IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES
ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 12, Iss 01, 2023

EXPLORING GENDER PERSPECTIVES ON SOLID WASTE MANAGEMENT: AWARENESS, CHALLENGES, AND ECONOMIC OPPORTUNITIES IN RAIPUR

Asha Gupta[1], Dr. Dewashish Mukherjee[2]
[1]Mahant Lakshminarayan Das College, Raipur (CG)
[2]Principal, Mahant Lakshminarayan Das College, Raipur (CG)

Abstract

Urbanization and population growth at a fast pace are indeed the biggest challenges in municipal waste management for developing countries like India. Cities like Raipur, Rudrapur, and Bilaspur are feeling a growing pressure to establish effective, sustainable, and inclusive waste management systems so that public health, environmental, and economic concerns could be properly addressed. This study aims at evaluating challenges, economic opportunities, and potential improvements in SWM with an emphasis on public engagement, willingness to pay for improved services, and the integration of waste-to-energy (WTE) technologies. Auxiliary industries were also analyzed in promoting sustainable solutions to waste management.

The systematic review of the peer-reviewed literature and case studies conducted on different cities in India and adjacent states shows results on different aspects related to SWM practices, geospatial techniques for landfill site selection, WTP models, and WTE technologies. Based on the findings, the patterns, challenges, and best practices were thereby identified. Public awareness is quite critical to make appropriate segregation and recycling of wastes. The probability of better services depends entirely on transparent and efficient systems in WTP for residents. Inadequate infrastructure, along with barriers provided by regulatory mechanisms, impedes the progress. However, economic prospects of WTE projects and recycling industries offer immense scope. Innovation in geospatial technology combined with public-private partnerships can efficiently resolve operational issues.

Effective SWM in urban areas requires a multi-pronged strategy combining public engagement, financial sustainability, and technological innovation. Addressing regulatory and infrastructural challenges while fostering economic opportunities can transform waste into a resource, promoting environmental sustainability and economic growth.

Keywords: Municipal solid waste, urbanization, waste management, Raipur, sustainable practices

1. Introduction

Solid waste management (SWM) would become an integral part of urban infrastructure since it has direct interfaces with public health, environmental sustainability, and economic development. The rapid pace of urbanization and industrialization in developing countries such as India has increased problems in MSWM (Gupta et al., 2015). The city of Raipur is the capital of the Indian state of Chhattisgarh and, like other Indian cities, faces the increase waste burden and the need for sustainable WM solutions (Lanjewar et al., 2014).

Waste management at the solid level includes a stream of waste and collection followed by separation, transport, treatment, and disposal, involving a significant number of diverse materials such as organic waste and recyclables, hazardous wastes (Sharholy et al., 2008). Local municipal authorities are crucial as they primarily assume the responsibility for effective, functional waste management systems (Joshi & Ahmed, 2016). In fact, even though policy frameworks exist, such as the Solid Waste Management Rules 2016, most municipalities- this includes Raipur Municipal Corporation (RMC)- lack basic infrastructure, community awareness, and financing (Multaniya et al., 2021).

It would depend on the awareness level of the citizen and their willingness towards attaining sustainable waste management practices. From literature, it has been proven that successful SWM relies on the participation and awareness of the public, as well as economic incentives (Guerrero et al., 2015). In Raipur, the case is worse, as most people living in that area do not have an understanding of what segregates waste, landfill management, and recycling (Jharia, 2014).
It examines citizen awareness, the economic prospects of the industries associated with SWM, and how residents are willing to financially contribute toward the initiative in Raipur. This research study integrates the public perceptions with economic analyses to identify gaps in the existing system and come up with actionable solutions for sustainable waste management practices.

2. Review of Literature

Currently, municipal solid waste management has been an emergent issue in the context of urbanization and environmental degradation. Challenges and opportunities in SWM have invariably been analyzed against developing countries like India, as in Sharholy et al. (2008) and Joshi & Ahmed (2016). These would include inappropriate waste collection mechanisms, lack of public awareness, and the absence of modern waste processing technologies, in addition to Gupta et al. (2015).

Engaging the community, along with many economic incentives, can be essential to improve SWM systems, as exemplified in the case of the study in Rudrapur City Uttarakhand by Kaur and Punera (2022). Similarly, Zia and Devadas (2008), who studied the city of Kanpur, concluded that engagement from stakeholders notably improved waste segregation. The model cannot be scaled up, though, owing to deficiencies such as financial strains and lack of technical expertise, as expressed by Rathore and Sarmah (2019).

The SWM practices of Raipur have been assessed in terms of geospatial site assessment and community participation (Multaniya et al., 2021). These studies again call for the development of infrastructure and civic awareness. In addition, waste-to-energy projects have been identified to have an economical potential as a sustainable solution towards India's waste crisis (Malav et al., 2020).

Awareness and willingness to pay are significant enablers for SWM reform implementation. Empirical evidence from Bharatpur and Bilaspur reveal that the impacts of public involvement on improved waste management outcomes are directly related (Rai et al., 2019; Rathore & Sarmah, 2019). In Raipur city, however, awareness regarding the 4Rs and

knowledge regarding the management of the landfill site are highly insufficient (Lanjewar et al., 2014).

The literature also presents economic opportunity in SWM through the development of secondary industries including recycling plants, composting units, among others (Saja et al., 2021). Research has shown that through policy interventions, community education, and financial incentives, waste management can become an economically viable sector (Guerrero et al., 2015).

