



Research Article

Assessment of Household Practices of Solid Waste Management in Jammu City, India

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Abstract: The problem of Solid Waste Management (SWM) has gained recent attention in developing countries. The city of Jammu being a major city of Union Territory (UT) J&K, a prominent tourist and pilgrim site is facing a massive upheaval in the waste generation rates. The city is facing a sharp contrast between increasing generation rates on one hand and inadequacy of funds on the other hand. Jammu city is observed to generate 350-400 Tons per Day (TPD) with a per capita generation of 550 grams per day. The survey shows that residents of the city do not segregate waste at the source, possess inadequate storage facilities and often dump the waste openly without any treatment. They tend to have little knowledge about the efficient practices of waste management, adverse consequences on the environment and public health and the prevailing laws in the state. Thus, the sound planning of waste management study attempts to address the challenges linked to current household waste management practices. The study further recommends resorting to the practice of 3 Rs-Reduce, reuse and recycle, involving households in segregation at the source, making the residents aware of the existing by-laws and encouraging their participation in efficient waste management practices. These practices will act as a driver for behavior change of individuals towards efficient household practices of managing waste.

Keywords: solid waste management, household practices, Jammu city

JEL Code: Q01, Q53, R20, H80, Q50, Q58

1. Introduction

The problem of Solid Waste Management (SWM) has gained recent attention in developing countries (Hoorweg & Bhada-Tata, 2012). With the increase in urbanization, population and changing production and consumption patterns, the waste generation rates have up surged (Kreith & Tchobanoglous, 2002). Inadequate resources and a lack of administrative, legal, technical and institutional sets ups complicate the management of solid waste in developing countries including India. Solid waste segregation, waste collection systems, transportation systems and disposal methods have been evidenced to be unsustainable in India (Alam & Ahamade, 2013; Banerjee et al., 2019; Priti & Mandal, 2019). The Urban Local Bodies (ULBs) to whom the jurisdiction is endowed have failed to perform these services efficiently (Abarca-Guerrero et al., 2013).

India is witnessed to be the third largest producer of waste (International Solid Waste Association, 2013). According to the CPCB report 2019-2020, India is proclaimed to generate 150,761 Tons per day of solid waste (Central Pollution Control Board, 2018). The “Taskforce on Waste to Energy” Report 2014 by the Planning Commission estimated that India is expected to generate 0.45 million Tons per Day (TPD) of waste by 2031 and 1.19 million TPD by 2050 (Planning Commission Report, 2014). The per capita solid waste generation has increased at the rate of 1.3% per annum and is currently reported to be 450 grams per day (Das et al., 2019). In Indian cities, solid waste is disposed of unscientifically or in open dumps without proper controls and precautions thereby adversely affecting all the components of the environment and public health (Gupta et al., 1998). Unsanitary Landfilling is recorded to be the most usual disposal practice in India because it is economically feasible and requires no technical expertise (Sharholly et al., 2008).

Many cities in India are facing serious environmental degradation and health risks due to inefficient management of solid waste (Joshi & Ahmed, 2016). The city of Jammu being a major city of UT J&K, a prominent tourist and pilgrim site is facing a massive upheaval in the waste generation rates. The city is facing a sharp contrast between increasing generation rates on one hand and inadequacy of funds on the other hand (Masood & Ahmed, 2020). Jammu city is observed to generate 350-400 TPD with a per capita generation of 550 grams per day (Rabani & Thakur, 2020). The principal source of generation of waste is local inhabitants, vegetable and fruit shops, restaurants, hotels, hospitals, clinics and religious establishments. The Jammu Municipal Corporation is responsible for managing solid waste in the city. There exists almost no segregation at the source in the city due to a lack of awareness among residents (Kumar & Singh, 2013). The collection efficiency is reported to be as high as 90% (Alam et al., 2021). Despite the high collection efficiency, the collected waste is dumped onto the open trenching grounds at Kot Bhalwal without any prior treatment. There is no scientific treatment of waste in the city (Sharma, 2015). Open dumping of waste poses serious environmental and health risks to the nearby inhabitants.

Previous literature has held supply-side management responsible for inefficient SWM practices. However, there is a need to shift the focus towards demand-side management. Residents of the city are held accused of excessive waste generation rates and poor practices to handle the waste. Residents of the city are observed to follow poor practices of waste segregation, waste storage and waste disposal. They tend to have little knowledge about the efficient practices of waste management, adverse consequences on the environment and public and the prevailing laws in the state. To develop a sustainable SWM system in the city households need to adopt efficient and proper SWM practices.

According to the United Nations Statistical Division, SWM is a discipline that encompasses the generation, storage, collection, transportation, disposal and treatment of waste. This cradle-to-cradle approach best addresses the public health, environmental, financial and aesthetic considerations. The research attempts to explore current waste management practices from the generation of waste to dispose of waste. It further assesses the knowledge, awareness and participation of residents in waste management practices in the city.

The findings of the study are crucial for the waste management authorities to design and provide an effective and specific action plan in the city. The policymakers will be able to address the challenges associated with SWM practices at the household level. The study would help environmental educators, health officers, researchers, government officials and the general public in framing community-based SWM promotion activities to encourage mass participation. The findings would further contribute in building mass awareness programs aiming to improve the knowledge and perception of the individuals. The following research can be further used as a basis for future participatory and inclusive waste management setups in local communities.

2. Literature review

The literature shows that there exists plenty of studies on current waste management practices, socio-economic factors affecting waste management practices, perceptions, behavior and knowledge of individuals towards the waste management practice. Stanley et al. (2012) address the poor waste management practices in SabonGari, Zaria. The study concludes that households generated a substantial amount of waste that ends up in drains, vacant plots and roadsides affecting the environment and public health adversely. The government authorities lacked funds and acted imprudent in overcoming the SWM challenges. The research recommends community-based public enlightenment on the environment and health impacts associated with improper management of Solid Waste. Monney et al. (2013) assess the characteristics of existing SWM in urban areas of Ghana: inconsistent waste collection services, poor waste recovery

