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## **To analyse the change in behaviour of households and their impact on solid waste management**

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**Abstract**---Rapid urban growth in Bengaluru has led to escalating challenges in solid waste management (SWM) due to increased municipal solid waste (MSW) generation from households. Understanding how demographic and behavioural factors influence household waste practices is essential for developing sustainable SWM strategies. This study aims to identify the key drivers affecting household waste generation, segregation, and disposal behaviours in HSR Layout, Bengaluru, focusing on how changes in consumer habits, awareness, and demographics impact SWM. A survey of 247 households in HSR Layout was conducted using a structured questionnaire to gather demographic data and insights into waste management practices. Statistical analyses, including descriptive and regression analysis, were used to assess relationships among variables such as education, income, and waste management behaviour. The results indicate that education, awareness, and supportive government policies are primary factors in promoting responsible SWM practices. While most households engage in basic segregation, gaps persist in handling sanitary, electronic, and hazardous waste. Increased individual efforts were noted in reducing single-use plastics and enhancing recycling practices, alongside

improvements in community waste collection and cleanliness. To improve SWM, this study suggests implementing targeted educational programs, upgrading waste infrastructure, and strengthening community engagement and policy enforcement. These measures can significantly enhance waste segregation, recycling, and disposal, supporting a more sustainable urban waste management system.

**Keywords**---Solid Waste Management (SWM), Household Waste Behaviour, Urban Waste Generation, Waste Segregation Practices and Sustainable Urban Management.

## 1. Introduction

Solid waste management (SWM) systems in cities like Bengaluru face a major challenge from the urban population and shifting lifestyles (Afroz et al., 2011). It is essential to comprehend how households, the main source of municipal solid waste (MSW), are changing their waste creation patterns to create sustainable and successful SWM plans. This study examines the behavioural shifts in Bengaluru's HSR Layout households and how they affect solid waste management.

The study intends to uncover important elements, such as consumerism, environmental consciousness, and demographic shifts, that impact household trash creation, segregation, and disposal methods. The research aims to comprehend how household habits are affecting the sustainability and efficiency of SWM in HSR Layout by looking at these elements. With this knowledge, evidence-based suggestions for bettering local garbage collection, sorting, and recycling procedures will be developed for legislators and waste management organisations.

Bengaluru's fast-growing residential neighbourhood, HSR Layout, is a prime example of the expanding problem of solid waste management in Indian cities. MSW generation has increased due to the layout's growing population, shifting consumer preferences, and growing reliance on throwaway items.

According to (Afroz et al., 2011), the literature on household waste management in India emphasises the significance of comprehending the elements that impact human behaviour and creating focused interventions to encourage appropriate trash disposal practices. Household trash generation and disposal behaviours have been found to be significantly influenced by a number of factors, including cultural attitudes, income, education level, and access to waste management services (Chikowore, 2020). However, more investigation is required to comprehend the unique circumstances and difficulties encountered by HSR Layout and to customise solutions appropriately.

With an emphasis on the particular context of HSR Layout, this study seeks to close this gap by offering insights into how home behaviour change might be used to increase SWM sustainability and efficiency. In order to promote responsible waste management in the region and help create a cleaner and healthier

Bengaluru, the study can help build evidence-based interventions by identifying the factors impacting household garbage generation and disposal behaviours.

## **2. Review of Literature**

A key factor in the efficiency of solid waste management systems is household behaviour. Waste management practices are much improved when household attitudes, participation, and acceptance are improved, according to research done in Bekasi City, Indonesia. This illustrates the effectiveness of community-based awareness initiatives in promoting waste management behaviour changes (Ferdinan et al., 2021). In a similar vein, opinions regarding composting and recycling have been found to be important factors in determining waste management techniques. Research suggests that long-term engagement in trash diversion initiatives is largely dependent on predispositions, such as worries about rodents or convenience considerations like time and effort (Tucker & Speirs, 2003). Significant gains in waste management techniques have also been demonstrated by interventions meant to increase knowledge through training initiatives. A quasi-experimental study conducted in Indonesia found that educational campaigns dramatically raised household knowledge and practice levels, highlighting the transformative power of focused awareness initiatives (Widiyanto et al., 2019). Socioeconomic variables also affect how people handle their garbage. According to research conducted in rural China, compliance with appropriate garbage disposal is favourably correlated with economic and educational attainment. Effective waste management was also shown to be significantly facilitated by accessible infrastructure and close proximity to collection stations (Wang et al., 2018). In addition, local efforts and public policy have a big impact on how households handle garbage. Higher educational attainment and the application of reward and penalty systems were found to increase adherence to waste sorting procedures in a Shanghai study. In order to support these results, public awareness efforts were essential (Tang et al., 2022). Furthermore, cultural and demographic differences affect how garbage is generated and managed. Greater trash output in Chittagong, Bangladesh, was positively correlated with higher incomes and larger family sizes, underscoring the necessity of demographically specific interventions (Sujauddin et al., 2008). Poor waste management techniques have been linked to waterborne and respiratory infections, according to studies. To reduce these health hazards, better education and infrastructure are essential (Boadi & Kuitunen, 2005). trash generation has been shown to decrease measurably as a result of local trash prevention initiatives including composting and food waste reduction. The best results were obtained by integrated approaches that combined several therapies (Sharp et al., 2010).

Knowledge, lifestyle, and socioeconomic factors have also been demonstrated to impact household environmental awareness. Housewives with greater environmental knowledge showed better waste management practices, according to an Indonesian study, highlighting the value of behavioural and educational interventions (Givano & Ismail, 2020). Urban regions pose distinct issues, as evidenced by Shanghai, where a dense population calls for better garbage sorting procedures backed by policy enforcement and public education (Ye et al., 2020). Household adherence to waste management regulations in urban settings has

been improved by financial incentives including curbside recycling programs and unit pricing (Morris & Holthausen, 1994).

Source reduction has been demonstrated to be impacted by the integration of several waste prevention strategies. Campaigns that combine regulatory enforcement, infrastructure upgrades, and awareness campaigns highlight the value of diverse waste management strategies (Sharp et al., 2010). Locally driven initiatives to promote sustainable and hygienic waste management techniques have been successful, as demonstrated by community-led regulations like those in Thailand (Jeamponk, 2013). Addressing social and psychological motivators, highlighting the necessity of community engagement, and implementing specialised educational programs might further improve urban recycling performance (Knickmeyer, 2020).