3. Objectives

The key objectives of this study are:

3.1 To assess public awareness regarding SWM practices in Raipur.
3.2 To evaluate the willingness to pay (WTP) for improved waste management services among the residents of Raipur.
3.3 To explore the economic prospects of establishing auxiliary industries such as recycling plants, composting units, and waste-to-energy facilities in Raipur.
3.4 To identify the challenges faced by the Raipur Municipal Corporation (RMC) in establishing these auxiliary industries.

4. Methodology

In the current study, the mixed-method approach has been followed. Quantitative and qualitative data have been collected so that a comprehensive understanding about the concerns related to SWM in Raipur will be understood.

4.1 Survey Design and Data Collection

A structured questionnaire was designed to measure public awareness, WTP, and perceived opinions on SWM practices. A mix of closed-ended and open-ended questions was included in the questionnaire and administered to 100 respondents from Raipur comprising 53 females and 47 males. The participants were chosen from various socio-economic groups to increase diversity. Samples were gathered through face-to-face interviews as well as internet survey.

4.2 Qualitative Interviews

Besides the survey, 10 key informants were interviewed qualitatively, which consisted of municipal officials, waste management experts, and representatives from NGOs engaged in waste management activities. The purpose of these interviews was to understand the challenges that the RMC faces while dealing with waste and the feasibility of auxiliary industries like recycling and composting plants.

4.3 Data Analysis

Data analysis with percentage comparison is on the proportion of responses in every category, like Strongly Agree and Agree for those variables. Such percentages can be compared across groups, such as male respondents and females, to ascertain whether certain trends and patterns exist about public opinion or behavior regarding the management of solid waste.

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 12, Iss 01, 2023

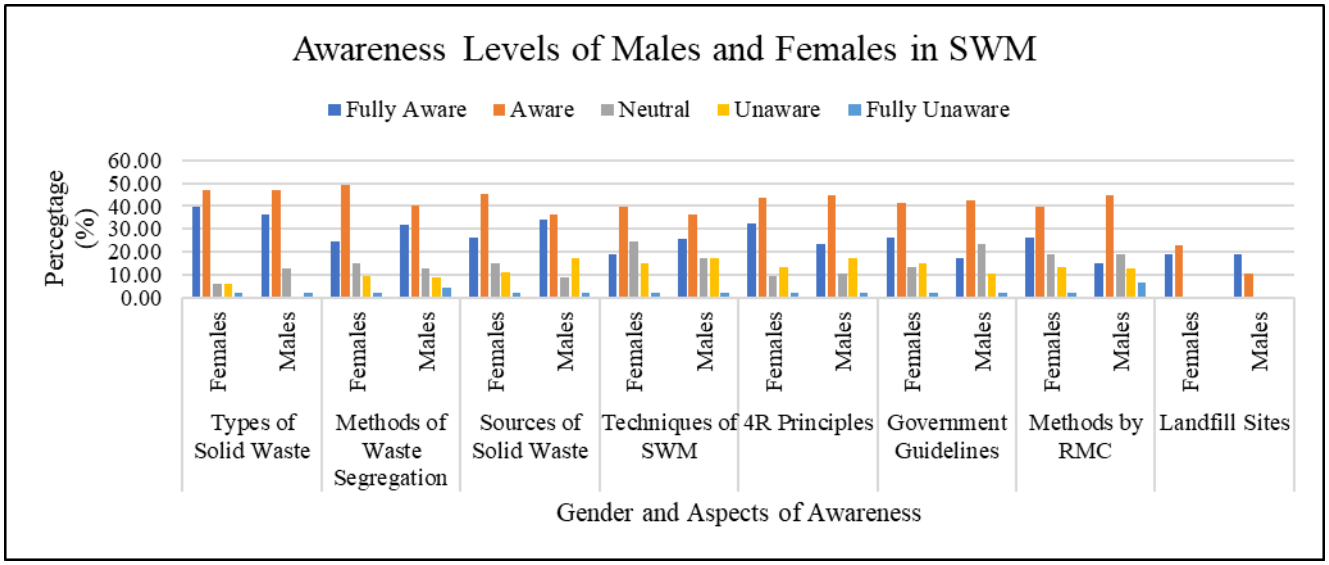
5. Results and discussion

The survey assessed the awareness levels of males and females regarding various aspects of solid waste management (SWM) in Raipur. The results, expressed in percentages, are detailed below:

5.1 Public Awareness of Solid Waste Management

5.1.1 Awareness Levels of Males and Females in SWM

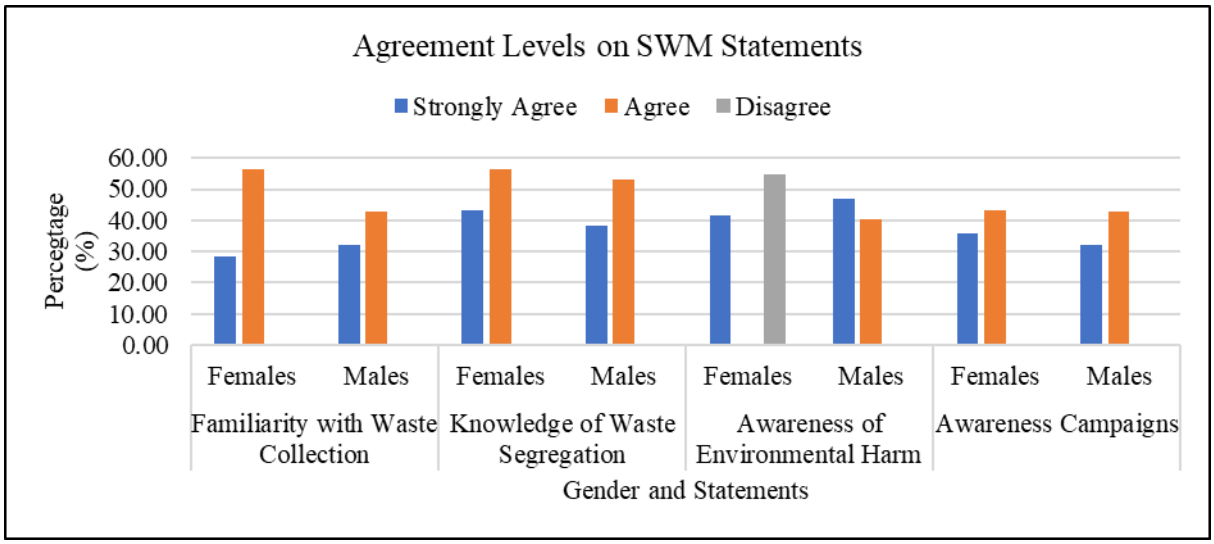
Aspect	Category	Fully Aware	Aware	Neutral	Unaware	Fully Unaware
Types of Solid Waste	Females	39.60%	47.20%	5.70%	5.70%	1.90%
	Males	36.20%	46.80%	12.80%	0.00%	2.10%
Methods of Waste Segregation	Females	24.50%	49.10%	15.10%	9.40%	1.90%
	Males	31.90%	40.40%	12.80%	8.50%	4.30%
Sources of Solid Waste	Females	26.40%	45.30%	15.10%	11.30%	1.90%
	Males	34.00%	36.20%	8.50%	17.00%	2.10%
Techniques of SWM	Females	18.90%	39.60%	24.50%	15.10%	1.90%
	Males	25.50%	36.20%	17.00%	17.00%	2.10%
4R Principles	Females	32.10%	43.40%	9.40%	13.20%	1.90%
	Males	23.40%	44.70%	10.60%	17.00%	2.10%
Government Guidelines	Females	26.40%	41.50%	13.20%	15.10%	1.90%
	Males	17.00%	42.60%	23.40%	10.60%	2.10%
Methods by RMC	Females	26.40%	39.60%	18.90%	13.20%	1.90%
	Males	14.90%	44.70%	19.10%	12.80%	6.40%
Landfill Sites	Females	18.90%	22.60%	-	-	-
	Males	19.10%	10.60%	-	-	-



ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 12, Iss 01, 2023

5.1.2 Agreement Levels on SWM Statements

Statement	Category	Strongly Agree	Agree	Disagree
Familiarity with Waste Collection	Females	28.30%	56.60%	-
	Males	31.90%	42.60%	-
Knowledge of Waste Segregation	Females	43.40%	56.60%	-
	Males	38.30%	53.20%	-
Awareness of Environmental Harm	Females	41.50%	0.00%	54.70%
	Males	46.80%	40.40%	0.00%
Awareness Campaigns	Females	35.80%	43.40%	-
	Males	31.90%	42.60%	-



There is strong gender-based trends in awareness levels with regard to SWM, as well as participation rates, in Raipur. Females were generally more aware than males of the various types of solid waste and segregation, 4R principles amongst others; however, awareness of critical topics, such as landfill sites and agency participation, was very low amongst both genders. Only 18.9% of females and 19.1% of males were fully aware of landfill sites, showing a clear weakness in public understanding on key SWM processes.

One of the trends emerging from the responses is the disagreement among women regarding the impacts of poor waste management on the environment, in that 54.7% reported disagreement. This points to a critical gap in education and outreach regarding environmental sustainability.

Agreement levels toward awareness campaigns and waste segregation at home were high among both genders, indicating potential for positive behavioral changes with targeted awareness programs. Awareness campaigns focusing on landfill management, agency roles, and practical aspects of SWM could significantly improve public understanding and participation.

The survey revealed remarkable gender-based disparities in regard to awareness levels, where females have been shown generally to be more aware across most aspects of SWM. However,

differences in the gaps between knowledge and practice persist; although many respondents acknowledged that segregation of waste is important, they failed to do so regularly. This is along the lines of Kaur & Punera (2021), which argues that no amount of awareness can suffice to change behaviors unless accompanied by supportive infrastructure and enforcement. This gap thus demands targeted campaigns and appropriate facilities to promote practical involvement in waste segregation and recycling.

SWM cannot be successful without public awareness and participation. As per Gupta et al. (2015) and Sharholy et al. (2008), the main problem for establishing an efficient waste management system in Indian cities is the lack of knowledge in society concerning segregation and recycling of waste. Studies by Saja et al. (2021) and Joshi & Ahmed (2016) have demonstrated that cities with efficient public education and participation have fewer contaminations in the waste. In Bilaspur, public awareness initiatives have been successful in enhancing the segregation activity. According to Rathore & Sarmah (2019), these findings justify the efforts put for sustained education in municipal areas.

5.2 Willingness to Pay for Improved Waste Management

The following analysis presents the results of the survey on the willingness to pay (WTP) for solid waste collection services, focusing on respondents' preferences and opinions related to payment willingness, preferred payment methods, and utilization of the collected fees.