mechanisms, disposal of unsegregated waste, lack of regulations and low participation rate of the private solid waste collection company. The study suggests adopting efficient waste recovery mechanisms and cost recovery mechanisms via pay as you dump method to offset the waste management costs. Yoda et al. (2014) use a mixed method approach to assess the disposal practices and perceptions of households in Urban Accra. The study concludes that the majority of the waste generated by households largely consisted of food and plastics. The generated waste is stored in uncovered bins without being segregated. A large proportion of the households practiced indiscriminate and crude dumping in gutters, streets roads, etc. The author suggests improving people's practices and perceptions, provision of more community bins and more engagement of private contractors to handle the waste management practices efficiently. Suthar and Singh (2015) estimates the quality and quantity of household solid waste generated among different socio-economic groups and family sizes in Dehradun city. The generation rate of waste was higher in higher-income groups followed by middle and low-income groups. The generation rates increased with the increase in family size showing a positive correlation. The major constituents of waste reported were majorly kitchen/food waste followed by plastics, cardboard, glass/ceramic and other miscellaneous waste. The study puts forward waste as a potential source of energy and manure. Birara and Kassahun (2018) examined household solid waste management practices in the city of Bahir Dar, Ethiopia. The study shows that 78% of the respondents felt that existing SWM services were not satisfactory. Only 29% of respondents receive SWM services that too once a week. 66% of sample respondents practice illegal disposal of waste posing environmental risks. The author indicates poor monitoring and implementation of the SWM services in the city and suggests the households, municipal authorities, micro and small enterprises and Non-Governmental Organizations (NGOs) effort together to improve the status of SWM services. Ibrahim et al. (2019) surveyed that conducting health awareness programs have a profound effect on improving the families' knowledge and their stated practices regarding Household Solid Waste Management (HSWM). Muiruri et al. (2020) evaluated the residents' disposal practices of solid waste in Eastleigh Nairobi County, Kenya. The study documents irregular waste collection, illegal disposal, lack of awareness amongst the residents, reluctance to pay for SWM services and high cost of curbside services. The study recommends optimum allocation of resources to handle SWM services effectively and further suggests encouraging participation of relevant stakeholders and creating awareness through Information, Education, and Communication (IEC) programs. Balu et al. (2020) used participatory research methodology based on the Human Centred Design (HCD) approach to assess the impact of poor waste management and sanitation practices in Indpur, Himachal Pradesh. The HCD approach provides a novel solution for constructing plastic blocks that address the twin challenge of plastic waste management and unhygienic sanitation practices. Odonkor et al. (2020) surveyed the SWM practices among households in Ghanaian districts. The study found that community bins were located at distant places, the number of waste collection points was very few and the distance from the community to the final disposal site covered a journey of 1-2 hours. Poor sanitation in the study area resulted in the morbidity of diseases such as malaria, diarrhea, cholera and other related diseases. Keeping in few the major findings the authors recommend district assembly provides waste collection bins to every household to avoid indiscriminate disposal. Addo et al. (2020) evaluate the SWM practices and concerning challenges in the Techiman Municipality, Bono East Region. It is observed that households were dissatisfied with the working of the Municipality towards SWM. The Results show that increasing per capita generation rates, lack of collection efficiency, no source segregation, lack of recycling, poor participation of the private sector, non-compliance with Municipal Solid Waste Management Rules (MSWM) rules, inadequate infrastructure for scientific treatment and disposal of solid waste have given rise to the problem of SWM in the municipal area. The study recommends adopting source segregation, making households aware of the by-laws, encouraging private sector participation and constructing a sanitary landfill to cope with the existing scenario of SWM. Chikowore (2021) examines the social and demographic factors influencing waste disposal practices in Chitungwiza, Zimbabwe. The study reveals that gender, income and employment are the factors influencing residents' waste management practices. Research further suggests environmentalists formulate strategies on SWM keeping in view the social-economic status of the participants. Anyasi and Atagana (2021) analyzed the domestic practices of managing SWM in the Ethekewini Metropolitan Area. The study found that residents in urban suburbs and peri-urban suburbs are engaged in inefficient and ineffective methods of managing waste thereby causing adverse environmental consequences. Sultana et al. (2021) aimed to examine the practice of SWM amongst households in the Mugda community, Dhaka. The study reveals that the level of awareness and practice of household SWM stands at a moderate level. Training on household SWM and recyclable waste management were found to be statistically correlated with household SWM. Mahmood et al. (2021) report that MSWM

in Dir city largely comprises residential waste followed by commercial waste. Concerned Municipal Authorities have failed to perform the MSWM services efficiently due to a lack of available resources. The research further highlights the negative consequences on the environment and public health due to existing poor practices of MSWM. Fadhullah et al. (2022) investigate the perceptions and practices among residents in Panji, Malaysia regarding household SWM. Using Principal Component Analysis the study identifies the positive relationship between waste segregation and age, marital status and type of house. The study highlights the importance of waste segregation and encourages community participation in segregating the waste and further adopts the 3R approach. Lazo and Gasparatos (2022) studied the prevalence of positive and negative behaviors towards various household SWM practices. Results have been analyzed using Exploratory Factor Analysis (EFA). It is observed that satisfaction with waste management services has a negative significant influence on existing backyard burning and illegal dumping behaviors while the distance of the households from the city center (remoteness of the households) has a positive significant influence on these negative behaviors. Attitudes, awareness and knowledge of the households have a positive influence on source segregation and recyclable donation. Income and location are observed to most relevant predictors for the use of the drop-off stations and the selling of recyclables.

The literature reveals that the sustainability of waste segregation, storage and disposal practices are largely influenced by human behavior, perception and awareness. It also showed that the efficiency of waste collection services is determined by clientele perception and satisfaction. A holistic assessment of SWM practices and services is incomplete without the views of patronage. The improvement strategies of the above literature should not be considered as an end but their inferences should be used to design and implement target-specific programs for a marked population. Moreover, less attention has been paid to understanding the context details of HWM practices in Jammu city.

With the above backdrop, the objectives of the study are:

- To ascertain the social-economic profile of the residents of the study area.
- To identify the household practices of waste management in the study area.
- To assess the knowledge and perception of households towards sustainable waste management practices.

3. Material and methods

3.1 Sample design

Jammu is the winter capital of the Indian Union Territory of Jammu & Kashmir. It is the largest city in the Jammu District. The city lies on the banks of River Tawi and is surrounded by northern plains and the Himalayas on the south and north respectively. The city covers an area of 240 square kilometers and is divided into 75 wards which are grouped into 3 zones based on the passing of River Tawi as shown in Figure 1. Zone 1 & 2 lie on the northern bank of the river while Zone 3 is located on the southern bank. Zone 1 covers the old city area with a highly dense population and poses serious challenges for the collection and transportation of waste. Zone 2 encompasses the semi-urban areas of the old city which extends to Barnai, Shazadpur and Chenora-Keran. Zone 3 is locally called as Trikuta Region having a high-income population area thus producing a good amount of waste in comparison with the other wards.

The population of Jammu has been recorded as 612,163 based on a census in 2011 with a representation of 52.7% as males and 47.3% of females. In addition to this, the city has been divided into 75 sanitary wards at the municipal level for the execution of various administrative activities. Out of the total wards, 8 (10% of the total wards) wards have been selected using proportional sampling. The purposely selected wards are Trikuta Nagar, Gandhi Nagar, Bahu West, Bahu East, MohallaMalhotrian, Bhagwati Nagar, Greater Kailash and TawiVihar as shown in Figure 2. These wards are further categorized into Jammu Development Authority (JDA) and Housing Colonies, Private Colonies, Slum areas and Old city and its fringes. A sample of 60 respondents has been selected from each ward thus making a sample equal to 480.