Waste sorting practices were found to be positively influenced by higher income levels. Compliance in high-income areas was much enhanced by awareness efforts that addressed sorting processes (Miliute-Plepiene & Plepys, 2015). The literature as a whole emphasises the intricacy of managing waste in the home and the interaction of environmental, behavioural, and socioeconomic factors. For sustainable waste management techniques, targeted interventions, governmental legislation, and educational initiatives are still essential.

This study aims to identify the key drivers affecting household waste generation, segregation, and disposal behaviours in HSR Layout, Bengaluru, focusing on how changes in consumer habits, awareness, and demographics impact SWM.

### **3. Material and Methods**

#### **3.1 Geographical Location of the Study Area**

Hosur-Sarjapur Road Layout, or HSR Layout, is a carefully designed residential neighbourhood in southeast Bangalore that is well-known for being close to important IT hubs like Whitefield, Koramangala, and Electronic City. Comprising seven sectors, each with a mix of independent homes, apartments, and gated communities, it spans an area of roughly 7.5 to 8 square kilometres. Due to the area's rapid urbanisation and attraction to professionals working in surrounding tech parks, the population of HSR Layout has increased dramatically, with current estimates ranging between 1.5 and 2 lakh persons.

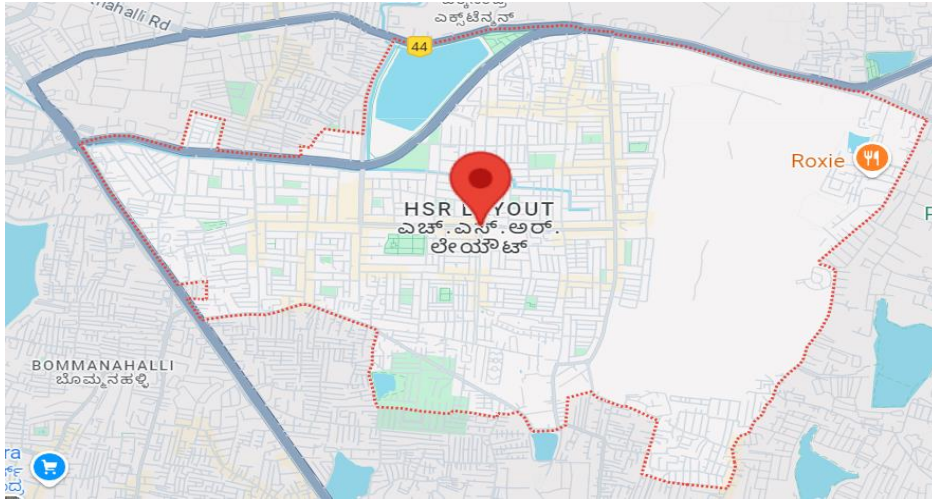


Figure No. 1: Geographical location of the study area- HSR Layout  
Source: Google Map, 2024

### 3.2 Methodology

The analysis of household behaviour changes and their effects on solid waste management is the main goal of this study. The study's foundation is a primary survey that was carried out in August and September of 2024 among the people who live in Bengaluru's HSR Layout. After receiving input from both academic and non-academic specialists, a structured questionnaire was created and further improved. By evaluating each item's relevance, the suitability of the phrases used, the questions' logical flow and order, the structure, and the total amount of time needed to complete the survey, these experts assessed the validity of each item in the questionnaire.

There are seven sections in the actual questionnaire. The respondents' demographic data is gathered in the first portion, while their awareness and practices about SWM are examined in the second. The difficulties they encounter or the behavioural adjustments they have made with regard to waste management in their homes are examined in the third section. Responses range from "strongly disagree" (assigned as 1) to "strongly agree" (assigned as 5) on a five-point Likert scale, which is used in the fourth part to gauge respondents' opinions regarding a variety of SWM-related issues. Respondents are asked to offer comments and ideas on how SWM procedures might be enhanced in the concluding section.

A sample of 247 respondents, chosen using basic random sampling techniques, were given the survey. The questionnaire, which was accessible offline and online through Google Forms, was willingly completed by the respondents. To reach a wider audience, the link to the online questionnaire was distributed by email and WhatsApp, among other communication channels.

### 3.3. Empirical Model for Household Waste Management Behaviour

The present study used the multiple linear regression model of ordinary least squares, which is the most often used method for parameter estimation because of its ease of use (Shafiei, 2017).

To investigate the determinants impacting home waste management behaviour, multiple regression analysis was performed. Multiple regression equations can be written in mathematical format as follows:

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + \beta_{11}X_{11} + \beta_{12}X_{12} + \beta_{13}X_{13} + \varepsilon \dots\dots\dots (1)$$

Where: Y is the dependent variable (Household Waste Management Behaviour),  $\beta_0$  is the intercept (constant).  $\beta_1, \beta_2, \dots, \beta_{13}$  are the regression coefficients for the corresponding predictor variables.

$X_1, X_2, \dots, X_{13}$  represent the independent variables:  $X_1$  = Gender,  $X_2$  = Age,  $X_3$  = Family Size,  $X_4$  = Education,  $X_5$  = Occupation,  $X_6$  = Income,  $X_7$  = Lived in City,  $X_8$  = Awareness,  $X_9$  = Disposal Method,  $X_{10}$  = Attitudes,  $X_{11}$  = Community Programs,  $X_{12}$  = Government Policies and  $X_{13}$  = Availability of Recycling Facilities.

Empirical specification for the model can be explained by

$$\text{HH Waste Management Behavior} = \beta_0 + \beta_1 (\text{Gender}) + \beta_2 (\text{Age}) + \beta_3 (\text{Family Size}) + \beta_4 (\text{Education}) + \beta_5 (\text{Occupation}) + \beta_6 (\text{Income}) + \beta_7 (\text{Lived in City}) + \beta_8 (\text{Awareness}) + \beta_9 (\text{Disposal Method}) + \beta_{10} (\text{Attitudes}) + \beta_{11} (\text{Community Programs}) + \beta_{12} (\text{Government Policies}) + \beta_{13} (\text{Availability of Recycling Facilities}) + \varepsilon \dots\dots\dots(2)$$

### 3.4. Data Analysis:

Descriptive analysis, multiple regression analysis, and one-way ANOVA were all used in this study. The data was presented in an understandable and instructive way using descriptive analysis, which summarised the data using frequencies and percentages to make the results easier to handle (Zulkipli et al., 2018). By offering a summary of the data distribution, this approach made it possible to spot important trends and patterns. To investigate the correlations between variables, chi-square tests and multiple regression analysis were used. The IBM SPSS Statistics (Statistical Package for the Social Sciences) 21 version was utilised to analyse the data.

