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# Analysis of Waste Management Process Followed by BBMP need to Encourage Segregation Using Technology

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***Abstract***
*With the growth in population, the management of solid wastes is one of the primary concerns that is faced by the Government. The huge amount of solid waste that are generated need to be transported and disposed of properly. Numerous problems are rising constantly due to improper disposal of these wastes. This paper talks about the analysis of the process undertaken by the Bruhat Bengaluru Mahanagara Palike (BBMP) in waste management. A general survey was conducted in parts of the Jakkur ward in Bengaluru to analyze the processes carried out by BBMP on a day to day basis to manage waste. A questionnaire was prepared for both citizens as well as the BBMP workers. A survey was done for 545 houses and the difficulties and problems in the existing system were compiled. Observations were made on the conditions of the transfer station and disposal site. Findings and studies have shown that one of the vital problems is the segregation of waste at source. With the recent technological advancements, we are convinced that this problem can be tackled using a mobile application that encourages segregation at the source. The method used to do is by incentivizing the citizens based on the amount of segregated waste being dumped. The citizens will be credited based on the type and amount of disposed waste as each waste material will be assigned their respective fixed value. With this app, Remote monitoring of disposal trucks and the amount of waste dumped on a daily basis with real-time data is possible.*

***Keywords:*** *BBMP Analysis, incentivizing, mobile application, segregation at source, solid waste management*

## Introduction

Rapid Urbanisation in Indian cities combined with a growing population, Industrialization, and lack of proper infrastructure has made the solid waste management scenario very tough. The state of Karnataka alone generates 11186 TPD of solid waste out of which 9706 TPD is collected, 3475 TPD is treated and 5170 TPD is landfilled. There are 276 local bodies excluding BBMP in the state of Karnataka and yet it is difficult to manage the waste [1].

Bengaluru is one of the largest cities in India with an estimated population of around 9,621,551[6]. The BBMP carries out the collection, street sweeping, transportation, processing, and disposal of Municipal Solid Waste from generators in the city of Bengaluru. It has a system of the door to door collection for collecting the MSW and this has to be processed before landfilling [2].

**Table No. 1** Quantity of Waste generated in Bengaluru



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| Particulars | Waste generation TPD | Waste Collection TPD |
|---|---|---|
| Residential, small commercial and street sweeping | 4200 | 3800– 4000 |
| Bulk generators | 1480 | 1300-1400 |
| Total | 5680 | 5100-5400 |

**Source:** SPCB Report 2017-18

Although the 75 - 90% of the waste generated is collected efficiently even with a waste generation rate of 0.5 kg/capita/day, only 10% of the waste is recycled currently [3].
Segregation at source is still a concern in Bengaluru though awareness is growing eventually. The collection of solid waste is carried out in two phases. The primary collection which is the door to door collection of solid waste using auto tipper & pushcarts. About 20000 Pourakarmikas are utilized in the door-to-door collection, street sweeping, and transportation of MSW. This waste is then brought to a common point from where the waste is transferred to landfill sites or treatment plants through tipper trucks & compactors [4].
As per schedule II of the Solid Waste Management Rules, 2016, every waste facility shall include composting as one of the technologies for the processing of biodegradable waste. Likewise, in Bengaluru we have 9 aerobic composting facilities that use wind rows method but none of these places have an effective way to treat the leachate runoff or percolation. [5]