5.2.1 Willingness to Pay for Solid Waste Collection Services

Category	Females (%)	Males (%)
For Better Services	58.5	51.1
Government's Responsibility	41.5	46.8
Uncertainty	0	0

While a majority of respondents, especially females (58.5%), expressed willingness to pay for improved services, the opinion that waste collection should be a government responsibility was also prominent, especially among males (46.8%).

5.2.2 Willingness to Pay: Amount Per Month

Amount Range (₹)	Females (%)	Males (%)
Less than ₹20	30.2	19.1
₹20-50	35.8	34
₹50-100	18.9	17
More than ₹100	1.9	6.4
I don't want to pay	13.2	21.3

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 12, Iss 01, 2023

The results suggest that the majority of respondents (females 66%, males 53.2%) were willing to pay a modest amount for waste collection, with a significant portion of males (21.3%) unwilling to pay at all.

5.2.3 Preferred Payment Methods

Payment Method	Females (%)	Males (%)
Along with the monthly bill	37.7	36.2
Online payment	32.1	23.4
Direct cash payment to waste collectors	17	10.6
Any of the above	11.3	25.5

The majority of respondents, particularly females (37.7%), preferred paying along with the monthly bill, while a significant number of males (25.5%) were open to any of the payment methods.

5.2.4 Utilization of Fees Collected for Solid Waste Management

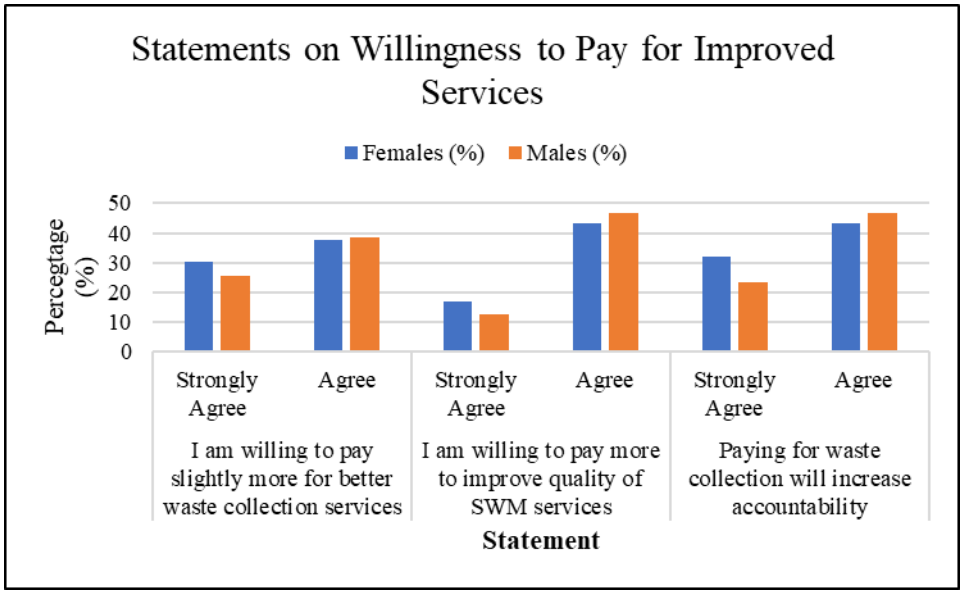
Utilization Purpose	Females (%)	Males (%)
Administrative expenses	7.5	2.1
Better vehicles and equipment	26.4	27.7
Developing recycling facilities	16.9	10.6
All of the above	47.2	55.3

A majority of both males and females (47.2% females, 55.3% males) agreed that the fees should be allocated to all the suggested purposes, particularly towards improving vehicles, equipment, and recycling facilities.

5.2.5 Statements on Willingness to Pay for Improved Services

Statement	Response	Females (%)	Males (%)
I am willing to pay slightly more for better waste collection services	Strongly Agree	30.2	25.5
	Agree	37.7	38.3
I am willing to pay more to improve quality of SWM services	Strongly Agree	17	12.8
	Agree	43.4	46.8
Paying for waste collection will increase accountability	Strongly Agree	32.1	23.4
	Agree	43.4	46.8

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 12, Iss 01, 2023



Overall, a significant portion of participants (females 68%, males 61.7%) agreed that they were willing to pay more for better services and that such payments would lead to increased accountability.

The survey data reveals that most of the respondents are ready to pay for municipal solid waste collection services. However, once again a significant portion feels the same should be the government's concern. Generally, people prefer month-long billing for this purpose. People have a strong inclination towards using fees for improving waste collection infrastructure and for developing recycling facilities. The willingness to pay for better services and the perception of higher accountability also strengthen the policy of paying to services for waste management, but financial constraints are still a concern to some.

The survey showed that there was a positive attitude of paying for better waste management services, since 60% of the respondents are willing to contribute mainly for waste segregation and recycling programs. That is in accordance with what Kaur & Punera (2021) observed: residents are usually to pay for services when clear environmental and economic advantages are promised. Despite this, there is still much apathy towards paying for waste collection, primarily because of economic motive and lack of perceived near-term benefit-the suggestion, however, that stronger incentives will be required to ensure mass participation.

Willingness to Pay (WTP) for better waste management services is a sine qua non for the sustainability of SWM systems. Kaur & Punera, (2023), concluded that the people in Rudrapur generally are willing to pay more for the enhanced collection and disposal services with higher efficiency and accountability. Gupta et al. (2015) and Zia & Devadas (2008) opine that municipal benefits can be garnered by pursuing fee-based systems combined with public education so that residents are willing to pay for quality services. The success of WTP programs in cities like Bharatpur (Rai et al., 2019) underlines the possible cost recovery in SWM.