## 4. Results and Discussions

### 4.1. Waste Management Behaviour of Household

#### 4.1.a. Descriptive analysis of households' respondents

Table No. 1 demonstrates that the study's respondents' demographic profile exposes a number of important traits. As for the distribution of respondents by gender, women make up 59.1% of the sample, while men make up 40.9%. The bulk of respondents are middle-aged, as evidenced by the fact that the greatest

age groupings of respondents are between the ages of 30 and 39 (44.5%) and 40 and 49 (44.9%). 10.5% of them are between the ages of 50 and 59.

Table No. 1: Descriptive analysis of households' respondents

| <b>Demography</b>           | <b>Attributes</b>   | <b>Frequency</b> | <b>Percentage</b> |
|-----------------------------|---------------------|------------------|-------------------|
| <b>Gender</b>               | Male                | 101              | 40.9              |
|                             | Female              | 146              | 59.1              |
| <b>Age</b>                  | 30 to 39 years      | 110              | 44.5              |
|                             | 40 to 49 years      | 111              | 44.9              |
|                             | 50 to 59 years      | 26               | 10.5              |
| <b>Family Size</b>          | 1-3 members         | 127              | 51.4              |
|                             | 4-6 members         | 101              | 40.9              |
|                             | More than 6 members | 19               | 7.7               |
| <b>Education level</b>      | Degree              | 97               | 39.3              |
|                             | Post Graduation     | 150              | 60.7              |
| <b>Occupation</b>           | Skilled             | 40               | 16.2              |
|                             | White Collar        | 165              | 66.8              |
|                             | Business            | 42               | 17.0              |
| <b>Income of the family</b> | <50,000             | 13               | 5.3               |
|                             | 50,000 – 1Lakh      | 22               | 8.9               |
|                             | 1Lakh – 1.50 Lakh   | 97               | 39.3              |
|                             | 1.50 Lakh- 2 Lakh   | 85               | 34.4              |
|                             | >2Lakh              | 30               | 12.1              |

Source: Primary Survey

Just 7.7% of respondents have families greater than six people, whereas 40.9% have families with four to six members and more than half (51.4%) have families with one to three members. This implies that the majority of the population is made up of small to medium-sized families.

With a large percentage of respondents (60.7%) holding a postgraduate degree and the remaining 39.3% having finished an undergraduate degree, the population is clearly highly educated. Sixty-six percent of the respondents work in white-collar occupations, 16.2% are in skilled occupations, and 17% are in business.

The majority of respondents (39.3%) claim a family income of between 1 and 1.5 lakh rupees per month, while 34.4% report an income between 1.5 and 2 lakh rupees. Just 5.3% of the sample earn less than 50,000 rupees per month, while a lesser fraction (12.1%) report a family income above 2 lakh rupees per month. This suggests that middle-class to upper-class households make up most of the sample.

According to the demographic statistics, the majority of the respondents are middle-aged, well-educated, and relatively well-off. They work in white-collar jobs and reside in small to medium-sized homes.

#### 4.1.b. Municipal Solid Waste Generation

Table No. 2: Multiple Comparisons  
Dependent Variable: Total Waste Generation Per day

| (I) Income of the family |                   |             | Mean Difference (I-J) | Std. Error | Sig.  | 95% Confidence Interval |             |
|--------------------------|-------------------|-------------|-----------------------|------------|-------|-------------------------|-------------|
|                          |                   |             |                       |            |       | Lower Bound             | Upper Bound |
| Tukey HSD                | <50,000           | 50,000 – 1L | -1.063*               | 0.200      | .000  | -1.61                   | -0.51       |
|                          |                   | 1L – 1.50 L | -0.463                | 0.169      | 0.051 | -0.93                   | .00         |
|                          |                   | 1.50 L- 2 L | -.519*                | 0.170      | 0.022 | -0.99                   | -0.05       |
|                          |                   | >2Lakh      | -0.387                | 0.190      | 0.252 | -0.91                   | 0.14        |
|                          | 50,000 – 1Lakh    | <50,000     | 1.063*                | 0.200      | .000  | 0.51                    | 1.61        |
|                          |                   | 1L – 1.50 L | .600*                 | 0.135      | .000  | 0.23                    | 0.97        |
|                          |                   | 1.50 L- 2 L | .544*                 | 0.137      | 0.001 | 0.17                    | 0.92        |
|                          |                   | >2Lakh      | .676*                 | 0.161      | .000  | 0.23                    | 1.12        |
|                          | 1Lakh – 1.50 Lakh | <50,000     | 0.463                 | 0.169      | 0.051 | .00                     | 0.93        |
|                          |                   | 50,000 – 1L | -.600*                | 0.135      | .000  | -0.97                   | -0.23       |
|                          |                   | 1.50 L- 2 L | -0.055                | 0.085      | 0.966 | -0.29                   | 0.18        |
|                          |                   | >2Lakh      | 0.076                 | 0.120      | 0.969 | -0.25                   | 0.4         |
|                          | 1.50 Lakh- 2 Lakh | <50,000     | .519*                 | 0.170      | 0.022 | 0.05                    | 0.99        |
|                          |                   | 50,000 – 1L | -.544*                | 0.137      | 0.001 | -0.92                   | -0.17       |
|                          |                   | 1L – 1.50 L | 0.055                 | 0.085      | 0.966 | -0.18                   | 0.29        |
|                          |                   | >2Lakh      | 0.131                 | 0.122      | 0.816 | -0.20                   | 0.47        |
|                          | >2Lakh            | <50,000     | 0.387                 | 0.190      | 0.252 | -0.14                   | 0.91        |
|                          |                   | 50,000 – 1L | -.676*                | 0.161      | .000  | -1.12                   | -0.23       |
|                          |                   | 1L – 1.50 L | -0.076                | 0.120      | 0.969 | -0.40                   | 0.25        |
|                          |                   | 1.50 L- 2 L | -0.131                | 0.122      | 0.816 | -0.47                   | 0.20        |

\*. The mean difference is significant at the 0.05 level.