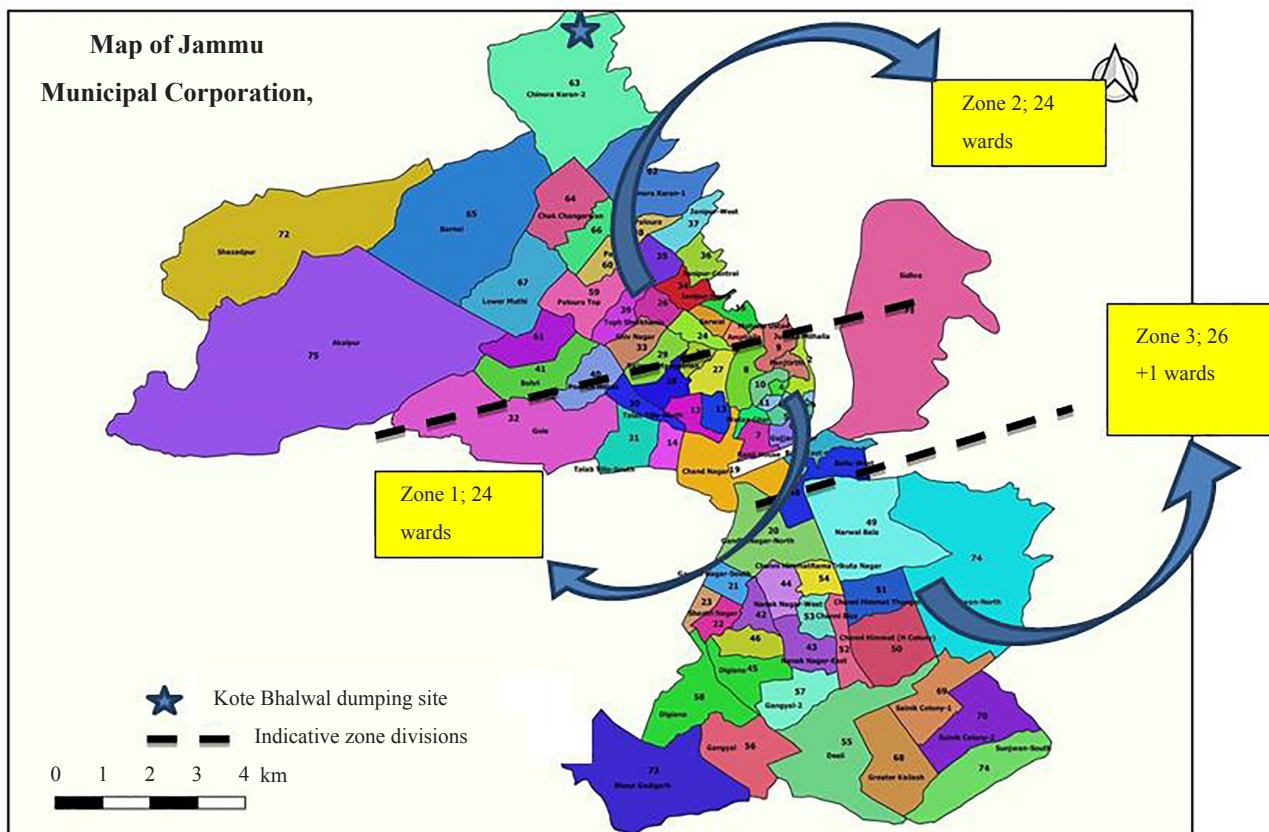


Figure 1. Map of Jammu Municipal Corporation, J&K, India.

Source: Jammu Municipal Corporation, 2020

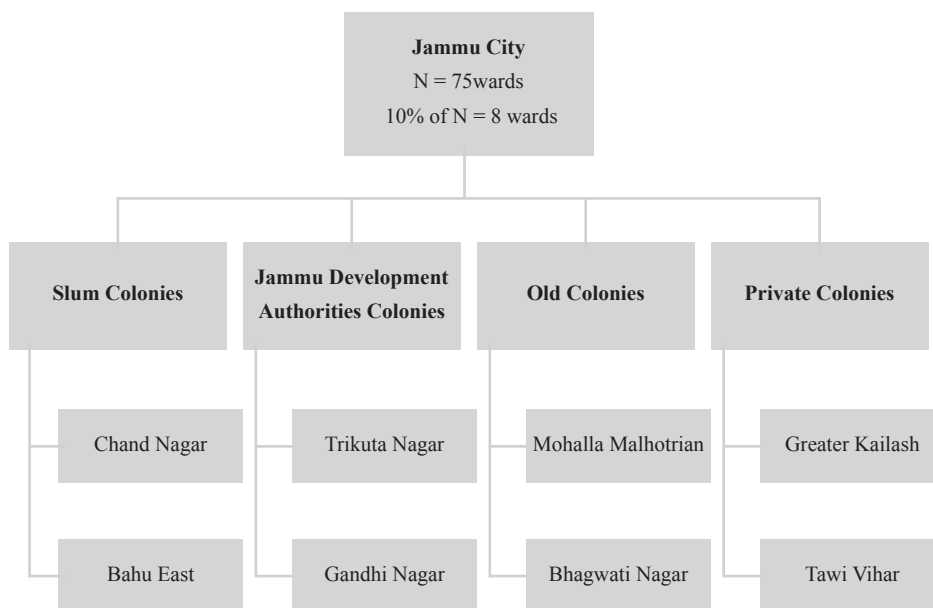


Figure 2. Selected wards for Sampling

3.2 Methodology

The Social dimension of MSWM is evaluated in terms of the household's current practices of waste management, households' behavior and household's knowledge towards sustainable practices of SWM. A cross-section study design was conducted for the compilation of primary data. The author has conducted face-to-face interviews via structured interview schedule with the households. The interview schedule was framed in English language. However, the questions were asked by the author in Hindi and other local languages. The average time taken for each interview was approximately 15-20 minutes. Before conducting final survey, a pilot test was conducted on a sample of 80 respondents and the Cronbach Alpha was found to be 0.76. The final survey instrument comprised three sections. The first section comprised the social-economic profile of the respondents. It contained the gender, age, education, income and marital status of the respondents. The second section consisted of structured and semi-structured questions on current household practices of segregating, storing, collecting, disposing and treating waste. The third section pertains to yes/no type questions concerning awareness about sustainable practices, Municipal Solid Waste (MSW) Rules and environmental repercussions. Descriptive statistics such as frequencies and percentages were used to measure the above variables.

4. Results

4.1 Assessment of solid waste management practices of the households

Solid Waste Management practices encompass waste generation, segregation, storage, primary and secondary collection, transfer and transportation, treatment and disposal of waste. The following objective attempts to identify the structure of SWM and the sustainability of the process from generation to disposal through households' behavioral perspective.

4.1.1 Social and economic profile of the respondents

The social economic attributes of the respondents were studied in terms of their gender, age distribution, caste, family size, marital status, education and monthly income. The frequency and percent distribution of respondents for each selected independent variable have been presented separately as Table 1.

Table 1 shows the social profile of the respondents in the study area. The majority of the respondents are males in JDA Colonies (58.33%) and Private Colonies (56.67%), while the majority of the respondents are females in Old City (55.83%) and Slum Areas (50.83%). A considerable proportion of the respondents lie between 20-60 years in all the selected wards. The majority proportion of sample respondents in Trikuta Nagar (71.7%), Gandhi Nagar (78.3%), Greater Kailash (63.3%), Tawi Vihar (53.3%) and Bhagwati Nagar (60%) belongs to the general caste. The proportion of Schedule Caste respondents is high in Bahu East (70%), followed by Bahu West (26.7%) and Malhotra Mohalla (25%). Few percentages of the OBC respondents are found in Malhotra Mohalla and Bahu West wards. A large proportion of the sample respondents are found to be married in each selected ward, with very few proportions of the respondents being divorced or widowed/widower. The survey shows that most of the sample respondents (59.83%) in the City have a family size of between 1-4 members.

Table 1. Social Economic Profile of the Respondents

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Gender of the Respondents					
Male	70 (58.33)	68 (56.67)	53 (44.17)	59 (49.17)	250 (52.08)
Female	50 (41.67)	52 (43.33)	67 (55.83)	61 (50.83)	230 (47.92)
Total	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)
Age of the Respondents					
0-20	30 (25.00)	16 (13.33)	18 (15.00)	18 (15.00)	82 (17.08)
20-40	24 (20.00)	40 (33.33)	24 (20.00)	44 (36.67)	132 (27.50)
40-60	42 (35.00)	44 (36.67)	48 (40.00)	40 (33.33)	174 (36.25)
Above 60	24 (20.00)	20 (16.67)	30 (25.00)	18 (15.00)	92 (19.17)
Total	120 (100)	120 (100)	120 (100.00)	120 (100)	480 (100)
Caste of the Respondents					
General	90 (75.00)	70 (59.32)	68 (56.67)	65 (54.17)	293 (61.30)
Schedule caste	18 (15.00)	28 (23.73)	27 (22.50)	27 (22.50)	100 (20.92)
Schedule Tribe	02 (01.67)	09 (07.63)	06 (05.00)	01 (00.83)	18 (03.77)
OBC	10 (08.33)	11 (09.32)	19 (15.83)	27 (22.50)	67 (14.02)
Total	120 (100)	118 (100)	120 (100)	120 (100)	478 (100)

Table 1. (cont.)