5.3 Challenges in Solid Waste Management

This section presents the results of the survey on the challenges faced in solid waste management in the respondents' areas. The analysis covers various challenges related to waste collection, concerns, priorities for improvement, and suggested steps for improvement.

5.3.1 Major Challenges in Solid Waste Management

Challenge	Females (%)	Males (%)
Irregular Waste Collection	15.1	19.1
Garbage Pile-ups	20.8	12.8
Negligence by Waste Collectors	3.8	10.6
Lack of Waste Segregation	17	14.9
All of the Above	43.4	40.4

The findings show that the most prevalent challenge, especially for females (43.4%) and males (40.4%), is a combination of all the factors listed, including irregular waste collection, garbage pile-ups, negligence, and lack of waste segregation.

5.3.2 Most Common Issues Related to Waste Collection

Issue	Females (%)	Males (%)
Inconsistent Collection Timing	50.9	40.4
Insufficient Garbage Bins	28.3	25.5
Burning or Dumping of Garbage	20.8	31.9

The results suggest that **inconsistent collection timing** is the most common issue, particularly among females (50.9%), followed by burning or dumping of garbage, which was more frequently cited by males (31.9%).

5.3.3 Municipality's Top Priority for Waste Management Improvement

Priority	Females (%)	Males (%)
Purchasing More Waste Collection Vehicles	9.4	8.5
Optimizing Waste Collection Routes	0	4.3
Educating Residents on Waste Segregation	28.3	21.3

Improving Landfill Site Maintenance	18.9	6.4
All of the Above	43.4	57.4

The majority of respondents, particularly males (57.4%) and females (43.4%), believed that a combination of all improvements should be prioritized by the municipality.

5.3.4 Main Concern Regarding Solid Waste Management

Concern	Females (%)	Males (%)
Health and Hygiene	60.4	48.9
Environmental Protection	37.7	40.4
Cost of Waste Collection	1.9	4.3
Frequency of Collection	0	2.1

Health and hygiene were the primary concern for most participants, particularly for females (60.4%). Environmental protection was also a significant concern, but it was less pronounced compared to health concerns.

5.3.5 Effective Steps to Improve Solid Waste Management

Effective Step	Females (%)	Males (%)
Regular and Timely Waste Collection	34	31.9
Proper Disposal and Recycling	41.5	25.5
Establishing More Collection Points	0	10.6
Awareness Campaigns	17	12.8
Adherence to Cleanliness Standards	7.5	14.9

The majority of respondents, particularly females (41.5%), supported **proper disposal and recycling of waste** as the most effective step for improvement. Regular and timely waste collection was also crucial but slightly less favoured.

5.3.6 Statements on Solid Waste Management Issues

Statement	Response	Females (%)	Males (%)
Irregularity of Waste Collection	Strongly Agree	9.4	23.4
	Agree	49.1	63.8

Proper Disposal is a Significant Issue	Strongly Agree	35.8	25.5
	Agree	60.4	68.1
Difficulty Adhering to Cleanliness Standards	Strongly Agree	26.4	19.1
	Agree	45.3	34
Inconvenient Timing of Waste Collection	Strongly Agree	35.8	19.1
	Agree	41.5	44.7
More Awareness and Education Needed	Strongly Agree	47.2	46.8
	Agree	47.2	42.6
Municipality Should Allocate More Resources	Strongly Agree	37.7	44.7
	Agree	54.7	44.7

The survey indicated several major problems in solid waste management. The major issues included irregular waste collection and pile-ups, as well as the lack of segregation of waste. Concerns about health and hygiene cut across both genders; health emerged as the biggest problem for most respondents. The two crucial steps required for improvement included better timing for waste collection and proper disposal. Additionally, there is strong consensus on the necessity for increased awareness and education regarding waste management. Respondents also believe that the municipality should allocate more resources to improve waste management services, emphasizing a comprehensive approach to address these challenges.

Irregular collection is an issue in the waste management system of Raipur along with an increasing problem - garbage pile-up, and no segregation of the waste. Health and hygiene issues from both male and female respondents can be seen in line with what Multaniya et al., 2021 and Kaur & Punera (2021) conclude as not managing waste properly affects public health. Issues included irregular collection timings and too few waste bins, showing that in these areas there's more need for an infrastructure improvement and better service delivery consistency. The survey also showed broad support for education programs aimed at segregating waste, and it is such activities that can help resolve these persistent problems.

Challenges in SWM are seen across the rapidly urbanizing areas, including poor segregation waste, inadequate infrastructures, and lack of public participation. Indian cities like Raipur and Kanpur have increasingly faced issues of poor waste management due to increased rapid growth and unestablished effective waste collection systems, as reported by Joshi & Ahmed (2016). Studies by Sharholy et al. (2008), and Gupta et al. (2015) clearly emphasize the problems of waste management, disorganized waste collection and pollution in the environment. The inadequacy of suitable landfill sites and processing facilities also aggravates these problems (Multaniya et al., 2021).

