

Public Awareness and Environmental Prioritization in Urban Waste Management: An Empirical Study from Smart City Udaipur

Uttam Prakash Sharma¹, Nikita Sharma²

^{1,2} *Department of Botany, Faculty of Science, J.R.N. Rajasthan Vidyapeeth (Deemed to be University), Udaipur (Raj.)*

Abstract—This study investigates public awareness regarding the environmental and health impacts of waste, its contribution to epidemic outbreaks, and its potential for resource recovery in Smart City Udaipur. Using a survey of 519 residents, the research assesses the level of knowledge and perception toward landfill hazards, causes of disease outbreaks, and recycling possibilities. Findings indicate that only 41.23% of respondents were aware of the negative impacts of landfill sites on environmental and human health, while a significant proportion remained unaware or uncertain. Additionally, 45.66% of the participants identified the growing quantity of garbage as the main cause of epidemic outbreaks, followed by 38.34% who cited improper garbage collection. Only 55.11% acknowledged that a significant portion of household waste could be converted into useful resources. These results highlight critical gaps in environmental awareness, especially concerning the adverse effects of unscientific waste disposal and the benefits of sustainable waste practices. The study underscores the need for targeted public education campaigns, community engagement, and participatory governance in promoting informed waste management behavior. The research also contributes to policy formulation by revealing the disconnect between waste generation patterns and citizen knowledge, thus enabling municipal bodies to craft more responsive and effective waste strategies. This paper calls for integrating behavioral insights into waste management reforms to improve urban resilience and ecological sustainability.

Index Terms—Urban waste management, environmental awareness, landfill impact, epidemic causes, resource recovery, Udaipur

I. INTRODUCTION

Effective urban waste management is a cornerstone of environmental sustainability and public health. In

rapidly urbanizing regions like Udaipur, waste generation has increased sharply, stressing the need for community-level awareness and action. Without adequate knowledge of the consequences of improper waste disposal, communities are at risk of exacerbating pollution, disease, and resource depletion.

Despite efforts by municipal authorities to improve collection and disposal systems, public participation remains weak due to limited awareness. The health implications of landfill overflow, the role of garbage accumulation in spreading epidemics, and the potential of resource recovery are often poorly understood by citizens. These gaps hinder the success of sustainable urban waste initiatives and the development of a circular economy.

The present study focuses on evaluating the extent of awareness among Udaipur residents regarding three interrelated domains: the environmental and health impact of landfills, the perceived causes of epidemic outbreaks, and the potential of converting waste into resources. The aim is to provide empirical insights that can inform both policy design and community outreach strategies to improve waste governance in the Smart City mission framework.

Research Objectives:

1. To analyse existing waste management practices, including collection, transportation, treatment, and disposal in Smart City Udaipur.
2. To evaluate the environmental impact of current waste practices, especially in terms of pollution and resource loss.

Research Significance:

This research holds significant value for urban planners, municipal authorities, and environmental educators by identifying critical knowledge gaps in community awareness. By quantifying perceptions related to landfill impacts, epidemic risks, and recycling awareness, the study offers a data-driven foundation for designing targeted interventions aimed at enhancing urban sustainability and public health resilience.

II. REVIEW OF LITERATURE

Cheela et al. (2021) examined sustainable waste management in Indian Smart Cities by analyzing systemic inefficiencies and promoting integrated planning. Their study highlighted institutional barriers, data gaps, and citizen disengagement as major obstacles. The authors recommended decentralized waste systems, digital monitoring, and stakeholder collaboration. It serves as a foundational reference for operational reforms in urban waste management.

Ansari et al. (2024) investigated paradigm shifts in Saharanpur's Smart City waste governance, emphasizing the role of community co-production and smart sensors. The case study revealed how digital tools transformed compliance, tracking, and segregation practices. The authors advocated for context-specific tech adaptations in Indian waste ecosystems. This study underscores innovation as key to sustainable transitions.

Shruti et al. (2020) developed the Indian Smart City Environmental Sustainability Index to assess ecological performance across cities. The index included waste management, green cover, air quality, and public participation. Findings showed uneven implementation and weak environmental focus in many smart cities. The study called for recalibrating policy frameworks to prioritize sustainability indicators.

Rana (2023) discussed redevelopment strategies within Smart City frameworks, focusing on infrastructure, land use, and citizen inclusion. The report stressed the importance of aligning urban regeneration projects with sustainability goals. It emphasized participatory planning and resource optimization as key pillars. The work contributes to

understanding redevelopment challenges in growing Indian cities.

