



## **A Case Study of Waste Management Practices in a Residential Region**

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### **ABSTRACT**

*Waste generation has been increasing at a tremendous rate in the last three decades leading to challenges for the administration and government. Improper waste management has consequences for ecological imbalance. We investigated the waste management practices, track awareness of the stakeholders and efficiency of the environment management system in a major case study in this paper.*

**Received: 19 January 2024**

**Revised: 3 March 2024**

**Accepted: 12 March 2024**

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**Keywords:** Waste Management Practice, Waste Management Case Study, Stakeholders Awareness

### **1. Introduction**

Earth's systems are experiencing intense pressure on biological, chemical, and geological cycles resulting from human-induced resource use and overuse at a magnitude never before experienced [1] (Barnosky and Hadly, 2016). In the last two to three decades, human-intense activities have disturbed ecological balance. There is an urgent need to preserve the environmental features of the countries. Thus, research on a large scale is undertaken to find solutions. We need synergistic spaces where research findings are interpreted and applied in on-the-ground contexts in ways that acknowledge and meld with social, political, and economic milieus. [2] (Toomey 2017).

### **2. Early Studies**

The waste buried in landfills significantly reduces the ecological balance, which indicates an equilibrium challenge between economic and environmental protection and social progression for life's quality improvement. [6] (Saeidi-Mobarakeh et al., 2020)

The most significant problem that has become the main focus at the global level is environmental issues. From the results of surveys and comprehensive studies conducted by the World Economic Forum (WEF), it is clear that environmental issues are a global threat. [7] (Suryawati)

The study's results by Liu et al. (2015) [8] showed that knowledge and attitudes

are not correlated with environmental action. Stakeholders with a high level of knowledge and attitude towards the environment are inversely proportional to the actions or actions taken. Furthermore, Liu et al. (2015) concluded that there are factors that mediate knowledge and attitude with action. Varoglu et al. (2017) [9] found that knowledge of the environment is related to attitudes and behavior. However, attitudes towards the environment moderately correlate with knowledge and behavior, whereas knowledge of the environment and behavior has a low correlation. Wu and his coauthors, through a systematic methodology, conducted a study that presented the information system and framework design, such as Blockchain and IoT-enabled BIM platform [10] (Wu et al., 2022).

Many studies estimated the volumes of waste generated on campus, identified the causes of waste generation, evaluated the relationships between variables of waste and recommended possible strategies to reduce solid waste generation. [11, 12, 13] In a major study in Ecuador, it was found that municipalities that invested in more complex cooperation types achieved better integrated waste management performance, particularly in the disposal, citizen involvement, and recycling process that ultimately leads to environmental sustainability. [14]

### **3. Aim**

The aim of the current work is twofold. Waste management, a topic of universal concern, is undergoing a profound transformation. The shift from sporadic actions to continuous monitoring and processes is evident in offices, entertainment venues, transportation hubs, and residential complexes. This study focuses on recycling materials, a key action of the impact and value of a pollution-free society. Unlike traditional environmental conditions, modern systems primarily use reuse and recycling; our research delves into how citizens utilise and transform materials.

The primary aim of this study is to investigate the main issues behind improper waste management in a selected housing called Purva Venezia, an upper-middle-class residential building in Bangalore City in India. The investigation will focus on the effectiveness of the waste management strategy in place and the role of residents' awareness in its efficiency.

By understanding a significant urban problem—waste management, we can provide possible answers and contribute to developing more sustainable and efficient urban settlements. This work as urban planners and environmentalists is crucial in this process.

The current work intends to use the specific tasks below as an agenda. We define the area and coverage of the studied region.

We identify and locate the study area so that the target is clear. We measure the level of waste management awareness, as without the cooperation of the stakeholders, any effort will not yield results. Through this study, we understand the role played by each stakeholder in waste management. The real impact of any waste management system lies in several factors, of which the use of equipment is significant. Finally, we advocate measures for effective waste management implementation that help build strategies.