The Tukey HSD post-hoc test results show that there are notable variations in the daily amounts of garbage produced by various socioeconomic categories. Families with incomes under 50,000 produce substantially less trash than those with incomes between 50,000 and 1 lakh (mean difference = -1.063,  $p < .001$ ) between 1.50 lakh and 2 lakh (mean difference = -0.519,  $p = .022$ ). Waste generation, however, does not differ significantly between those making less than 50,000 and those making more than 2 lakh ( $p = .252$ ) or between those making 1 lakh and 1.50 lakh ( $p = .051$ ), but the latter comparison is marginally significant.

Compared to all other classes, waste production is substantially higher among families earning between 50,000 and 1 lakh. Their trash production is higher than that of families making less than 50,000 ( $p < .001$ ), 1 lakh to 1.50 lakh (mean difference = 0.600,  $p < .001$ ), 1.50 lakh to 2 lakh (mean difference = 0.544,  $p = .001$ ), and more than 2 lakh (mean difference = 0.676,  $p < .001$ ). The garbage generation differs significantly between families earning 1 Lakh to 1.50 Lakh and those earning 50,000 to 1 Lakh; the higher-income group generates less garbage (mean difference = -0.600,  $p < .001$ ). But there is little significance in comparing to

other categories, including those making less than 50,000, 1.50 to 2 lakh, or more than 2 lakh.

Families with incomes between 1.50 and 2 lakh produce much less trash than those with incomes between 50,000 and 1 lakh (mean difference = -0.544,  $p = .001$ ) and significantly more waste than those with incomes below 50,000 (mean difference = 0.519,  $p = .022$ ). Their waste production, however, is not appreciably different from that of people who make between one and one-half lakh or more than two lakh.

Lastly, compared to most groups, households making above 2 lakh do not significantly differ in their trash creation, with the exception of those making between 50,000 and 1 lakh, who produce noticeably less garbage (mean difference = -0.676,  $p < .001$ ).

All things considered, the analysis demonstrates that trash production rises with income, especially for families in the 50,000–1 Lakh income range, which continuously produces the most garbage over several comparisons. Families earning less than 50,000 tend to produce the least waste, whereas disparities across the mid-income groups (1 Lakh to 2 Lakh) are often not as noticeable.

According to Table No. 3, the trash generation data gathered from 247 respondents indicates a number of noteworthy trends across various waste categories. The majority of respondents (46.2%) stated that they generated 1-2 kg of dry waste per day, which suggests that the population under survey produces dry waste at a modest pace. 44.9% of respondents produced 2-3 kg of wet garbage each day, indicating a significant contribution from this category to total waste output. Regarding sanitary trash, a notable percentage (46.6%) produces less than 1 kg daily, whereas a smaller but considerable group (8.5%) generates more than 3 kg, which may raise questions about sanitary waste management procedures.

One noteworthy finding about e-waste is that 50.6% of respondents thought this category was "not applicable," indicating a lack of knowledge or involvement with the disposal of electronic waste. 44.9% of respondents said "not applicable" when asked about the development of hazardous waste, which may indicate a gap in the reporting or handling of hazardous materials.

Table No. 3: Waste Generation Trends Across Different Categories of Waste

| Waste Generation Per Day | Waste in Kg. | Frequency | Percent | Valid Percent | Cumulative Percent |
|--------------------------|--------------|-----------|---------|---------------|--------------------|
| Dry Waste                | < 1 kg.      | 74        | 30.0    | 30.0          | 30.0               |
|                          | 1-2 kg.      | 114       | 46.2    | 46.2          | 76.1               |
|                          | 2-3 kg.      | 59        | 23.9    | 23.9          | 100.0              |
| Wet waste                | < 1 kg.      | 29        | 11.7    | 11.7          | 11.7               |
|                          | 1-2 kg.      | 107       | 43.3    | 43.3          | 55.1               |
|                          | 2-3 kg.      | 111       | 44.9    | 44.9          | 100.0              |
| Sanitary                 | < 1 kg.      | 115       | 46.6    | 46.6          | 46.6               |

| Waste Generation Per Day | Waste in Kg.   | Frequency | Percent | Valid Percent | Cumulative Percent |
|--------------------------|----------------|-----------|---------|---------------|--------------------|
| Waste                    | 1-2 kg.        | 111       | 44.9    | 44.9          | 91.5               |
|                          | Not applicable | 21        | 8.5     | 8.5           | 100.0              |
| E- waste                 | < 1 kg.        | 56        | 22.7    | 22.7          | 22.7               |
|                          | 1-2 kg.        | 66        | 26.7    | 26.7          | 49.4               |
|                          | Not applicable | 125       | 50.6    | 50.6          | 100.0              |
| Hazardous waste          | < 1 kg.        | 48        | 19.4    | 19.4          | 19.4               |
|                          | 1-2 kg.        | 88        | 35.6    | 35.6          | 55.1               |
|                          | Not applicable | 111       | 44.9    | 44.9          | 100.0              |
| Total waste              | 1-2 kg.        | 17        | 6.9     | 6.9           | 6.9                |
|                          | 2-3 kg.        | 127       | 51.4    | 51.4          | 58.3               |
|                          | > 3 kg.        | 103       | 41.7    | 41.7          | 100.0              |

The non-applicable portion took into account that the majority of respondents combine hazardous and e-trash with dry waste. According to the data, the majority of respondents (51.4%) generate 2-3 kg of waste each day, and 41.7% generate more than 3 kg. This highlights the sizeable amount of waste that need appropriate management and disposal techniques. By highlighting the various trash generation patterns in the community under examination, these insights point to potential locations for better waste management efforts.

#### 4.1.c. Municipal Solid Waste Segregation

Table 4 illustrates how the ANOVA analysis looks at variations in the kinds of waste that are routinely separated according to educational attainment. The amount of variance in waste segregation that can be accounted for by variations in educational attainment is represented by the sum of squares for the "between groups" variation, which is 25.804. There are two educational levels being compared, as shown by the between-group comparison's degrees of freedom of 1.

