

Data Collection and Analysis of Solid Waste Management in Thiruvananthapuram Corporation

BRIEF

Solid waste management and disposal are one of the most emerging challenges of the modern world, especially in economically developing countries due to their growing populations, lifestyle change, rising community living standards and increasing waste generation rates with the consequent increase in land requirements for waste disposing and dumping. Thiruvananthapuram Municipal Corporation (TMC) has been following decentralized solid waste management and encourages on-site management of biodegradable discards since 2013. We were able to understand that the major initiatives in Thiruvananthapuram city over the last 3 years were regarding solid waste management and to turn it into a green city. The following initiatives were taken under the program to drive the change:-

1. Green protocol implementation
2. Decentralized Waste Management
3. Green Army - a platform where individuals & groups work with school students to educate them about segregated waste management and other sustainable living practices in an urban environment
4. Waste management awareness festivals
5. Zero waste ward initiative

From our discussions, we identified a need for an impact analysis of the initiatives and generate performance models that could be used to implement the above initiatives in other districts in Kerala. Multiple innovative solid waste management technologies were also implemented along with the drive in different parts of Trivandrum, and the impact analysis along with regression analysis and optimization of the same were other requirements that we have identified. In our project, we wish to include:-

- Data collection from various organisations, government bodies, health inspectors and Green Army volunteers across the city. (Ref. 1)
- Engaging with recognised organisations in the field of solid waste management to identify Key Performance Indicators.

- Identifying and generating models to optimize the new technologies that were implemented as part of the initiative.
- To do a regression analysis of existing inflow and outflow, and assist government agencies in identifying gaps and engage in capacity building activities.
- Generate a template for easy implementation of the above initiatives in other districts.

SCOPE

For conducting this survey, we need to collect data about solid waste generated and collected from the 100 wards within Thiruvananthapuram Corporation (214.86 sq. km).

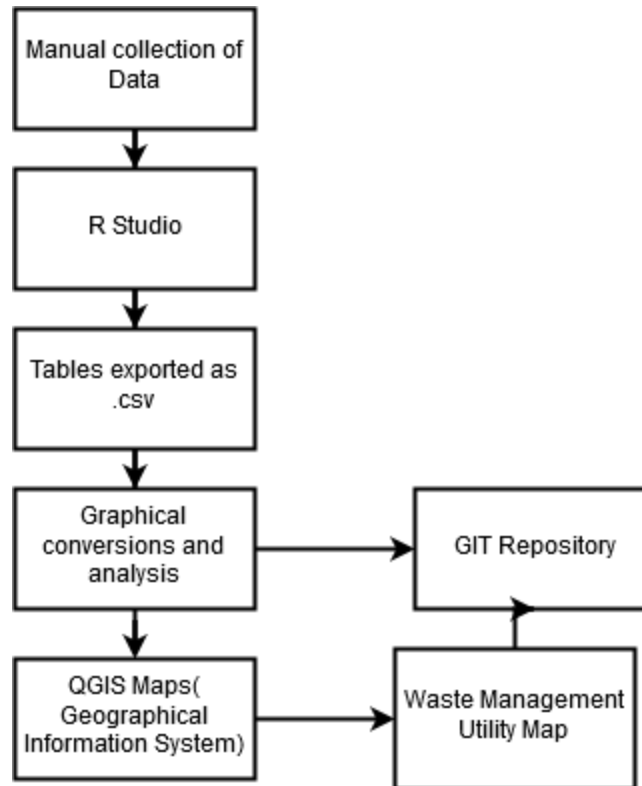
PARAMETERS

1. Infrastructure:
 - a. Transportation
 - i. Roads
 - ii. Number of collection vehicles
 - b. Utilities
 - i. Number of bio compost bins
 - ii. Number of waste bins
 - iii. Number of recycling centres
 1. Paper
 2. Plastic
 3. Metal
2. Services:
 - a. Recovery rate (tons/day)
 - b. Rate of segregation
 - c. Number of workers
 - d. Area covered per day
 - e. Number of projects undertaken by municipality
3. General:
 - a. Population
 - b. Ward area
 - c. Number of households
 - d. Number of stores/malls/shops

- e. Waste generated by the above
- f. Reduce
 - i. Carry bags
- g. Reuse
 - 1. E-waste matrices
 - 2. Hair waste from saloons
 - 3. Bottles
- h. Recycle
 - 1. Kilograms of waste converted
 - 2. Kilograms of construction waste converted
- 4. Centralised and Decentralised
 - a. Amount of fuel consumed (litre)
 - b. Energy saved due to recycling

TECHNICAL OVERVIEW

Collection of waste management data is done by the manual process of obtaining data from various municipalities or from corporation office or from wards through ward councillors or respective authorities. Survey cards can be issued which will collect the feedback data from the residents of each ward which helps to obtain impact data on various waste Management projects implemented- Collected data is processed and analysed using the Free software environment R, which can be used to analyse statistical data and to graphically classify the data available. Use of Rstudio is done to do the analytics part in R. The collected classified data from R is then made into a table which is stored as a .csv (Comma Separated Values) file. Use of QGIS which is a free and open-source cross-platform desktop geographic information system application that supports viewing, editing, and analysis of geospatial data to create a custom map of the surveyed area to plot or markup the data collected including the common waste collection points in each wards, availability of incinerators and data which are available for everyone to monitor or to make use of.