#### **3.1. Some Premises**

We have developed a few background points, as shown below.

1. The building's residents' awareness of waste management is mixed; some have a better understanding, and a few have a low level of awareness.
2. The waste management system of the building does not have a fully pledged waste management strategy.
3. There is a lack of proper equipment for the processing of waste in Purva Venezia

(We chose this as an additional study issue because this is also a main contributor to the problem which we investigated).

#### **4. Methodology**

To measure environmental data and waste management practice, we designed our study to elicit responses through two focusing points. The first is to observe the study environment to obtain the required data. Direct observation lends primary and accurate data that helps in optimum decision-making. Secondly is a carefully instituted questionnaire for which the stakeholders are the data source. Through a systematic and structured set of questions, we created the main data-tapping mechanism. The empirical research method used in this work involves a model to find the impact of one variable over others. The empirical model consists of using a survey-based questionnaire to collect the data to identify and interrelated variables available. It is challenging work to design and develop an effective, efficient, and all-inclusive questionnaire to be used for research data collection in real-life settings.

Anticipating a mix of qualitative, quantitative, and mixed-methods studies, and given the dual nature of our research questions (i.e., the first question is primarily quantitative in nature, the second more qualitative), we pursued a mixed-methods systematic data collection process as used in [15] (Heyvaert et al., 2017). This type of synthesis can accommodate results from different research designs; it involves flexible analytical tools that can be adapted to fit the data and research questions.

We started by sending or visiting various stakeholders to administer questionnaires we made to collect data on this topic. There were 54 stakeholders in all, including 41 residents, 10 housekeeping employees, 1 waste management administrator, 1 BBMP transporter (The Bruhat Bengaluru Mahanagara Palike is the administrative organisation in charge of maintaining public facilities and portions of the city's infrastructure), and 1 managing body member of the resident's association. This information was gathered in April and May of 2022. This time window was ideal for data collection since it allowed us, to gather the data before the start of the new academic year. We collected data and conducted analysis, after which we compiled everything into a report.

##### **4.1. Sampling Technique**

We primarily used stratified sampling to gather the data. We divided the total population into smaller groups, which included residents, housekeeping employees, waste management staff manager, BBMP transporter, and managing body members. This ensured that each group was included in the data collection. If we had used random or systematic sampling, including all the groups might have been an issue.

We gathered the information using primary data-collecting techniques, such as online questionnaires (We used Google Forms) and interviews.

We interviewed the supervisor of the housekeeping staff, from whom we obtained detailed information on Purva Venezia's waste management.

##### **4.2. Data Source**

1. It is located in North Bengaluru, Yelahanka New Town.
2. Yelahanka New Town is an established locality placed along the Bellary Road in the northern outskirts of Bengaluru.

##### **4.3. Waste Management system in the studied region- State of the Art**

###### **4.3.1. Purva Venezia's waste management system in detail**

More than 5000 people live in Purva. It consists of 16 blocks and 1332 apartments in total which impact on huge waste production. The proper management (collection, processing and proper disposal) of this waste is very crucial for the well-being of the residents and the environment they reside in. Purva Venezia is in contract with a company named Paradigm, which has over 50 employees responsible for collecting and processing waste in Purva Venezia.

The waste collection from each house marks the beginning of the waste management procedure. Each block has two housekeeping staff members who collect the household waste. Wet and waste dry waste are the two categories into which residents are expected to separate their

waste. In turn, this facilitates the subsequent steps. Garbage collection begins at 10 a.m. and can last until around midnight. When the waste is collected, it is divided into several categories by the housekeeping staff themselves. There are separate bins for medical waste and wastes like broken glass. Wet waste goes into one, and dry waste into another. All of this is manually separated.