Table No. 4: Waste Segregation and Education Level: One-way ANOVA

| Types of waste regularly segregate |                |     |             |        |      |
|------------------------------------|----------------|-----|-------------|--------|------|
|                                    | Sum of Squares | df  | Mean Square | F      | Sig. |
| Between Groups                     | 25.804         | 1   | 25.804      | 22.609 | .000 |
| Within Groups                      | 279.629        | 245 | 1.141       |        |      |
| Total                              | 305.433        | 246 |             |        |      |

Source: Primary Survey

The average variation attributable to variations in educational attainment is also demonstrated by the mean square for between-group variation, which is 25.804. The F-statistic, which calculates the ratio of variance explained by education level to variance within each education group, is 22.609. The p-value, or significance level, is .000, meaning that there is a very low possibility that the observed differences in trash segregation between educational levels are the result of chance.

The variance in waste segregation that cannot be accounted for by variations in educational attainment is represented by the sum of squares within groups, which is 279.629 with 245 degrees of freedom. The average variation in waste segregation within each schooling group is indicated by the within-group variation mean square, which is 1.141. The overall variation in the types of garbage segregated across all educational levels is reflected in the sum of squares, which comes to 305.433. The findings imply that the kinds of garbage that people routinely separate are greatly influenced by their degree of education. The extremely significant p-value and the strong F-statistic suggest that education contributes significantly to the explanation of variations in waste segregation practices. This suggests that people's approaches to waste segregation vary significantly depending on their educational background.

**Table No. 5: Waste Segregation Practice of the households**

| Types of waste regularly segregate |                                               | Frequency | Percent | Valid Percent | Cumulative Percent |
|------------------------------------|-----------------------------------------------|-----------|---------|---------------|--------------------|
| Valid                              | Organic + Dry waste                           | 74        | 30.0    | 30.0          | 30.0               |
|                                    | Organic +Dry + Sanitary                       | 66        | 26.7    | 26.7          | 56.7               |
|                                    | Organic +dry+ sanitary +E-waste               | 56        | 22.7    | 22.7          | 79.4               |
|                                    | Organic + dry +sanitary +E-w +Hazardous Waste | 51        | 20.6    | 20.6          | 100.0              |
|                                    | Total                                         | 247       | 100.0   | 100.0         |                    |

With a total valid sample size of 247, Table No. 5 analyses the waste types that participants routinely separate. The respondents had a modest level of awareness and behaviour about waste segregation, as shown by the mean score of 7.34. The median score of 7.00 indicates that half of the participants segregate their waste at or above this level, supporting the idea that many people are aware of how they dispose of their waste. A consistent trend in waste segregation procedures throughout the sample may be implied by the standard deviation of 1.114, which shows that there is comparatively little diversity in the replies and that the majority of participants cluster around the mean. According to the frequency distribution, 30% of participants said that a combination of dry and organic garbage is the most popular type of waste segregation. After that, 22.7% of respondents handle organic, dry, sanitary, and e-waste jointly, whilst 26.7% separate organic, dry, and sanitary garbage. The lowest percentage, 20.6%, suggests that participants are combining hazardous waste segregation with the other categories. The cumulative percentage shows a high level of participant awareness of waste management procedures and verifies that almost the whole sample (100%) has practiced at least one type of waste segregation. Overall, these findings imply that although appropriate waste segregation is on the rise, there is still room for improvement in the way hazardous waste management techniques are integrated.

#### 4.1.d. Municipal Solid Waste Disposal

Table No. 6: Waste Management Practices Across Different Types of Waste

| Types of Waste  | Waste Disposal Days | Frequency | Percent | Valid Percent | Cumulative Percent |
|-----------------|---------------------|-----------|---------|---------------|--------------------|
| Dry waste       | Daily               | 138       | 55.9    | 55.9          | 55.9               |
|                 | Every 2-3 days      | 109       | 44.1    | 44.1          | 100.0              |
| Wet waste       | Daily               | 163       | 66.0    | 66.0          | 66.0               |
|                 | Every 2-3 days      | 84        | 34.0    | 34.0          | 100.0              |
| Sanitary waste  | Daily               | 163       | 66.0    | 66.0          | 66.0               |
|                 | Every 2-3 days      | 37        | 15.0    | 15.0          | 81.0               |
|                 | Not sure            | 47        | 19.0    | 19.0          | 100.0              |
| E- waste        | Daily               | 9         | 3.6     | 3.6           | 3.6                |
|                 | Bi-weekly           | 58        | 23.5    | 23.5          | 27.1               |
|                 | Monthly             | 39        | 15.8    | 15.8          | 42.9               |
|                 | Irregularly         | 25        | 10.1    | 10.1          | 53.0               |
|                 | Not sure            | 116       | 47.0    | 47.0          | 100.0              |
| Hazardous waste | Daily               | 9         | 3.6     | 3.6           | 3.6                |
|                 | Every 2-3 days      | 9         | 3.6     | 3.6           | 7.3                |
|                 | Monthly             | 39        | 15.8    | 15.8          | 23.1               |
|                 | Not sure            | 190       | 76.9    | 76.9          | 100.0              |

The information provides a thorough summary of waste management procedures for various waste kinds. The majority of respondents (54.9%) said they dispose of dry garbage every day, whilst 44.1% said they do it every two to three days. Wet waste exhibits a similar pattern, with 34.0% being disposed of every two to three days and a noteworthy 66.0% being disposed of everyday. The majority of respondents (66.0%) dispose of sanitary waste every day, whereas 15.0% choose to do so every two to three days, and 19.0% are unsure of their disposal practices.

The frequency of disposal is significantly less consistent when it comes to e-waste. Just 3.6% of respondents said they disposed of their waste every day, while 23.5% said they did it every two weeks. 15.8% of e-waste is disposed of monthly, and 10.1% is disposed of sporadically. 47.0% of respondents, a sizable portion, express ambiguity about how frequently they dispose of their e-waste. Hazardous waste also has a less consistent pattern, with only 3.6% of people disposing of it every day and another 3.6% every two to three days. 15.8% of hazardous garbage is disposed of each month, however 76.9% of respondents are unaware of how frequently they handle hazardous waste. When compared to the less frequent and less definite disposal patterns shown in e-waste and hazardous garbage, the data generally shows a clear difference in disposal behaviours for typical waste kinds such dry, wet, and sanitary waste. This raises the possibility of a need for further education and awareness on appropriate disposal techniques, especially with regard to hazardous items and e-waste.