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Marital Status of the Respondents					
Unmarried	46 (38.33)	48 (40.00)	25 (20.83)	32 (26.67)	151 (31.46)
Married	61 (50.83)	67 (55.83)	74 (61.67)	77 (64.17)	279 (58.13)
Divorced	02 (01.67)	00 (00.00)	02 (01.67)	01 (00.83)	05 (01.04)
Widow/Widower	11 (09.17)	05 (04.17)	19 (15.83)	10 (08.33)	45 (09.38)
Total	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)
Family Size of the Respondents					
1-4 members	69 (57.50)	84 (70.00)	60 (50.00)	72 (60.00)	285 (59.38)
5-10 members	51 (42.50)	36 (30.00)	60 (50.00)	48 (40.00)	195 (40.63)
Total	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)

Note: Figures in parentheses represent the percentage of the column's total
Source: Field Survey

Table 2 shows the education profile of the respondents. The majority proportion of the respondents in JDA Colonies (58.33%) and Private Colonies (61.67%) have attained High School and University education. However, in Old city areas (40.83%) and Slum areas (35%), few sample respondents have attended High Schools and Universities. The proportion of respondents with primary and secondary education is high in these areas.

Table 3 shows the income profile of the respondents. A large proportion of the respondents in JDA Colonies (65%) and Private colonies (50%) have an income above Rs. 50,000 per month. Most of the sample respondents in the Old City (81.67%) and Slum area (88.3%) have an income between Rs. 0-50,000 per month. The JDA and Private Colonies have higher income groups than the Slum and Old City Areas.

Table 2. Education Profile of the Respondents

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Primary	26 (12.67)	14 (11.67)	28 (23.33)	34 (28.33)	102 (21.25)
Secondary	30 (25.00)	27 (22.50)	33 (27.50)	40 (33.33)	130 (27.08)
High school	40 (33.33)	42 (35.00)	31 (25.83)	21 (17.50)	134 (27.92)
University	24 (20.00)	32 (26.67)	18 (15.00)	09 (7.50)	83 (17.29)
No formal education	00 (00.00)	05 (04.17)	10 (08.33)	16 (13.33)	31 (06.46)
Total	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)

Note: Figures in parentheses represent the percentage of the column's total
Source: Field Survey

Table 3. Monthly Income Profile of the Respondents (in Rupees)

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Below Rs. 20,000	18 (15.00)	40 (33.33)	58 (48.33)	53 (44.17)	169 (35.21)
Rs. 20,000-50,000	24 (20.00)	20 (16.67)	40 (33.33)	53 (44.17)	137 (28.54)
Rs. 50,000-80,000	42 (35.00)	38 (31.67)	22 (18.33)	14 (11.67)	116 (24.17)
Above Rs. 80,000	36 (30.00)	22 (18.33)	00 (0.00)	00 (0.00)	58 (12.08)
Total	120	120	120	120	480

Note: Figures in parentheses represent the percentage of column total
Source: Field Survey

4.1.2 Generation of municipal solid waste

Quantification and characterization of household wastes play a significant role in estimating material recovery potential and determining sources of generation, treatment methods, and final disposal ways. The following Table estimates the quantity of waste generation per day and the type of waste generated by the households.

Table 4. Quantity of Waste generated per household per day

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
0-2 Kg	101 (84.17)	109 (90.83)	105 (87.50)	114 (95.00)	429 (89.38)
2-5 Kg	19 (15.83)	11 (09.17)	15 (12.50)	06 (05.00)	51 (10.63)
Above 5 Kg	00 (00)	00 (00)	00 (00)	00 (00)	00 (00)
Total	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)

Note: Figures in parentheses represent the percentage of column total

Source: Field Survey

Table 5. Type of waste generated by the households

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Food waste	120 (100.00)	120 (100.00)	120 (100.00)	120 (100.00)	480 (26.86)
Plastic	109 (90.83)	103 (85.83)	99 (82.50)	99 (82.50)	410 (22.94)
Paper/Cardboard	89 (74.17)	80 (66.67)	76 (63.33)	86 (71.67)	331 (18.52)
Rubber	28 (23.33)	34 (28.33)	22 (18.33)	42 (35.00)	126 (07.05)
Textiles	15 (12.50)	12 (10.00)	04 (03.33)	13 (10.83)	44 (02.46)
Wood	14 (11.67)	09 (07.50)	04 (03.33)	11 (09.17)	38 (02.13)
Glass	38 (31.67)	35 (29.17)	37 (30.83)	61 (50.83)	171 (09.57)
Metal cans/tins	42 (35.00)	35 (29.17)	53 (44.17)	57 (47.50)	187 (10.46)
Total	455	428	415	489	1787

Note: The respondents have responded to more than one characteristic, increasing response frequency. However, the responses did not increase the total number of respondents. Figures in parentheses represent the percentage of total respondents.

Source: Field Survey

Table 4 shows the quantity of waste generated by the sample households in a day. The majority of the respondents in JDA Colonies (84.17%), Private colonies (90.83%), Old city areas (87.5%) and Slum areas (95%) produce 0-2 Kg of waste per day. Significantly few sample households are observed to produce waste between 2-5 Kgs. There's hardly any household generating more than 5 Kg of MSW.

Table 5 shows the type of MSW generated by the households. As per the survey, households generate majorly food waste (100%), followed by plastic waste, paper/cardboard waste, metal can/tins, glass waste, rubber, textiles and wood waste.

4.1.3 Segregation of municipal solid waste

Sorting and segregating household waste is the first step in implementing successful and sustainable waste management systems. Waste segregation at source eases handling and processing, enhances the potential for resource recovery and reduces operational costs. The following tables show the status of segregation practice, the type of wastes usually segregated, door-to-door waste pick up in segregated form and availability of colour-coded bins in the city.

Table 6. Segregation of waste by the households

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Yes	38 (31.70)	27 (22.50)	18 (15.00)	10 (8.30)	93 (19.40)
No	82 (68.30)	93 (77.50)	102 (85.00)	110 (91.70)	387 (80.60)
Total	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)

Note: Figures in parentheses represent the percentage of column total
Source: Field Survey

Table 6 shows the segregation practice among households in the study area. The majority of the sample respondents from JDA Colonies (68.30%), Private colonies (22.50%), Slum areas (8.30%) and Old City and its fringes (15%) do not practice segregation at source. Only a few percent (19.40%) of the sample practice segregation at source in the study area.

Table 7 shows that the respondents who practice segregation at source majorly separate kitchen and food waste (23.66%), followed by plastic waste (21.12%), paper and cardboard waste (21.12%), e-waste (18.07%) and metals (16.03%).

Table 8 shows whether or not the door-to-door collection is carried out in the segregated form. There exists almost no segregation of MSW while collecting door-to-door waste. The municipal staff collects household waste in unsegregated form and compiles them together in the wheel cart or auto rickshaws. A few wards in Jammu City have initiated the two partitioned vehicles for door-to-door collection, but the process is still underway. Further, these partitioned vehicles are emptied onto a typical dumping yard making the segregation process at the source pointless.