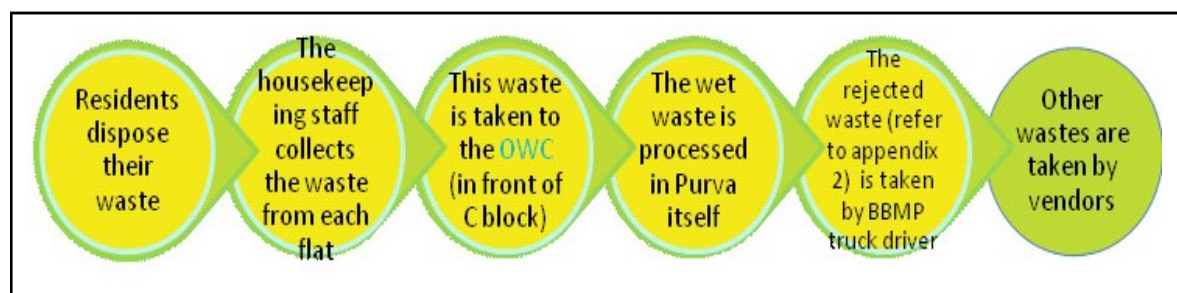
Electronic waste (e-waste) must be disposed of in a bin on the ground floor of every block. Additionally, there are bins in front of each block for pedestrians rather than randomly tossing trash.

After the waste is collected and partially segregated, it is taken to the OWC (Organic Waste Convertor), just in front of the C block (block in Purva Venezia). The rejected waste is kept separate. Every day around 1 p.m., a driver who works for the BBMP enters and collects this waste. The BBMP trucks gather in Yelahanka, where the waste is transferred into larger trucks and driven to landfills outside Bangalore.

Vendors collect other waste, including medical, electrical, and construction waste, which they eventually resell or recycle. Vendors such as Medicare, Nalanda Enterprise, and Recycle Lab buy the remaining waste.

A sum of money must be paid to clear up construction waste, the amount of which depends on the type and quantity of waste.

The OWC plant in the apartment handles the wet waste. Here, the dry waste is separated into 21 different categories. The wet waste is put into 29 big bins and used to make compost. This compost is used inside the apartment itself for gardening, and the excess is sold.



**Figure 1. The process of waste management in Purva**

## 5. Data Analysis

As indicated earlier, the data for this study were collected through a questionnaire and observations in the studied area. The questionnaire was prepared differently for each stakeholders, such as residents, waste management staff, and the administration of the residence citizens.

The answers are posted in the data analysis part by analysing all the questionnaires filled. Still, the issue-based analysis is presented logically, using the responses from all participants, such as residents, administrators, and waste management staff.

The residents are generally well aware of waste management systems in the practice of the studied environment.

### How frequently and what percentage of waste was collected?

This is a fundamental question. The waste management staff members were used as sources to understand this issue. They reveal that all members understand the waste management processes in the sampling region.

**Based on the data collected from the housekeeping staff**

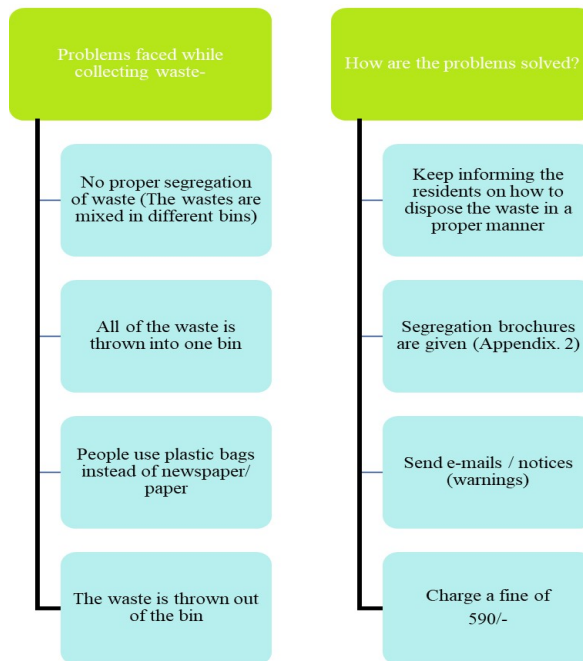
According to the data collected, the waste collected by the housekeeping staff is segregated properly; 20% of the waste is collected regularly, and 10% of the waste is not segregated at all. The rest, 70% of the waste, is separated infrequently.