Table No.7: Disposal Method of Household Generated Waste

|       |                                          | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|------------------------------------------|-----------|---------|---------------|--------------------|
| Valid | In the public bin                        | 9         | 3.6     | 3.6           | 3.6                |
|       | Handover to municipal garbage contractor | 238       | 96.4    | 96.4          | 100.0              |
|       | Total                                    | 247       | 100.0   | 100.0         |                    |

According to the research, the vast majority of those in charge of waste collection—96.4% of respondents—choose to turn over the collected rubbish to the municipal garbage contractor. Only 3.6%, however, said they would put the trash in a public trash can. This obvious disparity shows that using official municipal services is preferred over unofficial disposal techniques. Overall, the findings indicate that participants heavily rely on municipal systems for trash management.

## 4.2. Changes in Households Behaviours

### 4.2.1. Changes in Waste Management Behaviour of Households Before Waste Management Initiatives in HSR Layout, Bengaluru

In Bengaluru's crowded residential area, HSR Layout, solid waste management has been an issue, particularly before significant changes were undertaken. In 2018, NGOs or RWAs took significant action pertaining to home garbage management in the HSR layout. This section outlines the usual household waste management attitudes and behaviours observed in HSR Layout prior to any notable improvements being made as a result of trash management initiatives of NGOs or RWAs.

#### 4.2.1.a. Inadequate Source Segregation

- *Mixed Waste Disposal:* Without separating their waste into several waste streams, most households in the HSR Layout disposed of all of their rubbish at once. This includes collecting and disposing of recyclables, hazardous garbage, dry waste, and wet waste all at once.
- *Inadequate Awareness:* This behaviour was influenced by a lack of knowledge and comprehension regarding the significance of waste segregation at the source. The advantages of sorting waste for recycling, composting, and appropriate disposal were not well known to many locals.

#### 4.2.1.b. Inappropriate Collection and Storage of Waste

- *Open Bins:* Households frequently utilised rubbish bags or open bins, which attracted stray animals, insects, and pests. This created health risks and added to the neighborhood's offensive odours.
- *Unregulated Collection:* Garbage spilt onto the streets and bins overflowed due to frequently irregular waste collection services. This made the region less aesthetically pleasing overall and led to unsanitary conditions.

#### **4.2.1.c. An excessive reliance on Municipal services**

- *Sole Reliance:* For the collection and disposal of rubbish, households mostly depended on the Bengaluru Municipal Corporation (BMC). As a result, the municipality was burdened and there was less opportunity for private involvement in trash management.
- *Absence of Alternatives:* The community's alternative waste management options, such as composting, recycling facilities, or waste exchange programs, were not well-known or easily accessible.

#### **4.2.1.d. Methods of Waste Generation**

- *High rubbish Generation:* As the population grew and lifestyles changed, households in the HSR Layout generated a lot of rubbish, which imposed a burden on the infrastructure for waste management in the area.
- *Excessive Packaging:* A significant amount of non-biodegradable waste was produced as a result of the overuse of packaging materials, especially for food and home goods.

#### **4.2.1.e. Lack of Community Engagement**

- *Low Involvement:* Initiatives for waste management lacked community participation and cooperation. Planning, carrying out, and overseeing waste management procedures were not actively participated in by the local population.
- *Limited Awareness programs:* The BMC may have held sporadic awareness programs, but they frequently fell short of reaching a sizable sample of the populace, leaving many locals ignorant of sustainable waste management techniques.

#### **4.2.1.A. Consequences**

- *Environmental Pollution:* Poor waste management techniques resulted in contamination of the land and water, air pollution from open burning, and possible harm to wildlife.
- *Health Risks:* Residents, especially children and the elderly, were at danger for health problems due to the overflowing garbage containers, bugs, and unsanitary surroundings.
- *Aesthetic Deterioration:* The neighborhood's aesthetics were badly damaged by filthy circumstances and overflowing garbage containers, which lowers the standard of living in general.

Prior to the modification, the HSR Layout's waste management procedures were generally unsustainable and had a negative influence on the environment and general public's health. In order to properly address the problem, more proactive and community-driven solutions became necessary.

#### 4.2.2. Changes in Waste Management Behaviour of Households After Waste Management Initiatives in HSR Layout, Bengaluru

Table No. 8: Changes in Personal Waste Management Behaviour

| Particulars                                                      | Items                                                                                              | Frequency | Percent | Valid Percent | Cumulative Percent |
|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|-----------|---------|---------------|--------------------|
| Changes made personally                                          | Increased recycling                                                                                | 9         | 3.6     | 3.6           | 3.6                |
|                                                                  | Improved waste segregation                                                                         | 14        | 5.7     | 5.7           | 9.3                |
|                                                                  | Reduced use of single-use plastics                                                                 | 28        | 11.3    | 11.3          | 20.6               |
|                                                                  | Used more environmentally-friendly products                                                        | 13        | 5.3     | 5.3           | 25.9               |
|                                                                  | improved waste segregation + reduced Single-use plastic + used more environmental friendly product | 89        | 36.0    | 36.0          | 61.9               |
|                                                                  | Above all                                                                                          | 32        | 13.0    | 13.0          | 74.9               |
|                                                                  | not applicable                                                                                     | 62        | 25.1    | 25.1          | 100.0              |
| Encouraged the head of the household to recycle or compost waste | Environmental concerns                                                                             | 72        | 29.1    | 29.1          | 29.1               |
|                                                                  | Community programs                                                                                 | 41        | 16.6    | 16.6          | 45.7               |
|                                                                  | Personal interest in gardening (for composting)                                                    | 101       | 40.9    | 40.9          | 86.6               |
|                                                                  | Government campaigns                                                                               | 33        | 13.4    | 13.4          | 100.0              |
| Encourage the head of the household to change WM behaviour       | More information on segregation and recycling                                                      | 41        | 16.6    | 16.6          | 16.6               |
|                                                                  | Improved waste collection services                                                                 | 70        | 28.3    | 28.3          | 44.9               |
|                                                                  | Peer or community support                                                                          | 13        | 5.3     | 5.3           | 50.2               |
|                                                                  | Increased awareness of environmental issues                                                        | 47        | 19.0    | 19.0          | 69.2               |
|                                                                  | Media campaigns (TV, social media, radio, etc.)                                                    | 13        | 5.3     | 5.3           | 74.5               |
|                                                                  | Personal health concerns                                                                           | 35        | 14.2    | 14.2          | 88.7               |
|                                                                  | Other                                                                                              | 28        | 11.3    | 11.3          | 100.0              |

Source: Primary Survey

The insights into participant behaviours related to waste management practices are shown in Table No. 8. In evaluating individual changes, a noteworthy 36% of participants mentioned a mix of better waste segregation, less dependence on single-use plastics, and the use of more eco-friendly products, indicating a substantial group effort towards increased environmental awareness. Only 13% of respondents recognised significant improvements in their personal waste management practices, including less littering, more recycling, better waste segregation, composting organic waste, using fewer single-use plastics, using more eco-friendly products, and ceasing to burn waste. However, 25.1% of those surveyed said they had previously put these waste management plans into action a few years prior.