**Methodology and Procedure**

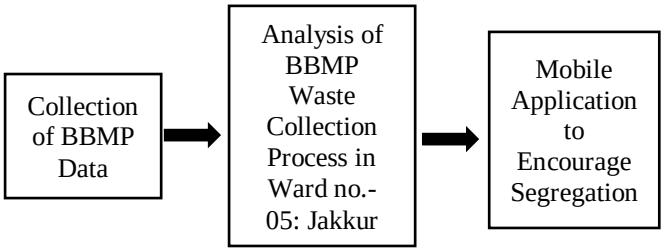


**Fig. 1** Methodology

Bengaluru is the capital of the Indian state of Karnataka. It has a population of over 9,621,551[6], making it a megacity and the third-most populous city and fifth-most populous urban agglomeration in India.
With its growing population, there has been a drastic growth in the generation of waste. As a thriving metropolitan city, Bengaluru is still struggling with the management of this enormous amount of waste generated every year. Over the years, Bengaluru has transformed from being called the Garden city of India to the Garbage City.
In an approach to improve the current Waste Management scenario, a study area of ward no:5 (Jakkur) was taken and analysis of the BBMP working process was done.



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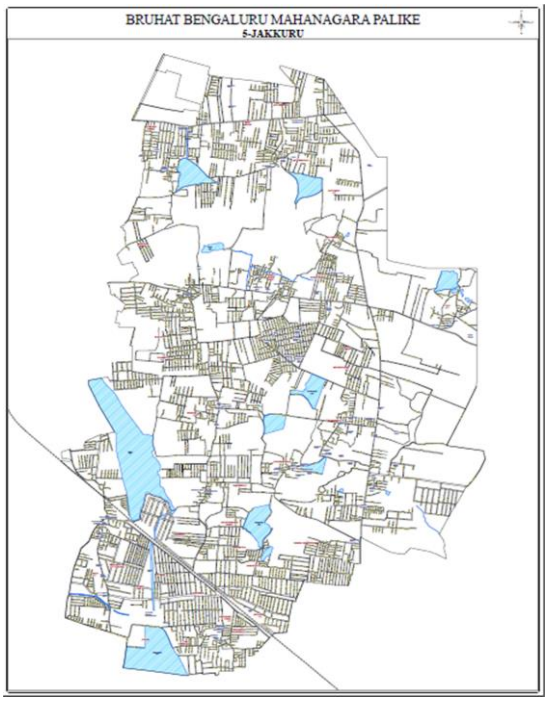


**Fig. 2** Study Area – Ward 5 (Jakkur) **Source:** [8]

The survey was conducted inward no.5 Jakkur with the permission of the local authorities. The survey was started early in the morning when all the garbage collectors come and assemble in the transfer station and the project group was divided into subgroups and each of them travelled with the garbage collector and interviewed the people of that locality. The collection process was observed and the problems faced by the garbage collectors and locals were recorded in the questionnaire sheet which was prepared. After the waste was collected it was brought to the transfer station. The waste which is collected is manually sorted by hand as much as possible and the rest is sent to the nearby landfill as mixed waste. The waste which is segregated was sent to two different places wherein the dry waste was sent to Palanahalli dry waste collection center. The wet waste which is generated was sent to Doddabidarakallu wet waste processing plant and manure is prepared in the plant and it is sold to the nearby farmers.



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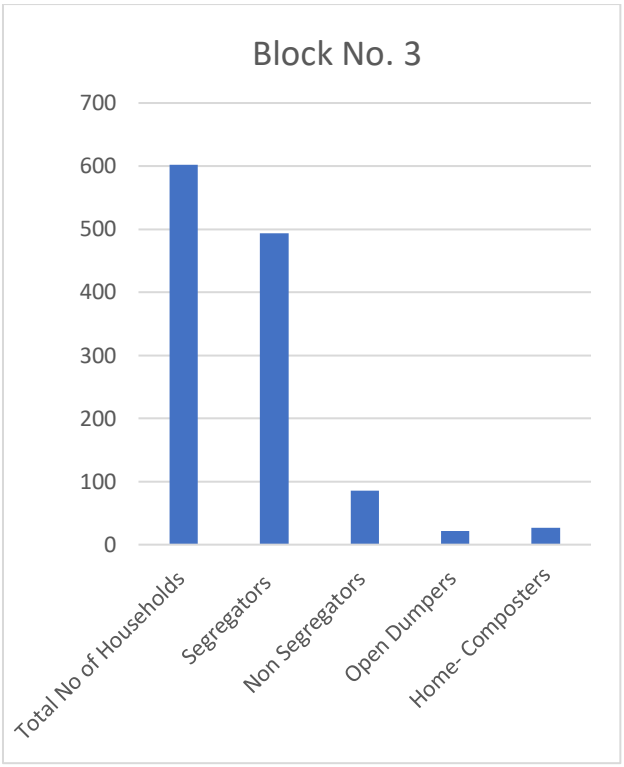