**Figure 2. Waste Collection Frequency**

We can conclude that the residents who have lived in Purva for a while are familiar with the apartment’s methods for managing household waste, whereas others who have recently moved in don’t know these methods but gradually do.

During the waste collection, the collection members encountered a few problems. The proposed solutions to these problems are also presented in the form of a flowchart.

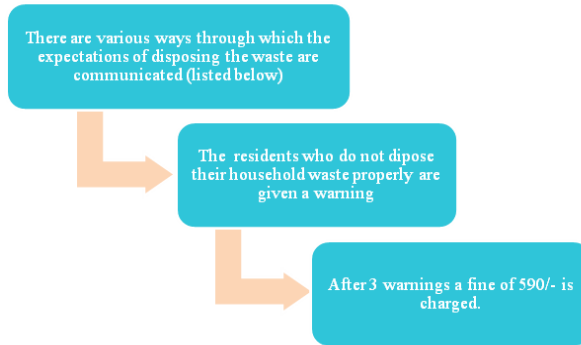


**Figure 3. Problems faced by housekeeping while collecting waste and how they solve it**

**Based on the data collected from the Administration**

In the words of the administration, the residents are aware of how they are expected to dispose of their household waste daily.

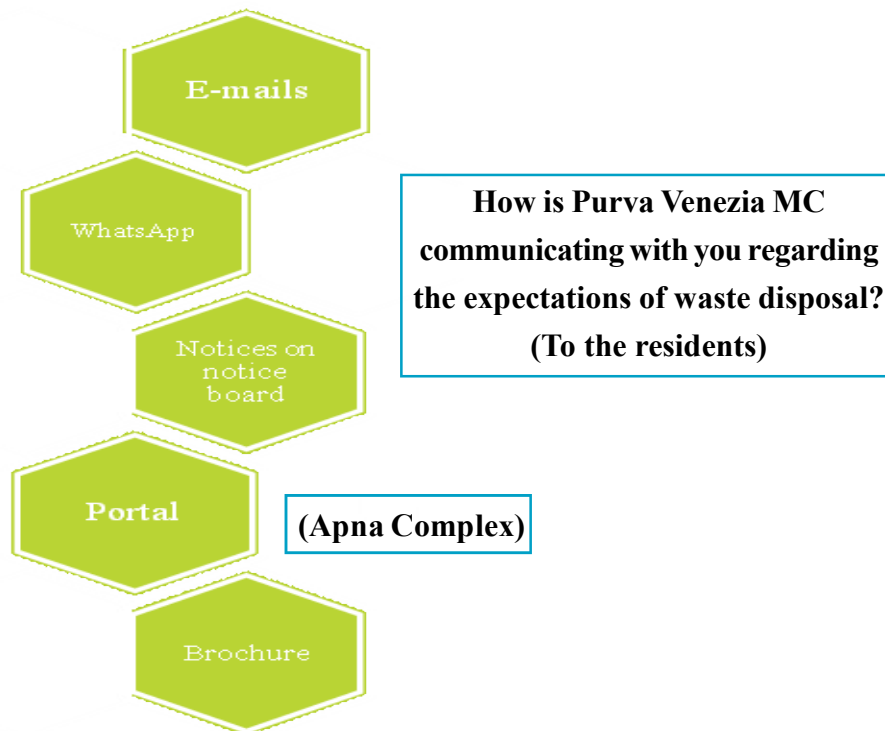
The administration’s actions of residents’ improper waste disposal are outlined in a figure below.