According to the data, 40.9% of respondents said that their own interest in gardening was the most important reason for increasing household recycling or composting. In addition, environmental concerns (29.1%) and community programs (16.6%) are acknowledged, demonstrating a multidimensional strategy where community-based and emotional factors come together to promote sustainable habits. Even while government campaigns are mentioned less frequently (13.4%), they nevertheless influence attitudes and actions.

Furthermore, with 28.3% of participants supporting improved garbage collection services, the encouragement of waste management behaviour change among household heads suggests a need for better information dissemination. Concurrently, heightened consciousness of environmental problems (19.0%) and individual health issues (14.2%) indicates that the population's priorities are changing with regard to waste management. Though acknowledged, the very low percentage of responders favouring media campaigns (5.3%) and peer or community support (5.3%) indicates that these channels might not have the same influence as individual motivations and useful service enhancements. This thorough investigation highlights how important it is for individuals, communities, and institutions to work together to promote efficient waste management techniques.

According to this study, 38.5% of participants highlighted a combination of irregular garbage collection schedules, a lack of infrastructure for waste management, and a lack of room for waste storage as obstacles to home waste segregation. In addition, irregular waste collection and a lack of time were the biggest challenges for 25.1% of the respondents. Another concern mentioned by 6.1% of respondents was a lack of room, however 36.4% of respondents said they had no trouble sorting their waste at home. The complexity of the problems with efficient residential waste segregation is shown by these findings, which also show the need for solutions that deal with infrastructure, time restrictions, space, and collection frequency.

The survey indicates improvements in community-level waste management techniques, as seen in table no. 9. The vast majority (30.8%) reported improved waste segregation procedures, which were followed by improved recycling facilities or programs (16.6%) and garbage collection services (16.6%). Furthermore, 5.3% reported more alternatives for disposing of rubbish and public dumpsters. This implies that numerous areas have seen success with enhanced garbage management initiatives. In addition, 78.1% of respondents said their community was cleaner or significantly cleaner than it was two years before, suggesting that overall neighbourhood hygiene has improved.

Table No. 9: Changes in Waste Management Behaviour at Community Level

| Particular                                      | Items                                               | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------------------------------------------------|-----------------------------------------------------|-----------|---------|---------------|--------------------|
| Changes noticed at the community/ neighbourhood | Improved waste collection services                  | 41        | 16.6    | 16.6          | 16.6               |
|                                                 | Better waste segregation practices at the community | 76        | 30.8    | 30.8          | 47.4               |

| Particular                                             | Items                                          | Frequency | Percent | Valid Percent | Cumulative Percent |
|--------------------------------------------------------|------------------------------------------------|-----------|---------|---------------|--------------------|
| level                                                  | level                                          |           |         |               |                    |
|                                                        | Enhanced recycling programs or facilities      | 41        | 16.6    | 16.6          | 64.0               |
|                                                        | More public bins and waste disposal options    | 13        | 5.3     | 5.3           | 69.2               |
|                                                        | improved waste collection service +segregation | 76        | 30.8    | 30.8          | 100.0              |
| Cleanliness of neighbourhood compared to two years ago | Much cleaner                                   | 22        | 8.9     | 8.9           | 8.9                |
|                                                        | Cleaner                                        | 171       | 69.2    | 69.2          | 78.1               |
|                                                        | About the same                                 | 54        | 21.9    | 21.9          | 100.0              |

Source: Primary Survey

### 4.3. Multiple Regression Analysis

To investigate the variables impacting home waste management behaviour, multiple regression analysis was performed. A comparatively significant association between the predictors and the dependent variable is indicated by the model summary's R-value of 0.735. The independent factors of gender, age, family size, education, income, awareness, attitudes, and the accessibility of government programs and recycling facilities account for roughly 54.1% of the variance in waste management behaviour, according to the R-square value of 0.541. The model's resilience and low overfitting are demonstrated by the adjusted R-square value, which stays at 0.515 after controlling for the number of predictors. The model's accuracy in making predictions is indicated by the estimate's standard error, which is 2.345.

According to the ANOVA table, the independent variables together help predict household waste management behaviour, and the total regression model is statistically significant with an F-statistic of 21.105 and a p-value of 0.000.

Table No. 10: Coefficients Model

| Model |                 | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig.  |
|-------|-----------------|-----------------------------|------------|---------------------------|--------|-------|
|       |                 | B                           | Std. Error | Beta                      |        |       |
| 1     | (Constant)      | -43.088                     | 6.019      |                           | -7.158 | .000  |
|       | Gender          | 2.694                       | 0.552      | 0.394                     | 4.876  | .000  |
|       | Age             | 0.54                        | 0.439      | 0.106                     | 1.23   | 0.22  |
|       | Family Size     | -1.999                      | 0.46       | -0.376                    | -4.35  | .000  |
|       | Edu             | 3.455                       | 0.526      | 0.502                     | 6.567  | .000  |
|       | Occupations     | 0.637                       | 0.436      | 0.109                     | 1.463  | 0.145 |
|       | Income          | -0.129                      | 0.256      | -0.038                    | -0.504 | 0.615 |
|       | Lived in city   | 0.349                       | 0.264      | 0.084                     | 1.323  | 0.187 |
|       | Awareness       | 0.98                        | 0.277      | 0.332                     | 3.535  | .000  |
|       | Disposal method | 9.851                       | 1.026      | 0.549                     | 9.603  | .000  |
|       | Attitudes       | 0.823                       | 0.5        | 0.113                     | 1.647  | 0.101 |

| Model |                                      | Unstandardized Coefficients |       | Standardized Coefficients | t     | Sig.  |
|-------|--------------------------------------|-----------------------------|-------|---------------------------|-------|-------|
|       | Community Prog.                      | -1.366                      | 0.251 | -0.314                    | -5.45 | .000  |
|       | Govt. policies                       | 0.969                       | 0.305 | 0.22                      | 3.175 | 0.002 |
|       | Availability of recycling facilities | 0.084                       | 0.218 | 0.026                     | 0.384 | 0.701 |

a Dependent Variable: HH Waste Management Behaviour

The dependent variable, "Household Waste Management Behaviour" (HH WM Behaviour), and a number of independent variables are examined in the regression analysis. The constant (-43.088) is negative and significant ( $p < 0.001$ ), meaning that the baseline home waste management behaviour would be low if all other variables were zero.