5.4 Economic Prospects in Solid Waste Management

5.4.1 Economic prospects in solid waste management:

Question/Option	Female (%)	Male (%)
Investment in Solid Waste Management - Investments by the		

municipality in solid waste management are economically beneficial:		
Strongly Agree	35.8%	29.8%
Agree	56.6%	51.1%
Neutral	5.7%	14.9%
No Answer	1.9%	4.3%
Improvements in waste management can lead to long-term savings:	**Female (%)**	**Male (%)**
Strongly Agree	22.6%	27.7%
Agree	62.3%	55.3%
Neutral	13.2%	12.8%
No Answer	1.9%	4.3%
Establishing industries related to waste management can boost the local economy:	**Female (%)**	**Male (%)**
Strongly Agree	28.3%	34%
Agree	66%	53.2%
Neutral	3.8%	8.5%
No Answer	1.9%	4.3%
Economic Opportunities in Solid Waste Management	**Female (%)**	**Male (%)**
Income from recycling plants	45.3%	46.8%
Income from compost production	18.9%	21.3%
Income from energy generation	17%	10.6%
Employment generation	18.9%	17%
Reinvestment of Income from Solid Waste Management	**Female (%)**	**Male (%)**
Cleanliness and environmental conservation	77.4%	66%
Education	9.4%	21.3%
Healthcare	13.2%	4.3%
Infrastructure development	0%	2.1%

This table provides the breakdown of responses on various aspects of economic opportunities and reinvestment in solid waste management.

The results show that there is good support for the economic benefits in the management of solid waste, which is through investment and its potential to upgrade the local economy by means of recycling, compost production, and energy generation. On the other hand, income from the revenue scheme of waste management must be reinvested into environmental conservation and cleanliness, which indicates the need to upgrade the general living condition and sustainability of the place. This reflects the increasing awareness of economic and environmental value achieved through effective waste management practices.

Respondents agreed highly that investment in solid waste management has long-term economic returns through efficiency improvement and by calling for the establishment of

recycling industries and energy. According to Kaur & Punera (2021) and Malav et al. (2020), that waste management has various contributions both towards environmental conservation and regional economic development. Moreover, many respondents feel that an effective system of solid waste management would provide a good avenue for job creation and boosting local industries-an aspect enhancing the economic chances of the waste management system.

Resource recovery and waste-to-energy initiatives of SWM offer huge economic opportunities. Malav et al. (2020) and Guerrero et al. (2015) have also discussed the possibility of energy recovery through waste conversion, which could be an environmentally friendly disposal method and gives economic value as well. In Bilaspur cities, WTE projects are also being contemplated to reduce dependence on landfill sites (Rathore & Sarmah, 2019). The importance on recycling and resource recovery, as noted by Singh & Kota in 2015, will be an economic growth opportunity that addresses the environmental need in growing urban areas such as Raipur, according to Lanjewar et al. in 2014.

5.5 Challenges in the Establishment of Auxiliary Industries

5.5.1 Establishment of auxiliary industries in solid waste management:

Question/Option		
General Agreement on the Benefits of Waste Management Industries		
Establishing waste management industries benefits both the environment and the economy:	**Female (%)**	**Male (%)**
Strongly Agree	37.7%	48.9%
Agree	56.6%	2.1%
Neutral	5.7%	8.5%
Disagree	-	36.2%
Recycling plants can be set up for solid waste management:	**Female (%)**	**Male (%)**
Strongly Agree	17%	40.4%
Agree	75.5%	46.8%
Neutral	7.5%	6.4%
Disagree	-	2.1%
Local job opportunities can be increased by setting up auxiliary industries:	**Female (%)**	**Male (%)**
Strongly Agree	37.7%	36.2%
Agree	58.5%	55.3%
Neutral	3.8%	4.3%
Energy production plants (e.g., biogas) can be established through solid waste management:	**Female (%)**	**Male (%)**
Strongly Agree	18.9%	40.4%
Agree	73.6%	53.2%
Neutral	5.7%	2.1%
Compost production units can be established:	**Female (%)**	**Male (%)**

Strongly Agree	34%	36.2%
Agree	62.3%	53.2%
Neutral	3.8%	6.4%
Perceived Beneficiaries of Waste Management Industries	**Female (%)**	**Male (%)**
Municipality, industrial operators, and local residents (via job creation):	86.8%	78.7%
Measures to Encourage Waste Management Industries	**Female (%)**	**Male (%)**
Providing subsidies and tax exemptions:	11.3%	10.6%
Guaranteeing the purchase of products from these industries:	13.2%	8.5%
Partnering with these industries for waste disposal:	26.4%	21.3%
All of the above	49.1%	53.2%
Support for Establishing Waste Management Industries	**Female (%)**	**Male (%)**
Yes, definitely	60.4%	68.1%
Maybe, depending on how the industries are managed	37.7%	23.4%
No, I think it won't be beneficial	1.9%	2.1%

This table summarizes the responses regarding the establishment of auxiliary industries in solid waste management, including the benefits, measures to encourage them, and support for their establishment.

The studies reveal a strong support towards implementation of waste management industries especially among females. Males and females concur to the effect that there would be environmental and economic benefits if these industries are implemented, in terms of job offerings and improved waste management. In terms of incentive promotion of financial issues and collaborations with waste management industries, perceptions of best measures are diverse. On a general level, respondents have greatly favoured the establishment of solid waste management industries; however, dependent management is slightly preferred for some.

The waste management industries have faced low-quality segregations, financial restraint, and legal hurdles in establishing these. According to Malav et al. (2020) and Kaur & Punera (2021), the local government authorities mostly cannot afford to fund such industries. However, the majority of the population is enthusiastic about auxiliary industries, particularly the women who consider this can generate employment and enhance waste management. Even though financial incentives and partnerships are very pivotal for achieving success, the regulatory framework has been emphasized and viewed as being highly essential for successful management.
Auxiliary industries, such as recycling plants and WTE facilities, are inherently capital-intensive from the initial capital investment perspective and also face regulatory hindrances.