Turaga et al. (2020) explored how urban green spaces contribute to India's smart city agenda, especially in waste buffering and environmental health. They found that green infrastructure helped mitigate solid waste accumulation and promoted community well-being. The study urged stronger policy linkages between waste and green space planning. It promotes a holistic view of urban resilience.

Prasad & Alizadeh (2020) performed a policy analysis of the Smart Cities Mission, identifying governance gaps in project selection and execution. Waste management emerged as a neglected area compared to energy and mobility. They argued for performance-based funding and transparent indicators. Their findings support more balanced and accountable urban development strategies.

Green, CONR Home Science (n.d.) offered an agricultural and community-level perspective on urban waste reuse and recycling practices. The report discussed vermicomposting, biogas, and organic waste conversion at household levels. It highlighted gender roles and household behavior in managing urban waste. This source contributes a socio-environmental angle to waste sustainability.

Mishra & Prasad (2024) presented smart water and waterfront redevelopment plans under the Smart Cities Mission, integrating solid waste concerns. Their approach emphasized adaptive reuse, smart bin placement, and waste-water co-management. The paper supports interlinking infrastructure sectors to boost overall urban efficiency. It is a valuable resource for cross-sectoral planning.

Alizadeh et al. (2023) analyzed India's Smart City response during COVID-19, focusing on digital waste alerts, health-waste coordination, and quarantine sanitation. Their findings showed scalability issues but also highlighted fast-tracked innovation during crises. They recommended codifying such emergency protocols into regular planning. The study bridges pandemic management and smart city functions.

Lnenicka & Saxena (2021) studied open data governance on smart city portals, including transparency in waste-related metrics. Their research found fragmented standards and limited citizen-facing data in Indian portals. The study proposed unified frameworks to enhance digital accountability. It

contributes to understanding the digital transparency aspect of smart waste systems.

Research Gap:

Although several studies have explored waste generation and disposal systems, limited empirical attention has been paid to the intersection of public

awareness, epidemic causation, and recycling potential in the Indian urban context. This study fills that gap by evaluating community knowledge in Smart City Udaipur, offering a holistic view of how perception influences waste behavior and health risk management.

III. METHODOLOGY

Component	Description
Study Area	Smart City Udaipur, Rajasthan
Sample Size	519 respondents
Sampling Technique	Stratified random sampling
Tool Used	Structured questionnaire (close-ended)
Key Variables	Awareness of landfill impact, causes of epidemics, recycling potential
Analysis Techniques	Frequency distribution, percentage analysis

Data Analysis

Table 1: Frequency and Percentage Distribution of Respondents' Awareness Regarding Environmental Impact, Epidemic Causes, and Resource Conversion Potential of Waste

Question	Response Option	Frequency	Percent
Are you aware about Negative Impact of Landfill on Environment and Human Health?	Yes	214	41.23
	No	172	33.14
	Can't say	133	25.63
	Total	519	100
Main causes of the outbreak of epidemic	Growing quantity of garbage	237	45.66
	Improper collection of garbage	199	38.34
	Others, specify	83	15.99
	Total	519	100
Do you know a much part of garbage can be converted into resources?	Yes	286	55.11
	No	121	23.31
	Can't say	112	21.58
	Total	519	100

Graph 1: Frequency and Percentage Distribution of Respondents' Awareness Regarding Environmental Impact, Epidemic Causes, and Resource Conversion Potential of Waste