Table 7. Type of waste usually segregated

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Kitchen and food waste	38	27	18	10	93
	(100.00)	(100.00)	(100.00)	(100.00)	(23.66)
Plastics	35	25	15	08	83
	(92.11)	(92.59)	(83.33)	(80.00)	(21.12)
Metals	24	22	12	05	63
	(63.16)	(81.48)	(66.67)	(50.00)	(16.03)
Paper and cardboard	31	27	17	08	83
	(81.58)	(100.00)	(94.44)	(80.00)	(21.12)
E-waste	29	21	13	08	71
	(76.32)	(77.78)	(72.22)	(80.00)	(18.07)
Total	157	122	75	39	393

Note: The respondents have responded to more than one characteristic, increasing response frequency. However, the responses did not increase the total number of respondents. Figures in parentheses represent the percentage of total respondents practicing segregation.
Source: Field Survey

Table 8. Door-to-door collection of segregated waste in segregated form

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Yes	00	00	00	00	00
	(00)	(00)	(00)	(00)	(00)
No	120	120	120	120	480
	(100)	(100)	(100)	(100)	(100)
Total	120	120	120	120	480
	(100)	(100)	(100)	(100)	(100)

Note: Figures in parentheses represent the percentage of column total
Source: Field Survey

The Table 9 shows the availability of different coloured bins in the community. Only a few percent of the sample respondents in JDA Colonies (29.17%), Private Colonies (35.83%), Old City Areas (34.17%) and Slum Areas (7.5%) stated that they have access to different colored bins. However, it is observed that only public bins are available in the communities, but the colored bins are hard to be seen. The colored bins are usually located at commercial sites and parks. Residential areas have less access to colored community bins in Slum and Old City areas compared to JDA and Private Colonies.

Table 9. Availability of different coloured bins in the community

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Yes	35 (29.17)	43 (35.83)	41 (34.17)	09 (07.50)	128 (26.67)
No	85 (70.83)	77 (64.17)	79 (65.83)	111 (92.50)	352 (73.33)
Total	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)

Note: Figures in parentheses represent the percentage of column total
Source: Field Survey

4.1.4 Storage of municipal solid waste

Storage facilities at source and community levels should be maintained in a hygienic and sanitary way. They should be easily accessible, easy to operate, and designed per the quantity of waste generated and population densities. The following tables assess the conditions of storage facilities at household and community levels.

Table 10. Type of bins used for storage of waste

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Plastic bags	05 (04.17)	01 (00.83)	11 (09.17)	24 (20.00)	41 (08.54)
Plastic bins	53 (44.17)	56 (46.67)	41 (34.17)	27 (22.50)	177 (36.88)
Card boxes	07 (05.83)	00 (00.00)	11 (09.17)	25 (20.83)	43 (08.96)
Metal Bins	55 (45.83)	63 (52.50)	45 (37.50)	22 (18.33)	185 (38.54)
No storage-direct disposal	00 (00)	00 (00)	12 (10.00)	22 (18.33)	34 (07.08)
Total	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)

Note: Figures in parentheses represent the percentage of column total
Source: Field Survey

Table 10 shows the type of bins used for waste storage by households. The majority of the sample respondents store household waste in either plastic (36.8%) or metal bins (38.54%) in the study area. Significantly few respondents are observed to store the waste in cardboard boxes (8.96%) or plastic bags (8.54%). Few respondents in Slum Areas (18.33%) and Old City Areas (10%) do not store their waste and thus directly dispose of the waste onto the roadsides or nearby vacant plots, harming the aesthetic surroundings.

Table 11. Number of times the household waste container is emptied

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Once a day	94 (78.33)	87 (72.50)	81 (67.50)	71 (59.17)	333 (69.37)
Once in two days	13 (10.83)	10 (08.33)	33 (27.50)	42 (35.00)	98 (20.41)
Twice a day	13 (10.83)	23 (19.17)	06 (05.00)	07 (05.83)	49 (10.20)
Total	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)

Note: Figures in parentheses represent the percentage of column total
Source: Field Survey

Table 11 shows the number of times the waste container is emptied. The majority of the sample respondents (69.37%) empty their waste containers once a day because the maximum generation of waste per day lies between 0-2 Kgs. Very few respondents in Slum Areas (05.83%) and Old City Areas (05%) empty their containers once in two days.

Table 12 shows the condition of community bins in the locality. The majority of the respondents in the study area report that the condition of community bins seems pathetic. They complain that community bins are rusted and worn out. They have usually uncovered containers toppled with mounds and bags of MSW. The problem of overflowing community dustbins is observed to exist at a colossal level. They are not only unpleasant sites but attract insects and pests, spreading deadly diseases, contaminating the air and posing serious health risks. Moreover, the respondents observe that stray cattle have been rummaging the waste bins and littering the garbage. This obstructs the roads and passages, causing inconvenience to commuters. A few percent of the respondents disclosed that uncovered and broken containers are filled with rain during the heavy rains releasing foul odours.

Table 13 shows whether the community bins are being cleaned or washed by the municipal workers or not. All the respondents in the selected wards stated that municipal workers never cleaned or washed community bins.

Table 12. Condition of Community/Public bins near your locality

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Rusting	82 (68.33)	67 (55.83)	101 (84.17)	102 (85.00)	352 (20.34)
Inadequate size/Overflowing	94 (78.33)	81 (67.50)	103 (85.83)	95 (79.17)	373 (21.56)
Uncovered/open lids	102 (85.00)	108 (90.00)	90 (75.00)	81 (67.50)	381 (22.02)
Broken Bins	57 (47.50)	58 (48.33)	55 (45.83)	54 (45.00)	224 (12.94)
Stray feeding on bins	65 (54.17)	58 (48.33)	70 (58.33)	50 (41.67)	243 (14.04)
Filled with rain water/wet waste	33 (27.50)	44 (36.67)	45 (37.50)	35 (29.17)	157 (09.07)
Total	433	416	464	417	1730

Note. The respondents have responded to more than one characteristic, which has eventually increased the response frequency. However, the responses did not increase the total number of respondents. Figures in parentheses represent the percentage of total respondents.

Source. Field Survey

Table 13. Cleaning of Public Bins by Authorities

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Yes	00 (00)	00 (00)	00 (00)	00 (00)	00 (00)
No	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)
Total	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)

Note: Figures in parentheses represent the percentage of the column's total

Source: Field Survey

4.1.5 Collection of municipal solid waste

The collection system should be carefully planned to avoid overloading primary and secondary storage facilities. The door-to-door collection system is proposed through partitioned vehicles in the City. However, the system has not been fully implemented in a few areas resulting in illegal dumping. The below tables depict the sample availing the door-to-door collection services, reasons for not availing of the services and rating of existing services.

Table 14 shows the availability of door-to-door collection services in the selected area. Respondents in Trikuta Nagar, Gandhi Nagar, Greater Kailash and Tawi Vihar reported having 100% door-to-door collection services in their wards. 23.3% of respondents in Bhagwati Nagar said that they do not have door-to-door collection services. Almost no door-to-door collection service exists in Malhotra Mohalla, Bahu East and Bahu West. The JDA Colonies and Private Colonies have better door-to-door waste collection service availability than Old City and Slum areas.

Table 14. Availability of Door-to-Door Collection Service

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Yes	120	120	46	17	303
	(100)	(100)	(38.33)	(14.17)	(63.13)
No	00	00	74	103	177
	(00)	(00)	(61.67)	(85.83)	(36.88)
Total	120	120	120	120	480
	(100)	(100)	(100)	(100)	(100)

Note: Figures in parentheses represent the percentage of column total
Source: Field Survey

Table 15. Door to Door Collection Service Availed by the Households

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Yes	116	111	36	06	269
	(96.67)	(92.50)	(30.00)	(5.00)	(56.04)
No	04	09	10	11	34
	(03.33)	(07.50)	(08.33)	(09.17)	(07.08)
Service not available	00	00	74	103	177
	(00)	(00)	(61.67)	(85.83)	(36.87)
Total	120	120	120	120	480
	(100)	(100)	(100)	(100)	(100)

Note: Figures in parentheses represent the percentage of the column's total
Source: Field Survey

Table 15 shows the percentage of households availing the door-to-door collection services. The majority of the respondents in the JDA Colonies (96.67%), Private Colonies (92.50%) and Bhagwati Nagar (78.26%) avail the door-to-door collection services in their areas. Very few respondents in Bahu West avail of the existing door-to-door collection services. No respondent in the Bahu East ward avails the curbside services. The percentage of households availing of the collection services are rarer in slum areas.