As per Malav et al. (2020), though WTE holds high potential, technological, financial, and political barriers often act as an impediment toward its full acceptability in cities such as Raipur. As Gupta et al. (2015) and Jharia (2014) further state, infrastructural inadequacy, a lack of proper policy support, public resistance are some factors that hinder the development of supplementary industries in SWM. Such industries require thoughtful planning, investment, and active engagement with stakeholders to counter such issues and provide positive value addition to sustainable waste management.

6. Recommendations

6.1 Public Education and Social Mobilization

Public awareness is integral for the proper functioning of SWM systems. Given that both cities, Raipur and Rudrapur, are fast transforming into urban communities, municipal investments in public education exercises on segregation of waste and recycle should be mainstreamed. Educating the public makes it possible to reduce contamination in recyclables, as waste ends up being more well segregated, as provided by Gupta et al. in 2015 and Sharholy et al. in 2008. Interactive workshops, media campaigns, and school-based programs can instill responsible behavior in managing wastes. Further, public participation in the decisions of waste management can be incentivized. Such models of community engagement have gained success in cities such as Bharatpur, as indicated by Rai et al. (2019). This will enhance the overall efficiencies of SWM services.

6.2 Receptions of WTP Mechanisms

For SWM systems to become financially sustainable, there should be engaging of the willingness of residents to pay for improved services. Kaur & Punera (2023) and Zia & Devadas (2008) research findings support this claim. For as long as its residents were provided with clear, efficient, and well-organized services, the residents of urban centers always were willing to pay for improved waste management. Municipalities can contemplate user charges for collection and disposal of waste with suitable incentives and price schemes in conformity with the level of services. A stratified WTP framework may be applied due to income levels for the purpose of equity. The proposal by Rai et al. (2019) that user charges holding appropriate liability and providing mechanisms for feedback mechanism can raise needed revenues for sustaining and enhancing provision of SWM services.

6.3 Issues related to Solid Waste Management in Raipur

Taking into view the challenges facing SWM in Raipur, improvement of it will require a more integrated approach. Source segregation of waste along with the newer collection system is needed these days (Sharholy et al., 2008). The municipalities need to upgrade the existing infrastructure of waste bins, collection vehicles, and sorting facilities. Geospatial techniques, like those studied by Multaniya et al. (2021), can determine the location of potential landfill sites and optimize collection routes. Development of appropriate technical infrastructure and making constant waste collection will help keep littering and pollution to a minimum in urban areas. The integration of informal waste collectors into the formal SWM

system can improve efficiency at the operational level and minimize operational difficulties associated with waste collection.

6.4 Waste-to-Energy Projects:

WTE projects represent economic opportunities related to SWM through the production of renewable energy while attempting to move away from landfills. According to Malav et al. (2020) and Guerrero et al. (2015), municipalities must invest in WTE technologies to recover energy from organic waste, thus reducing the use of landfills. For example, pilot plants of WTE may start cropping up in metropolitan cities such as Bilaspur, as envisioned by Rathore & Sarmah (2019). In addition, municipalities ought to foster private sector involvement in the implementation of WTE projects by setting up an appropriate enabler regulatory framework and incentives for investors.

6.5 Overcoming Challenges in Establishing Auxiliary Industries

The establishment of auxiliary industries such as recycling plants and WTE facilities faces several barriers, including financial and regulatory hurdles. To address these challenges, it is essential for governments to provide clear policies and financial incentives to attract investment in these sectors. As Jharia (2014) and Gupta et al. (2015) point out, public-private partnerships can form a significant role in getting over the capital investment barrier. Additionally, if research into cost-effective technologies and the development of innovation in waste processing are encouraged to reduce operational costs and make such industries morefeasible.

7. Conclusion

Thus, in Raipur city, that are rapidly urbanizing, improvement of SWM would demand an all-inclusive approach. Public education and participation are significant keys for effective waste collection, segregation, and recycling. User fee-based systems, which are financially viable through residents' willingness to pay for better services, can be instrumental for SWM being turned financially more sustainable. Still, infrastructural deficiencies, lack of segregation of waste, and regulatory constraints would have to be overcome to make a smooth transition toward a more efficient SWM system. In addition, the gaining acceptance of waste-to-energy projects coupled with overcoming barriers in the development of auxiliary industries would significantly enhance the economic prospects of SWM. Public-private partnership as well as innovation should be encouraged for setting up a sound SWM framework for the safe and sustainable management of urban waste. Then, if such recommendations are followed, cities will strengthen their waste management systems, reduce harmful environmental impacts, and boost their regional economy.

These strategies, therefore, will give the way to cleaner, greener, and more sustainable cities for better mutual benefits of community and the environment.

8. Bibliography

1 Guerrero, L., Maas, G., & Hogland, W. (2015). Solid waste management challenges for cities in developing countries. *Waste Management*, 33(1), 220-232. https://doi.org/10.1016/j.wasman.2012.09.008

2 Gupta, N., Yadav, K., & Kumar, V. (2015). A review on current status of municipal solid waste management in India. *Journal of Environmental Sciences, 37*, 206–217. https://doi.org/10.1016/j.jes.2015.01.034

3 Gupta, N., Yadav, K., & Kumar, V. (2015). A review on current status of municipal solid waste management in India. *Journal of Environmental Sciences*, 37, 206-217. https://doi.org/10.1016/j.jes.2015.01.034

4 Jharia, B. (2014). Waste management: A study on Raipur Waste Management Private Limited. *Recent Research in Science and Technology*, 6(4), 199-202.