**Figure 4. Administration Activities**

The administration clearly communicates the expectations and responsibilities of the residents for waste disposal activities

The administration’s outreach program propagates the notification campaign by issuing print brochures, emails, WhatsApp messages, webpage communication, and notice board bulletins. Thus, the system’s outreach activities are complete and ensure proper information delivery.

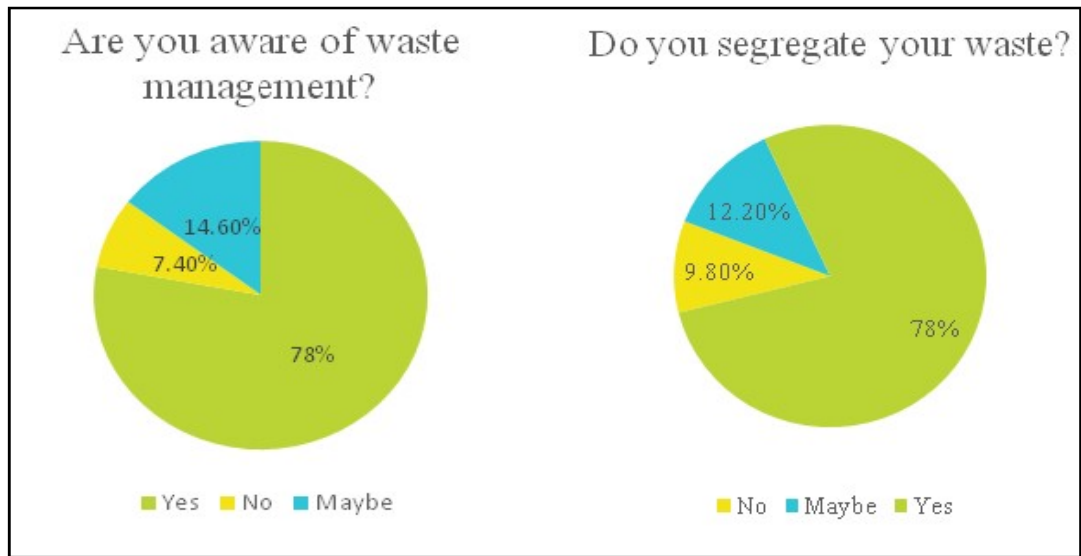


**Figure 5. Waste management practices notification**

The brochure handed out to the residents clearly states the categories in which the residents are expected to segregate the wastes. For clarity, the brochure is given in Kannada, apart from English. This ensures that the residents clearly understand what is expected of them.

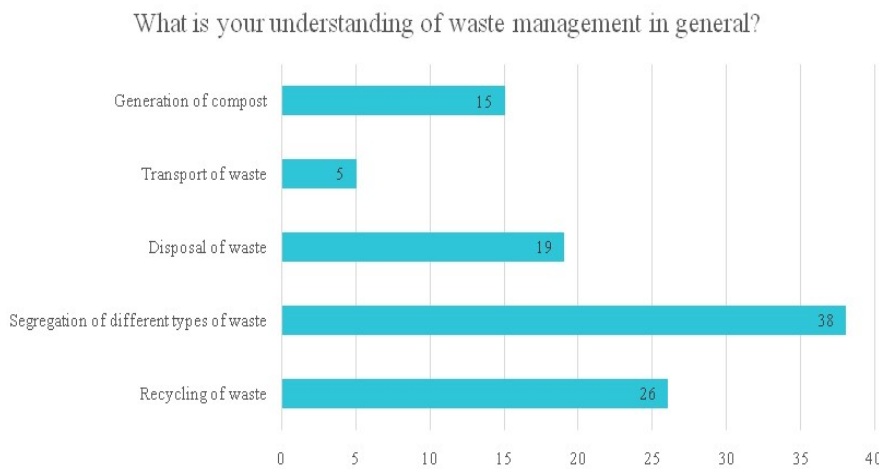
**According to the residents themselves**

The residents who are partially and not at all aware of waste management add up to 22%, despite the notification efforts. This number corresponds to the same as the residents who do not segregate their wastes. 78% of the residents are aware of waste management and segregate their waste, which is the same, suggesting that the people who are aware of waste management segregate their waste.



