 (Government of India, 2016) state that high levels of air pollution and insanitation indicate heavy urban settlement and inadequate waste disposal in Zones 3 and 5. The presence of landmarks on the map, including Cantonment Board, COD, Armapur Estate, and Aerodrome, also illustrates the impact of poor waste management in public and institutional areas. Taken together, this visualisation demonstrates that pollution is ubiquitous, heterogeneous, and strongly linked to inadequate municipal solid waste practices throughout the city.

**A. Literacy as a Driver of Segregation and Recycling**

Higher literacy levels are associated with better household segregation, higher recycling rates, and better disposal practices. Areas with higher literacy (Swaroop Nagar, Civil Lines) generally exhibit good adherence to SWM principles. It is no surprise that many low-literate areas, particularly slum clusters, are unaware of waste segregation, composting, and the health hazards arising from uncollected waste.

**B. Literacy Levels and Waste-Management Awareness in Kanpur**

Literacy levels show a strong positive correlation with waste management effectiveness, as indicated by the Waste Management Map of Kanpur City. Green-shaded northern areas, among the most literate regions, have better practices and greater public awareness. Southern and eastern orange zones are characterised by poor management levels, driven by low awareness and civic engagement. The central pink area indicates moderate performance, with public cooperation and municipal efforts gradually increasing. Overall, the list makes it evident that educated neighborhoods are more prone to engaging in sorting, recycling, and Source: primary data source.



[Fig.5: Responsible Dumping of Waste]

**V. STRATEGY AND CONSTRUCTION OF SUSTAINABLE MSWM IN KANPUR**

The following is an integrative approach to connect Kanpur's MSWM with the wider sustainable development agenda. These recommendations link technical measures to governance, financial, and social actions. You need a time-bound (5–10 years) plan that quantifies current and expected waste flows (by waste stream and zone), infrastructure demands, funding schemes, and institutional functions. The Smart City programme will be integrated with Kanpur Nagar Nigam's SWM planning for harmonious implementation. Undertake strong IEC (information-education-communication) campaigns to enforce the three-stream segregation (wet, dry, sanitary) in accordance with the SWM Rules, with region-wise targets and penalties. Offer households two/three bins and periodic collection.

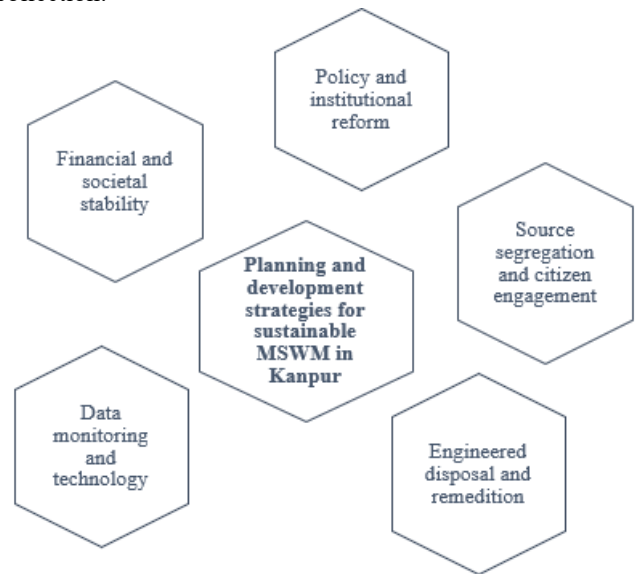


Figure: 6

Source: primary data source

**VI. LIMITATIONS OF THE STUDY**

This paper uses secondary data and document review. Variation in reported waste tonnages between documents (CPCB vs fresh academic estimates) underscores the importance of a city-wide, consolidated waste flow audit. Future work would benefit from primary field surveys, direct capacity assessments, and engagement with municipal officials to validate operational metrics.

**VII. CONCLUSION**

Kanpur's MSWM situation presents the classic urban-sustainability challenge: increasing waste generation confronting a legacy infrastructure and institutional constraints. However, the presence of large volumes of organic waste and an active informal recovery network creates a good opportunity. Kanpur can reduce the burden on landfills, recycle materials, create local green jobs, and safeguard the Ganga by implementing a coordinated, decentralised, and inclusive MSW strategy in support of the SWM Rules (2016) and using smart-city tools, PPP



models, and public participation. Based on recent cleanliness rankings and municipal initiatives reported by The Times of India (2022) [7], Kanpur has begun to improve solid waste management practices to support sustainable urban growth. Efforts such as door-to-door collection, public awareness campaigns, waste segregation, and scientific disposal techniques have boosted the quality of the city's sanitation standards. Effective municipal solid waste planning and management improve environmental quality, public health, and urban sustainability. However, issues such as rapid population growth, infrastructural backwardness, and improper waste segregation remain. Hence, it necessitates continuous monitoring, citizen participation, and adoption of the latest waste management technologies to reach sustainable development objectives in Kanpur City.

## DECLARATION STATEMENT

As the article's author, I must verify the accuracy of the following information after aggregating input from all authors.

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- **Author's Contributions:** The authorship of this article is contributed equally to all participating individuals.

## REFERENCES

1. Singh, R., & Chauhan, A. (2020). *Assessment of Municipal Solid Waste Composition and Management Practices in Kanpur City (Solid Waste Management Services and Urban Sanitation, 2016)*. International Journal of Environmental Research and Technology, 9(3), 45–52. URL: <https://www.ijert.org/municipal-solid-waste-composition-analysis-and-its-importance-a-case-of-kanpur>
2. Gupta, P. (2021). *Institutional Challenges and Sustainability Strategies in Municipal Solid Waste Management: A Case Study of Kanpur*. Journal of Urban Management Studies, 7(2), 112–126. URL: <https://openaccesspub.org/new-developments-in-chemistry/article/1442>
3. Kanpur Nagar Nigam. (2016). *Solid Waste Management Services and urban sanitation*. Retrieved from <https://kmc.up.nic.in>.
4. Ministry of Environment, Forest and Climate Change. (2016). *Solid Waste Management Rules, 2016*. Government of India. Retrieved from <https://cpcb.nic.in/rules->
5. Centre for Science and Environment (CSE). (2019). *Integrated Solid Waste Management Plan for Kanpur Municipal Corporation*. New Delhi: CSE India. Retrieved from <https://www.cseindia.org/>
6. Central Pollution Control Board (CPCB). (2021). *Status Report on Municipal Solid Waste Management in Kanpur City*. New Delhi: Ministry of Environment, Forest and Climate Change, Government of India. URL/PDF [https://cpcb.nic.in/uploads/MSW/MSW\\_AnnualReport\\_2020-21.pdf](https://cpcb.nic.in/uploads/MSW/MSW_AnnualReport_2020-21.pdf)
7. The Times of India. (2022). *Kanpur ranks in the national cleanliness survey; municipal actions and initiatives are reported*. Retrieved from <https://timesofindia.indiatimes.com>
8. World Population Review. (2023). *Kanpur Population 2023*. Retrieved from <https://worldpopulationreview.com>

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2. Environmental degradation due to solid waste: A case study of Kanpur City
3. Challenges of plastic waste and its recycling: A threat to the environment: A case study of Kanpur City

### Paper Presented –

1. “Disaster hazards and livelihood” in the 33rd Conference of the Indian Institute of Geomorphologists.
2. Impacts of waste management on the environment

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