5 Joshi, R., & Ahmed, S. (2016). Status and challenges of municipal solid waste management in India: A review. *Cogent Environmental Science, 2*. https://doi.org/10.1080/23311843.2016.1139434

6 Joshi, R., & Ahmed, S. (2016). Status and challenges of municipal solid waste management in India: A review. *Cogent Environmental Science*, 2, 1139434. https://doi.org/10.1080/23311843.2016.1139434

7 Kaur, S., & Punera, A. (2022). Enhancing Municipal Solid Waste Management in Rapidly Urbanizing Areas: A Case Study of Rudrapur City, India. *Journal of Environmental Science and Economics.* https://doi.org/10.56556/jescae.v2i4.616

8 Kaur, S., & Punera, A. (2022). Enhancing municipal solid waste management in rapidly urbanizing areas: A case study of Rudrapur City, India. *Journal of Environmental Science and Economics*, 2(4), 616. https://doi.org/10.56556/jescae.v2i4.616

9 Kumar, A., & Agrawal, A. (2020). Recent trends in solid waste management status, challenges, and potential for future Indian cities: A review. *Current Research in Sustainability*, 2, 100011. https://doi.org/10.1016/j.crsust.2020.100011

10 Lanjewar, S., Sharma, K., & Mahishwar, A. (2014). Solid waste management need & implementation in Raipur, Chhattisgarh. *Recent Research in Science and Technology, 6*, 60–61.

11 Lanjewar, S., Sharma, K., & Mahishwar, A. (2014). Solid waste management need & implementation in Raipur, Chhattisgarh. *Recent Research in Science and Technology*, 6(4), 60-61.

12 Malav, L., Yadav, K., Gupta, N., Kumar, S., Sharma, G., Krishnan, S., Rezania, S., Kamyab, H., Pham, Q., Yadav, S., Bhattacharyya, S., Yadav, V., & Bach, Q. (2020). A review on municipal solid waste as a renewable source for waste-to-energy project in India: Current practices, challenges, and future opportunities. *Journal of Cleaner Production, 277*, 123227. https://doi.org/10.1016/j.jclepro.2020.123227

13 Malav, L., Yadav, K., Gupta, N., Kumar, S., Sharma, G., Krishnan, S., Rezania, S., Kamyab, H., Pham, Q., Yadav, S., Bhattacharyya, S., Yadav, V., & Bach, Q. (2020). A review on municipal solid waste as a renewable source for waste-to-energy projects in India: Current practices, challenges, and future opportunities. *Journal of Cleaner Production*, 277, 123227. https://doi.org/10.1016/j.jclepro.2020.123227

14 Multaniya, A., Verma, S., & Beg, M. (2021). Assessment of suitable landfill site using geospatial techniques: A case study of Raipur urban region, Chhattisgarh, India. *International Journal of Research, 9*, 132–148. https://doi.org/10.29121/granthaalayah.v9.i3.2021.3778

15 Multaniya, A., Verma, S., & Beg, M. (2021). Assessment of suitable landfill site using geospatial techniques: A case study of Raipur urban region, Chhattisgarh, India. *International Journal of Research*, 9(3), 132-148. https://doi.org/10.29121/granthaalayah.v9.i3.2021.3778

16 Rai, R., Nepal, M., Khadayat, M., & Bhardwaj, B. (2019). Improving municipal solid waste collection services in developing countries: A case of Bharatpur metropolitan city, Nepal. *Sustainability*, 11(13), 3010. https://doi.org/10.3390/su11113010

17 Rathore, P., & Sarmah, S. (2019). Modeling transfer station locations considering source separation of solid waste in urban centers: A case study of Bilaspur city, India. *Journal of Cleaner Production*, 241, 118267. https://doi.org/10.1016/j.jclepro.2018.11.100

18 Saja, A., Zimar, A., & Junaideen, S. (2021). Municipal solid waste management practices and challenges in the southeastern coastal cities of Sri Lanka. *Sustainability*, 13(8), 4556. https://doi.org/10.3390/su13084556

19 Sharholy, M., Ahmad, K., Mahmood, G., & Trivedi, R. (2008). Municipal solid waste management in Indian cities - A review. *Waste Management, 28*(2), 459–467. https://doi.org/10.1016/j.wasman.2007.02.008

20 Sharholy, M., Ahmad, K., Mahmood, G., & Trivedi, R. (2008). Municipal solid waste management in Indian cities - A review. *Waste Management*, 28(2), 459-467. https://doi.org/10.1016/j.wasman.2007.02.008

21 Singh, L., & Kota, S. (2015). An analysis on TGA/DTA for municipal waste of Raipur city. *International Journal of Scientific Research*, 1, 12-15.

22 Zia, H., & Devadas, V. (2008). Urban solid waste management in Kanpur: Opportunities and perspectives. *Habitat International, 32*, 58–73. https://doi.org/10.1016/j.habitatint.2007.08.001

23 Zia, H., & Devadas, V. (2008). Urban solid waste management in Kanpur: Opportunities and perspectives. *Habitat International*, 32(1), 58-73. https://doi.org/10.1016/j.habitatint.2007.08.001