Males and females may display varying degrees of home waste management behaviour due to the positive and significant influence of gender ( $B = 2.694$ ,  $p < 0.001$ ). Additionally, education is a strong positive predictor ( $B = 3.455$ ,  $p < 0.001$ ), indicating that people with higher education levels are more likely to use better waste management techniques.

Regression analysis examines how a number of independent variables relate to the dependent variable, "Household Waste Management Behaviour" (HH WM Behaviour). If all other variables were zero, the baseline household waste management behaviour would be low, according to the constant (-43.088), which is negative and significant ( $p < 0.001$ ).

A positive and significant effect of gender ( $B = 2.694$ ,  $p < 0.001$ ) suggests that distinct levels of household waste management behaviour may be displayed by males and females. Additionally, education ( $B = 3.455$ ,  $p < 0.001$ ) is a strong positive predictor, indicating that people with higher education levels are more likely to use better waste management techniques.

Waste management behaviour is negatively impacted by family size ( $B = -1.999$ ,  $p < 0.001$ ), suggesting that bigger families may have more difficulties effectively controlling their waste. People who are more aware of waste management practices are more likely to engage in proper household waste management behaviours, as seen by the positive and significant connection between awareness of waste management practices and behaviour ( $B = 0.980$ ,  $p < 0.001$ ). Additionally, the variable "Disposal method" had the largest positive effect ( $B = 9.851$ ,  $p < 0.001$ ), suggesting that people who dispose of their garbage properly greatly enhance their waste management behaviour.

The negative influence of community programs ( $B = -1.366$ ,  $p < 0.001$ ) implies that involvement in these programs may result in a decrease in individual household waste management efforts, maybe as a result of shared duty within the community. Government policies have a favourable impact on waste management behaviour ( $B = 0.969$ ,  $p = 0.002$ ), suggesting that they promote better practices. Therefore, the multiple regression equation can be expressed as follows:

$$\text{HH Waste Management Behavior} = -43.088 + 2.694X_1 + 0.540X_2 - 1.999X_3 + 3.455X_4 + 0.637X_5 - 0.129X_6 + 0.349X_7 + 0.980X_8 + 9.851X_9 + 0.823X_{10} - 1.366X_{11} + 0.969X_{12} + 0.084X_{13}$$

Given that their p-values are more than 0.05, factors like age, occupation, income, city residency, attitudes, and the accessibility of recycling facilities do not significantly affect how households manage their garbage. This implies that, within this model, these factors do not significantly influence changes in waste management behaviour. Overall, the findings point to government policies, appropriate disposal techniques, education, and awareness as the main forces behind efficient domestic trash management.

Factors including age, occupation, income, city residency, attitudes, and the accessibility of recycling facilities do not significantly affect how households manage their waste because their p-values are higher than 0.05. This implies that these elements don't have a significant impact on how waste management behaviour changes in this model. The findings generally imply that the main forces behind efficient household waste management are government regulations, appropriate disposal techniques, education, and awareness.

## 5. Conclusion

Based on a survey of 247 households, this report offers a thorough investigation of trash management techniques in Bengaluru's HSR Layout. Important details about the respondents' demographics, waste generation patterns, disposal techniques, segregation practices, and behavioural changes over time—both individually and collectively—are revealed by the study.

The majority of the respondents were middle-aged, well-educated, white-collar workers who made comparatively high salaries and lived in small to medium-sized houses. This demographic profile is important for influencing sustainable waste management practices and comprehending the possibility of change. The information shows that although most families produce moderate amounts of waste, a sizeable percentage produce more than 3 kg of waste daily. This highlights the necessity of strong waste management plans to account for the various patterns of creation.

According to the analysis, most of the respondents separate their waste in some way, with a sizable percentage separating dry and organic waste. Sanitary trash, e-waste, and hazardous garbage are less frequently included in the segregation process, though, which suggests that more knowledge and instruction concerning these waste streams is required. The study also shows that waste segregation practices are strongly influenced by educational attainment, with higher education levels being linked to increased process participation. According to the survey, most participants depend on municipal services for the collection and disposal of their waste. To properly manage these materials, clear regulations and infrastructure are necessary, as evidenced by the alarming lack of awareness and confidence regarding the disposal of hazardous and e-waste.

According to the report, there has been a noticeable change in how people manage their garbage, with more people making an effort to separate their waste

better, use less single-use plastics, and buy eco-friendly items. Space limitations, poor infrastructure, and irregular waste collection schedules are still issues, though, and they can impede development. Additionally, the study shows that waste management methods have improved at the community level, with advances in recycling programs, garbage collection services, segregation techniques, and the overall image of a cleaner neighbourhood.

## **6. Key recommendations for improving waste management in HSR Layout:**

- *Improved Education and Awareness:* Put in place extensive educational initiatives to increase knowledge of the value of waste segregation, appropriate e-waste and hazardous waste disposal techniques, and the negative effects that poor waste management has on the environment and human health.
- *Better Infrastructure:* Make investments in better garbage collection services, such as more regular collection times, better facilities for storing waste, and disposal systems designed specifically for hazardous and e-waste waste.
- *Community Engagement:* To promote shared ownership and accountability for waste management, promote community involvement through programs like recycling campaigns, composting initiatives, and waste exchange platforms.
- *Policy and Regulation:* Implement laws that encourage environmentally friendly waste management techniques, such as sanctions for inappropriate disposal of garbage and rewards for appropriate waste segregation.
- *Data-driven decision-making:* To guide focused interventions and track advancement towards sustainability objectives, keep gathering and evaluating data on waste creation, segregation, and disposal procedures.

## **Declarations**

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