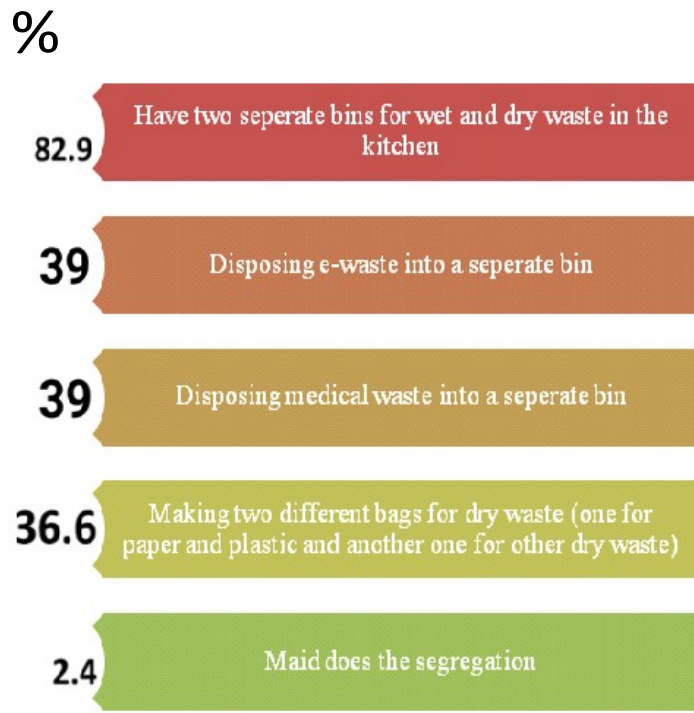
**Figure 6. Responses about the waste management practices**

Residents understand that waste management consists of segregating the waste. This is only partially accurate, as waste management includes disposing of waste as well as collecting, transporting, sorting, recycling, and generating compost (from wet waste). Stakeholders need to develop an understanding of the waste management systems which enable them to participate with good success. This kind of data is solicited and presented in the below figure.



**Figure 7. Understanding of the residents about waste management**

This is a brief account of how residents dispose of waste, which has been tracked and presented in Figure 8.



**Figure 8. Waste disposal types**

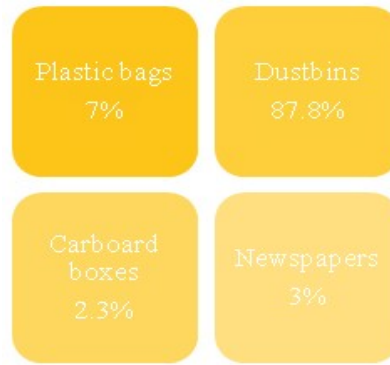
A perfect practice is how the residents understand the process even after reaching the models. The data reflects the categories of waste generally thrown out by the residents, and the figure (figure 9) below gives the categories.



**Figure 9. Waste Categories**



The waste generally thrown out by the residents is stored in the following form (figure 10) as evident from the data fed by the administration.



**Figure 10. Stored Waste**

The residents store and throw out different types of waste in different containers. For example, 3% of the residents use newspapers to dispose of wet waste, and 87.8% use dustbins (different for wet and dry waste) to dispose of and store the waste. Most stored waste exists in dustbins. The crucial issue here is the heterogeneous waste stored in dustbins. The dustbin is a generic category which accommodates many forms.

The residents using different types of storage for different types of waste show that most of them are aware of waste segregation.