Table 16. Reasons for Not Availing of the Door-to-Door Collection Services

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
High charges	00 (0.00)	03 (33.33)	04 (40.00)	06 (54.55)	13 (14.13)
No willingness to spend	04 (100.00)	07 (77.78)	05 (50.00)	11 (100.00)	27 (29.35)
Improper collection	01 (25.00)	04 (44.44)	03 (30.00)	06 (54.55)	14 (15.22)
Irregular services	04 (100.00)	05 (55.56)	07 (70.00)	04 (36.36)	20 (21.74)
No cooperative staff	02 (50.00)	02 (22.22)	04 (40.00)	02 (18.18)	10 (10.87)
Unreliable	00 (0.00)	02 (22.22)	04 (40.00)	02 (18.18)	08 (8.70)
Total	11	23	27	31	92

Note. The respondents have responded to more than one characteristic, increasing the response frequency. However, the responses did not increase the total number of respondents. Figures in parentheses represent the percentage of respondents not availing the services.

Source. Field Survey

Table 16 shows the reasons for not availing of the door-to-door collection services. A large proportion of the respondents stated that the reasons for not availing of the collection services are attributed to their poor willingness to spend (29.35%) and irregular collection of services (21.74%). Respondents alleged that services are not up to the mark and hence they are not willing to pay. Few respondents claimed that the waste collector visits them alternatively, sometimes twice a week, or irregularly, leading to waste collection in their backyards.

Table 17 shows the satisfaction of collection services amongst households availing the services. Of those availing the services, 47.41%, 57.66%, 47.22% and 33.33% of sample respondents in JDA Colonies, Private Colonies, Old City and Slum Areas, respectively, are not satisfied with the existing collection services.

Table 17. Satisfaction of the Collection Services amongst Households

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Yes	61 (52.59)	47 (42.34)	19 (52.78)	04 (66.67)	131 (48.70)
No	55 (47.41)	64 (57.66)	17 (47.22)	02 (33.33)	139 (51.67)
Total	116 (100)	111 (100)	36 (100)	06 (100)	269 (100)

Note: Figures in parentheses represent the percentage of column total
Source: Field Survey

Table 18 shows the reasons for non-satisfaction with the collection services. Non-satisfied respondents in JDA Colonies, Private Colonies, Old Cities and Slum Areas pointed to poor waste collection frequencies (44.22%) and non-cooperative sanitation staff (31.08%) as the significant reasons for non-satisfaction. Respondents complain that sanitation staff comes twice a week or once a week to collect the waste, thereby leading the households to dump it in nearby vacant plots or roadsides. They find the sanitation workers non-cooperative and work at their own will. Few respondents believed that these collection services are unreliable (9.56%), causing many inconveniences. Respondents of Slum Areas complain of irregularity of services and unreliability as the leading cause of non-satisfaction.

Table 18. Reasons for Non-Satisfaction with the Services

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Poor Frequency of waste collection	50 (81.97)	49 (76.56)	10 (58.82)	02 (100.00)	111 (44.22)
Charges high amount	17 (27.87)	15 (23.44)	05 (29.41)	01 (50.00)	38 (15.14)
Unreliable Services	11 (18.03)	09 (14.06)	02 (11.76)	02 (100.00)	24 (9.56)
Non-cooperative workers	32 (52.46)	41 (64.06)	04 (23.53)	01 (50.00)	78 (31.08)
Total	110	114	21	06	251

Note. The respondents have responded to more than one characteristic, increasing the response frequency. However, the responses did not increase the total number of respondents. Figures in parentheses represent the percentage of respondents unsatisfied with the services.

Source: Field Survey

Table 19 shows the rating of existing MSWM services in the City. The MSWM services encompass the collection, storage, transportation, disposal and processing of MSW. A large proportion of sample respondents rate the MSWM as poor (28.33%) and average (22.08%). Only 21.67% of respondents evaluate the MSWM services as good. There are hardly any extreme opinions regarding the rating of services. Very few respondents classify the MSWM services in the City as very good (8.54%) and very poor (19.38%).

Table 19. Rating of MSWM Services in the City

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Very Good	11	10	08	12	41
	(09.17)	(8.33)	(19.17)	(10.00)	(8.54)
Good	37	27	19	21	104
	(30.83)	(22.50)	(15.83)	(17.50)	(21.67)
Average	27	28	20	31	106
	(22.50)	(23.33)	(16.67)	(25.83)	(22.08)
Poor	33	32	34	37	136
	(27.50)	(26.67)	(28.33)	(30.83)	(28.33)
Very Poor	12	23	39	19	93
	(10.00)	(19.17)	(32.50)	(16.00)	(19.38)
Total	120	120	120	120	480
	(100)	(100)	(100)	(100)	(100)

Note: Figures in parentheses represent the percentage of column total
Source: Field Survey

4.1.6 Disposal and treatment of municipal solid waste

Municipalities are struggling with their unmanaged waste treatment process in the City. The conventional way of disposing the waste into landfills has posed serious environmental and public health repercussions. The waste management hierarchy ranks disposal and treatment methods in the descending order as: 3Rs-Reduce, Reuse and Recycle, WTE technologies, Composting and Landfilling. The city needs a shift from convention way to more sustainable alternatives of waste recovery. The following tables illustrate the existing disposal methods in the city and practices of open burning, composting and 3Rs by the residents.

The Table 20 shows the method of disposal of waste by households. The majority of the sample respondents avail the door-to-door collection in JDA Colonies (96.67%) and Private Colonies (92.5%). Many of the respondents in Old City (30.83%) and Slum Areas (43.33%) openly dump the waste on roadsides or nearby vacant spaces. 34.17% and 23.33% of the sample respondents dispose of the bin in community bins. The practice of open burning amongst the respondents is higher in Old City (15.83%) and Slum Areas (17.50%) than in JDA Colonies and Private Colonies.

Table 20. Methods of Disposal of Solid Waste

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Door-to-Door Collection	116	111	36	06	269
	(96.67)	(92.50)	(30.00)	(05.00)	(68.45)
Community bins	02	06	28	41	77
	(01.67)	(05.00)	(23.33)	(34.17)	(19.59)
Dumping on roadsides or nearby vacant spaces	02	03	37	52	94
	(01.67)	(02.50)	(30.83)	(43.33)	(23.92)
Burning of waste in open spaces	00	00	19	21	40
	(00.00)	(00.00)	(15.83)	(17.50)	(10.18)
Total	120	120	120	120	480
	(100)	(100)	(100)	(100)	(100)

Note: Figures in parentheses represent the percentage of column total
Source: Field Survey

Table 21 concludes that very few percent of the respondents in JDA Colonies (15%), Private Colonies (8.33%), Old City (3.33%) and Slum Areas (4.17%) practice composting of household waste in their homes. Though the proportion of the sample population practicing composting is deficient, the percentage of respondents practicing composting is higher in JDA and Private Colonies than in the Old City and Slum Areas. The low engagement in household composting could be attributed to the sample population's lack of knowledge and technical know-how. Moreover, possessing a garden is a motivating factor for practicing composting because people having gardens are more likely to use compost as a conditioner for soil health.

Table 21. Practice of Compost Pit at Home

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Yes	18	10	04	05	37
	(15.00)	(08.33)	(03.33)	(04.17)	(07.71)
No	102	110	116	115	443
	(85.00)	(91.67)	(96.67)	(95.83)	(92.29)
Total	120	120	120	120	480
	(100)	(100)	(100)	(100)	(100)

Note: Figures in parentheses represent the percentage of column total
Source: Field Survey

Table 22 shows the type of waste being composted at home. Out of the respondents who practice composting at their homes, a considerable proportion (almost 100%) of them responded that composting at home comprises garden/yard waste and kitchen/food waste. The garden waste includes dead leaves, twigs and branches. The kitchen waste consists of vegetable peels, fruit peels, food scraps and egg shells. Very few respondents reported that they also include animal excreta, fireplace ashes, papers and nutshells in the compost pit.