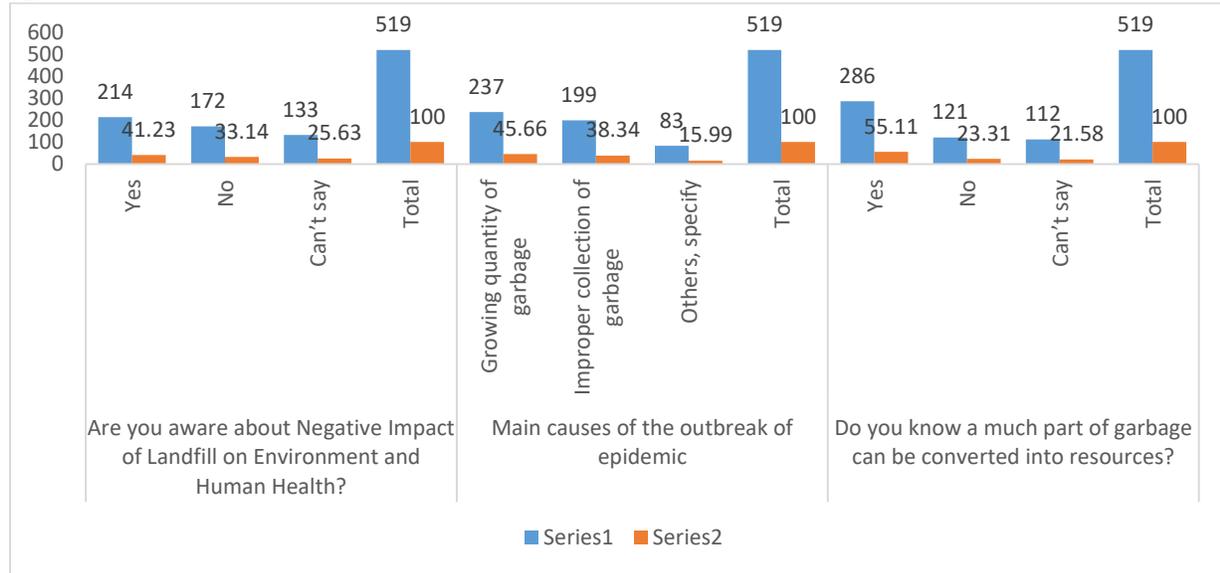


Table 1 and Graph 1 provides insights into respondents' awareness regarding the environmental and health implications of waste, its role in causing epidemics, and its potential for resource conversion. Among the 519 respondents, 41.23% indicated that they were aware of the negative impact of landfills on both the environment and human health. However, a significant 33.14% admitted they were unaware, and 25.63% responded with uncertainty, reflecting considerable gaps in public knowledge about the harmful effects of unscientific landfill practices.

When asked about the perceived causes of epidemic outbreaks, 45.66% of respondents believed that the growing quantity of garbage is the main reason, while 38.34% identified improper garbage collection as a major factor. An additional 15.99% attributed epidemics to other causes. These responses highlight that a large majority of participants associate poor waste management practices with public health risks, particularly in urban settings like Udaipur.

In terms of understanding the resource recovery potential of waste, 55.11% of respondents agreed that a significant portion of household and municipal waste

can be converted into useful resources. However, 23.31% were unaware of this fact, and 21.58% remained uncertain. This indicates a relatively positive perception of recycling and waste-to-resource initiatives, but also underscores the need for awareness programs and demonstrations to educate citizens about sustainable waste practices and circular economy principles.

To find the significant difference in the ranks assigned to environmental degradation factors caused by waste management practices. The distribution of ranks for each factor follows a normal distribution following hypothesis is framed and evaluated;

H₀₁: There is no significant difference in the ranks assigned to environmental degradation factors caused by waste management practices. The distribution of ranks for each factor follows a normal distribution.

H_{A1}: There is a significant difference in the ranks assigned to environmental degradation factors caused by waste management practices. The distribution of ranks for each factor follows a normal distribution.

Table 2: Descriptive Statistics table for ranks assigned to environmental degradation factors

Descriptive Statistics					
	N	Mean	Std. Deviation	Minimum	Maximum
Greenhouse gas emissions	519	6.65	3.631	1	12
Soil contamination	519	6.64	3.552	1	12

Water contamination	519	6.31	3.412	1	12
Deforestation due to landfill expansion	519	6.73	3.475	1	12
Wildlife habitat destruction	519	6.46	3.416	1	12
Air pollution from incineration	519	6.33	3.476	1	12
Noise pollution from waste disposal activities	519	6.27	3.351	1	12
Loss of biodiversity	519	6.75	3.283	1	12
Visual pollution from littering and dumping	519	6.26	3.452	1	12
Soil erosion due to improper waste disposal	519	6.53	3.484	1	12
Groundwater depletion	519	6.44	3.393	1	12
Chemical contamination of surface water bodies	519	6.63	3.476	1	12

Table 2 presents the descriptive statistics for the ranks assigned by respondents to various environmental degradation factors resulting from waste management practices. Each of the twelve factors was rated on a scale from 1 to 12, allowing for a comparative analysis of their perceived severity. The mean rankings range from 6.26 to 6.75, suggesting that respondents consider all listed environmental impacts to be relatively significant and closely related in importance.

The highest mean rank was assigned to loss of biodiversity at 6.75, followed closely by deforestation due to landfill expansion at 6.73, indicating that ecological degradation is a major concern among respondents. Greenhouse gas emissions and soil contamination also received high mean values of 6.65 and 6.64 respectively, reflecting a strong awareness of pollution-related environmental impacts. Chemical contamination of surface water bodies and water contamination were similarly perceived as important, with mean ranks of 6.63 and 6.31.