However, 7% of the residents use plastic bags for wet waste, which is not recommended as it's harder for housekeeping to separate the wet waste in the plastic bags.

**Challenges for the Residents**

In the figure below, we have listed the major issues the residents faced, as identified from the questionnaire responses. Also, we advocated a few solutions based on the participants' responses. This data will enable us to understand the issues, challenges, and opportunities for the participants.

Problems	How the residents solve their problems
The disposal of plastic bags as it is a non-biodegradable waste	Use newspaper instead
Throwing waste into paper bags. The paper gets soggy when disposing liquid or food	Put them in plastic boxes or covers
Disposing broken glass as the people who collect garbage may get hurt	Wrap the glass in newspaper and the put it in a cover
Segregation of waste- segregating wet wastes from other wastes (like oil from its plastic).	Check the guidelines given by administration
Bad smell from wet waste especially	Closed bins with lids can be used

**Figure 11. Challenges and Solutions for Residences**

For example, instead of using plastic bags, which are non-biodegradable, the residents use paper bags, which are much safer for the environment. This suggests that the residents can solve their problems easily using another alternative.

### **Role of each Stakeholder**

The residents generate household waste, and they are entrusted with classifying it and enabling better disposal. They play the main role by segregating the waste into two simple categories (wet and dry waste) to simplify further processes.

The administration works towards making Purva Venezia more sustainable. They recycle waste and make compost out of wet waste. The members also ensure that waste from each household is properly disposed of.

The administration of Purva Venezia acts as a medium of communication among the residents, Paradigm, and other stakeholders. The administration supports the housekeeping staff. They also monitor each vendor's activities and ensure vendors comply with an agreement. They follow up on the waste taken by the vendors from Purva Venezia. Where and how is this waste sent, recycled, or dumped?

The nature of communication among a community will affect that, as well as the possible mechanisms by which spatial structure can affect patterns of interaction in the work system. The administration communicates with stakeholders and the Government mainly through e-mails. They also inform residents how they are expected to dispose of the waste by giving out brochures, putting up posters below each block and communicating through the Apna Complex portal.

### **6. Summary**

We infer from all the data gathered that we documented that the Venezians (residents of Purva Venezia) are well informed on Purva's methods for managing waste and how to properly segregate their own home waste. Only the residents who have recently moved are initially unaware of the waste management here. Over time, they do, however, grow more conscious of the processes.

Purva has well-defined procedures for the housekeeping team to meet. Each month, there is a training session for the staff members, and there are daily meetings as well. BBMP itself holds weekly training sessions for BBMP drivers, and strict work standards are upheld.

The Purva managing board uses various communication channels to inform the Venezians (Purva's residents) of the proper ways to segregate their household waste. Purva follows a proper waste management system.

### **7. Conclusion**

It has been documented in many studies that the vast majority of solid waste is disposed of in landfills and fails to get back to the supply chain[16]. It is a primary concern in waste management despite huge efforts. It contradicts an essential need for a prosperous economy and yields issues with waste management practices. The administration took initiatives for fruitful implementation of operational measures and waste management policies; however, a significant volume of waste continues to exert pressure on the waste management administration across countries.

By concluding all my facts, it is indicated that no major issues were noticed in Purva Venezia's waste management system. Rather, it was proved to be efficient. It could always be better by using newer technology. Purva Venezia has also been recognised by *The economic times*, it has proved to be an effective producer of compost.

### **8. Future Directions**

1. To look into other factors that cause improper urban waste management is a comprehensive study where large-scale exercises can be instituted.

2. If possible, use a larger sample size (more people) and study area. A bigger study area tends to result in more samples. This will improve efficiency because more people will have their opinions known, and the general conclusions should be similar. For example, how often is your waste collected? (In this case, every day.) All residents should provide the same responses; if there are a few variations (such as once or twice a week), the person is not being truthful.
3. Have fewer open-ended questions in the questionnaire for ease of analysis.

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