Table 22. Type of Waste Being Composted at Home

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Kitchen/food waste	18 (100.00)	10 (100.00)	03 (75.00)	05 (100.00)	36 (38.30)
Garden/yard Waste	14 (77.78)	10 (100.00)	03 (75.00)	05 (100.00)	32 (34.04)
Animals excreta	04 (22.22)	04 (40.00)	00 (00.00)	01 (20.00)	09 (09.57)
Others	09 (50.00)	06 (60.00)	00 (00.00)	02 (40.00)	17 (18.09)
Total	45	30	06	13	94

Note: The respondents have responded to more than one characteristic, increasing the response frequency. However, the responses did not increase the total number of respondents. Figures in parentheses represent the percentage of respondents practicing composting at home.

Source: Field Survey

Table 23. Status of Open Burning of Waste in the City

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Yes	20 (16.67)	24 (20.00)	48 (40.00)	56 (46.67)	148 (30.83)
No	100 (83.33)	96 (80.00)	72 (60.00)	64 (53.33)	332 (69.17)
Total	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)

Note: Figures in parentheses represent the percentage of column total

Source: Field Survey

The above Table 23 shows that burning waste is a more common scenario in Old City Areas (40%) and Slum

Areas (46.67%). Respondents in Bhagwati Nagar, Old City, Bahu West and Bahu East agree that the burning of waste is still practiced despite being banned by the JMC. Respondents report that roadside waste, leftover waste at collection points, overflowing community bins, and waste collected from community parks and temples are frequently burned with impunity. This quick way of waste disposal has many environmental and public health implications.

Table 24. The extent to which Residents stick to the 3 Rs-Reduce, Reuse and Recycle

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Very Strongly	28 (23.33)	21 (17.50)	06 (5.00)	07 (5.83)	62 (12.92)
Strongly	38 (31.67)	43 (35.83)	19 (15.83)	17 (14.17)	117 (24.38)
Moderately	38 (31.67)	26 (21.67)	48 (40.00)	42 (35.00)	154 (32.08)
Weakly	14 (11.67)	22 (18.33)	31 (25.83)	36 (30.00)	103 (21.46)
Very weakly	02 (1.67)	08 (6.67)	16 (13.33)	18 (15.00)	44 (9.17)
Total	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)

Note: Figures in parentheses represent the percentage of column total
Source: Field Survey

The Table 24 shows that 3Rs-Reduce, Reuse and Recycle occupy the highest place in the waste management hierarchy. This strategy helps to cut down waste production, thus conserving natural resources. The data shows that many respondents in JDA Colonies (31.67%) and Private Colonies (35.83%) strongly stick to the practice of the 3Rs. Very few respondents in JDA Colonies and Private Colonies weakly and very weakly follow the 3R practice. The proportion of respondents weakly sticking to the practice of 3Rs is high in Old City (25.83%) and Slum Areas (30%). Few respondents in these areas strongly and very strongly stick to the practice of the 3Rs. Overall, the respondents in the City moderately (32.08%) stick to the practice of 3Rs, with negligible respondents very strongly adhering to the practice.

The Table 25 show that a major proportion of the sample responded that they are habitual in reusing plastic waste (43.21%), followed by cardboard (21.17%), clothes (16.56%) and glass (12.95%). Sample respondents expressed that plastic and glass bottles and containers have been reused as flower pot and kitchen storage containers. Plastic boxes serve the purpose of great storage bins for jewelry, household items and other sundries. Plastic bags are taken again and again to the grocery store while shopping. They further responded that old books and magazines are donated to libraries and schools. Blank sheets are used for making rough drafts. Respondents conveyed that the cardboard and other packing materials can be reused for packing again. Respondents reveal reusing old towels, bedsheets and clothes as a dust cloth

in the house. Sometimes the old furniture is padded or slipcovered for reusing purposes.

Table 25. Type of Waste that the Residents Usually Reuse

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Glass	56	21	10	17	104
	(46.67)	(17.50)	(8.33)	(14.17)	(12.95)
Plastics	101	87	67	92	347
	(84.17)	(72.50)	(55.83)	(76.67)	(43.21)
Paper	06	01	03	02	12
	(5.00)	(0.83)	(2.50)	(1.67)	(1.49)
Card boards	35	27	42	66	170
	(29.17)	(22.50)	(35.00)	(55.00)	(21.17)
Clothing	20	28	38	47	133
	(16.67)	(23.33)	(31.67)	(39.17)	(16.56)
Any other	12	09	09	07	37
	(10.00)	(7.50)	(7.50)	(5.83)	(4.61)
Total	230	173	169	231	803

Note. The respondents have responded to more than one characteristic, increasing the response frequency. However, the responses did not increase the total number of respondents. Figures in parentheses represent the percentage of total respondents.

Source. Field Survey

Table 26. Separating Recyclable Waste and selling it to the Kabadi Walas

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Yes	99	101	107	113	420
	(82.5)	(84.17)	(89.17)	(94.17)	(87.50)
No	21	19	13	07	60
	(17.50)	(15.83)	(10.83)	(05.83)	(12.50)
Total	120	120	120	120	480
	(100)	(100)	(100)	(100)	(100)

Note: Figures in parentheses represent the percentage of column total

Source: Field Survey

Table 27. Type of Waste Being Separated and Sold to Kabadiwalas

	JDA colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Newspapers/magazines/old books	76 (76.77)	56 (55.45)	69 (64.49)	74 (65.49)	275 (24.21)
Cardboards	36 (36.36)	31 (30.69)	35 (32.71)	32 (28.32)	134 (11.80)
Glass bottles	41 (41.41)	49 (48.51)	53 (49.53)	42 (37.17)	185 (16.29)
Plastic cans/bottles	94 (94.95)	98 (97.03)	94 (87.85)	99 (87.61)	385 (33.89)
Metals tins/cans	34 (34.34)	38 (37.62)	47 (43.93)	38 (33.63)	157 (13.82)
Total	281	272	298	285	1136

Note. The respondents have responded to more than one characteristic, increasing the response frequency. However, the responses did not increase the total number of respondents. Figures in parentheses represent the percentage of total respondents selling the separated waste to KabadiWalas
Source. Field Survey

Table 28. Purpose of Selling the Recyclable Items to Kabadiwalas

	JDA colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Convenience	74 (74.75)	76 (75.25)	53 (49.53)	53 (46.90)	256 (22.90)
Buy back price	84 (84.85)	104 (102.97)	99 (92.52)	103 (91.15)	390 (34.88)
Household tradition	97 (97.98)	100 (99.01)	106 (99.07)	102 (90.27)	405 (36.23)
Environment concern	23 (23.23)	29 (28.71)	09 (08.41)	06 (05.31)	67 (05.99)
Total	278	309	267	264	1118

Note. The respondents have responded to more than one characteristic, increasing the response frequency. However, the responses did not increase the total number of respondents. Figures in parentheses represent the percentage of total respondents selling the separated waste to KabadiWalas
Source. Field Survey

Table 26 shows whether the recyclable waste is separated and sold to kabadiwalas. The majority sample of the respondents in JDA Colonies (82.5%), Private Colonies (84.17%), Old City (89.17%) and Slum areas (94.17%) claimed to separate the recyclable waste for selling to Kabadiwalas.

Table 27 shows the type of waste being separated and sold to Kabadiwalas. Sample Respondents separate plastic cans/bottles (33.89%) majorly followed by Newspapers/magazines/old books (24.21%), glass bottles (16.29%), metal tin/can (13.82%) and cardboard (11.80%).