**Fig. 3** Graph of data from Block 3

With roughly 602 units of households, 494 units throw out segregated wastes whereas as the 86 units do not segregate while disposal to BBMP. Out of the 494 households, 27 units compost their wet waste. Open dumping is done by 22 units due to the uneven timings of the working class people and the time when the door to door collection is done by BBMP and also the availability of unused lands nearby.

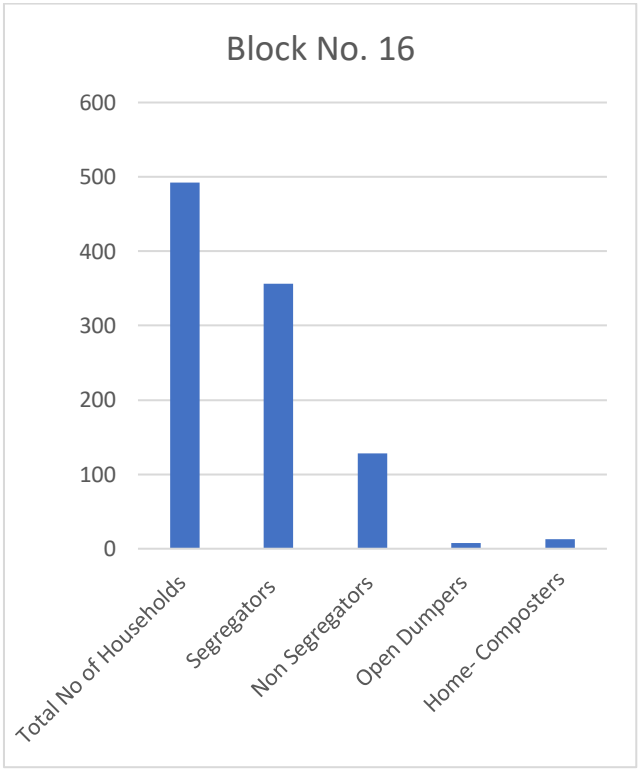


**Fig. 4** Graph of data from Block 16



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In Block no. 16, the total number of households is found to be 492 units. Here 356 households segregate waste whereas 128 units do not. Open dumping is minimal with 8 units due to the availability of trash bins. Out of the 356 households, 13 units compost their waste.