Lower but still considerable ranks were given to factors like noise pollution from waste disposal activities and visual pollution from littering and dumping, with mean values of 6.27 and 6.26 respectively. These responses suggest that while aesthetic and sensory nuisances are acknowledged, they are perceived as slightly less critical compared to ecological and health-related consequences.

The standard deviations for all variables fall within a narrow range of approximately 3.28 to 3.63, indicating a consistent level of variability in responses. All factors received the full range of rankings, from 1 (most significant) to 12 (least significant), demonstrating diverse individual perspectives. These descriptive results form a basis for testing the null hypothesis H01, which posits no significant difference in the rankings. Following Statistical testing will determine whether the observed differences in mean ranks are due to chance or reflect a genuine prioritization among environmental degradation factors.

Table 3: One-Sample Kolmogorov-Smirnov Test table for ranks assigned to environmental degradation factors

	N	Normal Parameters ^{a,b}		Most Extreme Differences			Kolmogorov-Smirnov Z	Asymp. Sig. (2-tailed)
		Mean	Std. Deviation	Absolute	Positive	Negative		
Greenhouse gas emissions	519	6.65	3.631	.125	.101	-.125	2.850	.000

Soil contamination	519	6.64	3.552	.117	.106	-.117	2.668	.000
Water contamination	519	6.31	3.412	.111	.111	-.090	2.532	.000
Deforestation due to landfill expansion	519	6.73	3.475	.111	.098	-.111	2.525	.000
Wildlife habitat destruction	519	6.46	3.416	.101	.101	-.099	2.301	.000
Air pollution from incineration	519	6.33	3.476	.104	.104	-.082	2.359	.000
Noise pollution from waste disposal activities	519	6.27	3.351	.101	.101	-.097	2.310	.000
Loss of biodiversity	519	6.75	3.283	.098	.089	-.098	2.232	.000
Visual pollution from littering and dumping	519	6.26	3.452	.114	.114	-.092	2.592	.000
Soil erosion due to improper waste disposal	519	6.53	3.484	.106	.099	-.106	2.409	.000
Groundwater depletion	519	6.44	3.393	.091	.091	-.088	2.079	.000
Chemical contamination of surface water bodies	519	6.63	3.476	.106	.106	-.105	2.416	.000

Table 3 presents the results of the One-Sample Kolmogorov-Smirnov (K-S) test, which was applied to assess whether the distribution of ranks assigned to various environmental degradation factors follows a normal distribution. For all twelve environmental factors evaluated, the K-S test yielded statistically significant results, with asymptotic significance (2-tailed) values equal to .000. This indicates that the distribution of rankings for each factor significantly deviates from a normal distribution.

Each variable also shows non-zero values for the Kolmogorov-Smirnov Z statistic, ranging from 2.079 to 2.850. The absolute values of the most extreme differences between observed and expected cumulative distributions range from .091 to .125, further supporting the presence of non-normality. For example, greenhouse gas emissions and soil contamination exhibited the highest deviations, with absolute differences of .125 and .117 respectively, and corresponding Z-values of 2.850 and 2.668.

Since all p-values are less than the conventional alpha level of 0.05, the null assumption of normality is rejected for all factors. This confirms that the distribution of ranks assigned to environmental degradation factors is not normally distributed. As a result, non-parametric statistical tests, such as the Friedman test, are appropriate for analyzing whether there are significant differences in how these factors were ranked by respondents. These findings support the requirement for further hypothesis testing under HA2 to evaluate differences in perceived environmental impact.

IV. CONCLUSION

The study reveals a moderate level of environmental awareness among Udaipur's residents, with only 41.23% recognizing the detrimental effects of landfills on health and the ecosystem. The widespread attribution of epidemic outbreaks to the accumulation and poor handling of garbage illustrates a partial

understanding of the link between sanitation and disease. Encouragingly, over half of the respondents acknowledged the potential to convert waste into valuable resources, signaling openness to circular economy principles. However, the persistence of “Can’t say” responses across key variables points to an urgent need for sustained public education and participatory communication strategies. By identifying specific knowledge gaps, this study provides actionable insights for municipal policy, community outreach, and sustainable waste infrastructure development aligned with Smart City objectives.

V. SUGGESTIONS

- Launch city-wide public awareness campaigns about the health risks of unscientific waste disposal.
- Promote waste-to-resource programs through local workshops and media outreach.
- Improve visibility and accessibility of formal waste management systems to reduce open dumping.

VI. LIMITATIONS

- The study is geographically limited to Udaipur and may not generalize to other urban contexts.
- Respondent awareness levels were self-reported and may be influenced by recall or social desirability bias.

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