Table 28 shows the purpose of selling the recyclable items to the Kabadiwalas. The data reveals that most of the respondents sell the recyclable items to the Kabadiwalas for two reasons: conventional and household tradition of selling the waste to waste collectors (36.23%) and getting paid the buyback price (34.88%) for waste sold. However, it is of prime importance to note that very few samples responded to environmental concerns (5.99%) to sell the recyclables. Thus, the population has to be made aware of the positive environmental benefits of recycling and the importance of the 3Rs.

4.2 Knowledge and awareness of the households regarding solid waste management practices

Table 29. Awareness of the Households Regarding Sustainable Practices of SWM

		JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Are you concerned about the proper and efficient management of MSW?	Yes	101 (84.17)	102 (85.00)	87 (72.50)	70 (58.33)	360 (75.00)
	No	19 (15.83)	18 (15.00)	33 (27.50)	50 (41.67)	120 (25.00)
	Total	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)
Are you aware of biodegradable and non-biodegradable waste?	Yes	75 (62.50)	70 (58.33)	60 (50.00)	40 (33.33)	245 (51.04)
	No	45 (37.50)	50 (41.67)	60 (50.00)	80 (66.67)	235 (48.96)
	Total	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)
Do you think open dumping and burning MSW leads to air, water and soil pollution? (only burning)	Yes	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)
	No	00 (00)	00 (00)	00 (00)	00 (00)	00 (00)
	Total	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)

Table 29. (cont.)

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total		
Do you think improper and unsanitary MSWM leads to various health problems?	Yes	93 (77.50)	81 (67.50)	66 (55.00)	51 (56.67)	291 (64.67)	
	No	27 (22.50)	39 (32.50)	54 (45.00)	39 (43.33)	159 (35.33)	
	Total	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)	
	Do you know that 3Rs occupy the highest priority while open dumping and burning occupy the least in the management process?	Yes	19 (15.83)	12 (10.00)	15 (12.50)	05 (04.17)	51 (10.63)
		No	101 (84.17)	108 (90.00)	105 (87.50)	115 (95.83)	429 (89.38)
		Total	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)
Do you think composting is the cheapest way to decompose organic waste, releasing various useful gases?		Yes	45 (37.50)	45 (37.50)	27 (22.50)	20 (16.67)	137 (28.54)
	No	75 (62.50)	75 (62.50)	93 (77.50)	100 (83.33)	343 (71.46)	
	Total	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)	
	Are you aware that there is an enactment of MSW rules 2016 to regulate the management of MSW in your area?	Yes	21 (17.5)	23 (19.17)	13 (10.83)	03 (2.50)	60 (12.50)
No		99 (82.50)	97 (80.83)	107 (89.17)	117 (97.50)	420 (87.50)	
Total		120 (100)	120 (100)	120 (100)	120 (100)	480 (100)	

Note: Figures in parentheses represent the percentage of total respondents.

Source: Field Survey

Any waste management program must include public awareness, participation in relevant legislation, strong

technical support and adequate money. A person unaware of the effects of waste believes that if they continue to live with the waste, nothing will happen, which stifles reasonable waste management efforts. According to the research, knowledge of SWM is measured in terms of behavioural change toward what people do. The study uses ‘yes and no’ descriptive frequency tables to estimate household respondents’ awareness level.

Table 29 shows the level of awareness amongst households about practices of solid waste management. The data shows that a large number of the respondents (75%) are concerned about the efficient management of solid waste. However, few sample respondents (51.04%) are aware of the classification of biodegradable and non-biodegradable waste. The proportion of respondents who are well aware that open burning and dumping of solid waste have profound environmental and health implications is relatively high. A meager percentage of respondents (10.63%) know that the 3Rs occupy the highest position in the waste management hierarchy. The respondents have poor knowledge about composting as the cost-efficient method of managing organic solid waste (71.46%). Most of the respondents (87.5%) are unaware of the enactment of Solid Waste Management Rules, 2016. The results depict that respondents have poor knowledge about the efficient and proper practices of managing solid waste. The respondents of Old City and Slum areas have insufficient knowledge and awareness compared to those of JDA and Private Colonies.

4.3 Participation of the households in solid waste management activities

Waste management plans can only be successful if the community support and actively participate in them. As the largest stakeholder, households are essential in reducing waste volume and increasing the recovery rate. Involving household communities enhances a sense of responsibility for maintaining services the local authority provides. Furthermore, household participation may include material, financial or physical contributions to solid waste management activities.

Table 30. Participation of the Residents in Community Clean-Up Activities

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Yes	06 (05.00)	03 (02.50)	06 (05.00)	00 (00.00)	15 (03.13)
No	114 (95.00)	117 (97.50)	114 (95.00)	120 (100)	465 (96.88)
Total	120 (100)	120 (100)	120 (100)	120 (100)	480 (100)

Note: Figures in parentheses represent the percentage of column total
Source: Field Survey

From Tables 30 and 31, it is inferred that the participation rate (3.13%) for community clean-up drives is poor amongst the residents. Significantly few respondents have participated in any community cleaning drives or activities. However, it is observed that no one has taken the initiative to conduct community clean-up drives in the City. Moreover, the City has no active community-based organizations working towards the cause of SWM.

Table 31. Initiation of Clean-Up Drive in the Community

	JDA Colonies	Private Colonies	Old City and its Fringes	Slum Areas	Total
Yes	00	00	00	00	00
	(00)	(00)	(00)	(00)	(00)
No	120	120	120	120	480
	(100)	(100)	(100)	(100)	(100)
Total	120	120	120	120	480
	(100)	(100)	(100)	(100)	(100)

Note: Figures in parentheses represent the percentage of column total
Source: Field Survey

5. Conclusions and policy implications

Solid waste Management has become a global issue in recent times. The city of Jammu is facing a massive upsurge in waste generation rates. Due to inadequate resources, the ULBs have failed to perform SWM services effectively. The study evaluates the practices, perceptions and knowledge of the households towards sustainable management of solid waste in Jammu City. The study shows a strong disconnect between current policies of SWM and existing household practices. The household practices of segregating, storing, disposing and treating waste are dissatisfying in the city. These practices are found to be worse in Slums and Old city areas. There exists almost no segregation practice amongst households. The respondents of Slum areas and Old city areas have discriminatory storage facilities and often dump the wastes on the roadsides or nearby vacant plots owing to the unavailability of the door to door collection services. Open burning of waste is observed to be a common scenario in both the Slum Wards. Respondents in the study area do not practice any composting or treatment of household waste. The Respondents have little knowledge about the sustainable methods of managing solid waste. Respondents are unaware of the enactment of SWM Rules, 2016. Awareness and Knowledge regarding SWM principles and morals are poor in Slum and Old city areas. The study observes resilient non-participation of households or communities towards SWM practices.

To overcome the disconnect between sustainable practices of SWM and existing household practices, there is a need for a self and community-driven approach toward a more comprehensive outlook of Integrated Solid Waste Management. The following are the recommendations based on the study:

- The municipal authorities should provide different colored bins to the households to ensure the segregation of waste at the source.
- The waste collection should be carried out in partitioned vehicles to avoid the mixing of dry and wet waste.
- The community bins should be cleaned regularly by the municipal staff.
- There is a need for government to strengthen district by-laws to ensure proper waste management.
- The concerned authorities should expand and upgrade waste treatment mechanisms.
- The concerned authorities should sensitize the residents on the sound practices of SWM which include minimizing the generation of waste, segregation of waste at source, proper disposal of household waste and sticking to the practice of 3Rs.
- Communities should be encouraged to decompose household organic waste in the nearby small pits from which by-products of manure can be used further.
- Various education and awareness programs should be initiated to urge the residents to quit illegal dumping and burning of waste and rather resort to appropriate practices of SWM.

Conflict of interest

The authors declare no competing financial interest.

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