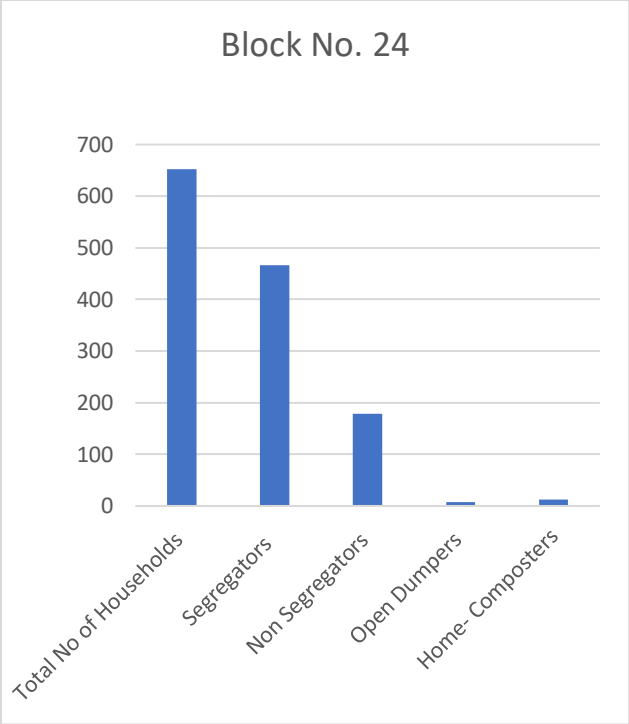


**Fig. 5** Graph collected from Block 24

In Block no. 24, 466 out of the 652 total number of households segregate waste and 178 households dispose of without segregation. Only 12 out of the 466 households compost at home because of reasons such as non-availability of composting equipment, space, etc. Open dumping is minimal at 8 households due to proper placements of trash bins at required locations.

With the exponential rise in population throughout the world, Solid waste management systems have failed to keep pace with the social and economic development that has taken place throughout the years. Findings and study of selected areas have shown that one of the vital problems of domestic waste management i.e. waste management at source is non-segregation of waste. Segregation of waste has proven to be an important aspect of the scientific disposal of waste.[7] With the recent technological advancements, we are convinced that this problem can be tackled using an app which encourages segregation at source. The method used to do so is by incentivizing the citizens based on the amount of 'segregated' waste being dumped. Incentivizing people will be based on a model where a fixed rate for each of the various types of waste materials that are available will be assigned the citizens will be credited based on the type and amount of disposed waste. With this app, Remote monitoring of disposal trucks and the amount of waste dumped on a daily basis with real-time data is possible. This data collected can be subsequently analyzed for various purposes for the constant enhancement of the system.

## Working of the App

### i.Incentive Model Working

When a resident/individual throws out segregated waste, the driver of the trucks measures the quantity of the waste disposed of. i.e. Both dry and wet waste using a regular weighing machine.



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This quantity is inputted manually by the driver into his app which generates a QR code for the individual to scan and earn points on based on the quantity.
The QR Code that is generated is based on the type of waste and the quantity in terms of gms or kgs.

**ii. Waste Truck Tracker**

The app can track the waste truck on the map around the city, Places such as designated Pickup or disposal locations, etc can be seen.
If a truck is filled, upon the driver's input the app will notify the residents about the detour the truck will have to take. This notification will only appear if the truck isn't on the scheduled route at the scheduled time.
For the management team, the data collected from all the travel and quantity disposed of will be easily accounted for. This can plan much more efficient routes, saving time, money, fuel, and carbon emissions through the future integration of machine learning in this field.

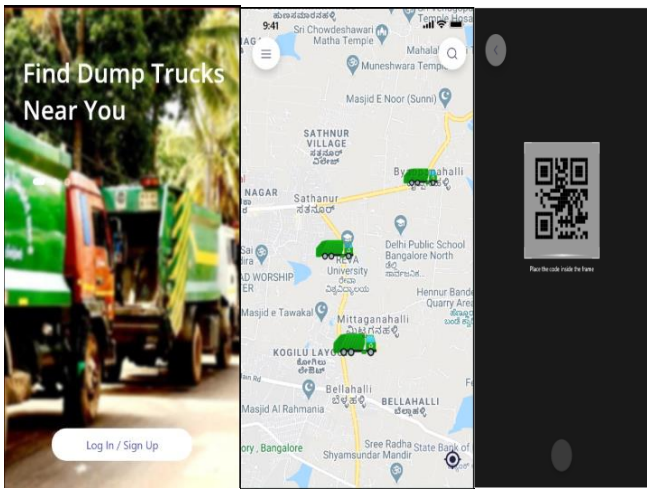


**Fig. 6** Sample of App Design

**Results**

**Discussion**

The improvements that are found out during the survey are listed below.

- Segregation was done in few houses while a majority of houses did not do it.
- The timings for the collection of waste was unsuitable for working-class citizens.
- Alternating days for the collection of wet waste and dry waste is done by BBMP. This often causes trouble for citizens who produce a higher amount of wet waste or the citizens who failed to dump the waste on a particular day.
- Although a few citizens suggested the provision of common dustbins at particular points, this often led to higher hygiene problems and dumping of unsegregated waste.
- The BBMP workers faced hazardous situations during the collection of waste and also the future segregation of unsegregated waste.
- Although the BBMP collected segregated wastes at few houses, they were altogether sent as mixed waste to the disposal site on the day of dry waste collection.
- The segregated dry waste was sent to Palanahalli Dry Waste Collection Center from where it was sent to various recycling plants. On the days of wet waste collection, the waste was sent to Doddabidarakallu wet waste processing center.



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**Benefits of the App**

**i. To the Users**

- One of the main difficulties that the residents faced during the survey is that the waste trucks are not always on time and miss their opportunity to dispose of waste. this can be due to several factors. To tackle this, the app will notify the users when the disposal trucks are nearby the area and thus users can always locate the trucks at any time of the functioning hours.
- The incentive model used by the app will encourage the residents/ users to dispose of more segregated waste with enthusiasm and with caution. With this model, more participation of citizens will be seen without the need for advertising the model.
- The App will be able to show the residents the actual impact of their contribution to society, making them more environmentally conscious.
- Ease and accessibility of the User interface and User Experience (UI/UX) make the app very easy to use for the everyday person.
- The Incentive model will be based on points. These points will be converted into items of monetary value.

**ii. To the Workers**

- Segregation of waste will ensure the workers will not be exposed to harmful substances that otherwise would be mixed when they are disposed of.
- The need for segregators (Workers who segregate waste in collection centers) will be eliminated.
- Accountability in Waste management personnel will be increased through this app as the drivers and collectors of each app will have to be logged into the app for the process to go through.

**ii. To the Pollution Board**

- The main motive of the app will be to make sure all the waste is segregated accordingly at the source.
- One of the main reasons for the poor performance in the solid waste management system is the fact that all types of waste are being mixed preventing their proper disposal. Each waste material, be it wet, dry, and hazardous waste have its own respective disposal methods. These disposal methods are only possible when the waste is not mixed. This is exactly what the app will try to overcome.
- Through the app, Efforts are being made to convert the waste collected to be turned into various eco-friendly products such as bricks made of waste materials, etc.
- Waste truck drivers will have a cloud-based app that connects to data management platforms which can plan much more efficient routes, saving time, money, fuel, and carbon emissions.

**Conclusion**

Management of solid wastes is a major challenge these days for the administrators, engineers, and planners. Unfortunately, in many developing countries, like India, the system for managing wastes is primitive and cannot cope with the huge volumes of wastes being generated. Civic bodies have to redraw long term vision in solid waste management and rework their strategies as per changing lifestyles. They should reinvent garbage management in cities so that we can process waste and not landfill it. This should be done with adequate provisioning in processing and recycling. To do this, households and institutions must segregate their waste at the source so that it could be managed as a resource.

Hence, an effort is made to manage the waste by analyzing the current solid waste management system of BBMP through a survey. The survey helped us understand the various points of improvement required in the system. It was identified that segregation did not happen at the grassroots level and this caused problems at various levels of management that include collection, transfer, and deposition of



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waste at the landfill. It was also found that the timing of collection of waste did not match that of the working-class people and this leads to the dumping of unsegregated waste in random places of the city.

The involvement of technology i.e. the application will help encourage segregation through technological means. This will prove useful to various sections of the society mainly the citizens, BBMP workers, and the BBMP management system.

For the citizens, the app helps track the location of the dump truck, notifies the arrival of the truck, and also the incentives provided. The segregation of waste at source helps in improving the safety and health of the workers since there is minimal contact of unsegregated waste. It also helps them work in a more hygienic environment. As a consequence of the above, the BBMP management system will now have to go through an easier process. They can also track the position of the truck, reduce manual labor in segregation, and increase the speed of the process and also reduce pollution to a large extent.

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