LITTERATI:

Litterati is a global community that's crowdsource-cleaning the planet, from students in South Africa to activists in Italy, and neighbors across the US. And collecting a ton of data in the process, helping businesses and communities identify the root of the problem and drive change. It's the power of what happens when individuals join forces for a greater good.

So by using the framework of this app, we can develop a similar open source app which can be used to collect waste from every area by capturing an image and geotagging it to the map. This helps in easy collection of data because of the massive crowdsourcing. Including tagging of new dustbins and common waste collection depots onto the map makes it even easier for the citizens to get to know about this. (Ref. 7)

CONSTRAINTS AND RISKS

The manual data collection takes huge amount of time. The lack members in the team to manually collect these data from the current 100 wards in the corporation area will also increase the workload. We also will face difficulty in collecting accurate data regarding each variables in the survey form.

Since precise data from every household cannot be collected, the data collected should be averaged out to obtain a general trend which is the the only possible solution.

We also face the constraint of getting data from the public firms without proper permission or affiliation.

MODULES DEFINITION

Collection of data regarding Infrastructure:

Data collection of infrastructural would involve data regarding transportation and utilities. Transportation data includes availability of roads or pathways which are used to collect waste from every common collecting points/waste bins in a Ward area. It can be done by measuring the length of road available per area on a Ward. Other transportation data may include the availability of collection means or vehicles to collect waste from the sites.

Suchitwa Mission (SM) (Ref. 3) extends technical support to Local Self Government Institutions in identifying issues, suggesting mitigation measures in Municipal Solid Waste Management (MSW). Also, the city corporation has launched a new mobile app called 'Smart Trivandrum', through which residents can get updates on dry waste collection drive as per collection calendar, location of material recovery facilities and aerobic bins. Data related to utilities like bio composts, waste bins and recycling centres, can be obtained from SM and Smart Trivandrum app.

The health inspector in each ward has the data and the effectiveness of services provided such as frequency of waste collection, the number of workers available per ward, the area covered by the workers in one day and also the projects undertaken.

The general data that needs to be collected includes population, ward area, number of households, number of stores/malls/shops and waste generated by the them. Such datas would require a survey. Apart from these, there could be centres that may be implementing the three 'R' concept, namely Reduce, Reuse and Recycle.

There are arrangements to collect E-Waste, along with tube lights and CFLs, from all the government institutions in Kerala, and scientifically recycle the same in association with a leading recycling organization approved by the central pollution control board and Kerala state

pollution control board and to issue the mandatory destruction certificate for the recycled E-Waste. The information about E-waste centers are available in SM. (Ref. 6)

The data of hair waste is recorded by each saloon. The percentage of this waste reused for fertilizers, cosmetics, etc. will also be available.

The reuse of plastic and glass bottles is done by many private sectors. These data are available with the health inspectors of each ward.

The total kilogram of waste that was converted and also the total kilogram of constructional waste that was converted to useful things could be calculated.

KEY PERFORMANCE INDICATOR

CONCEPT OF ZERO WASTE:

Zero waste is said to be achieved when each household in a ward attains some fixed parameters such as:

1. 60% of the waste should be composted at home itself.
2. The waste collected from the households by the authorities should be less than 20% of the overall waste produced.
3. 90% waste segregation should be done at the household.

For each ward the data is analyzed to match for Zero waste concept. Key Performance Indicator is used to find the best ward or the ward which follows all the requirements to become a zero waste ward.

SERVICE PROVIDER

1. Haritha Gramam :

Main feature is provision of garbage units which include kitchen bin, bio-clean and plastic sack(which are provide free of cost). Maintenance and service cost is Rs 200 per month. Collection strategie include;collection of plastic waste once in a month,discarded footwear and bags once in 3 months;broken glass and e-waste once in 6 months. (Ref. 4)

2. Upcycling :

Old sari is reused as an sari bags to replace plastic bags. Water bottles are filled with clay mud to be used as constructional block units. Coconuts shells are used as utensils.

3. Sunage :

Awareness campaigns are done to inculcate better practices among people. Plastic wastes are collected once in a week. CCTV cameras are installed to ensure proper dumping of waste. A meagre sum of Rs 300 per month is charged to collect different type of waste. (Ref. 5)

4. Thumburmozhi:

Evolving a Eco Friendly, cost effective, aerobic composting system suitable for agro climatic conditions of the state of kerala. It is a one of the most effective method of decentralised bio-waste management system used all over kerala. We plan on conducting a regression analysis on this and optimise the need and use of thumburmuzhi across kerala. (Ref. 9)

5. Pelican bio-tech(Pelican Foundation) :

Offers odourless composting solutions to manage piling waste using composer. Cost of product is Rs 12/L to be used in ratio 1:10, ie, 5L of composorb is used to make 50L of soilless plant media from waste. (Ref. 2)

6. Material Recovery Facilities (MRFs):

Facilities that takes in materials and processes them for end user manufacturing. Mainly 2 types: clean and dirty materials recovery facilities. (Ref. 8)

- A clean MRF accepts recyclable commingled materials that have already been separated at the source from municipal solid waste generated by either residential or commercial sources. The percentage of residuals from a properly operated clean MRF should not exceed 10% by weight of the total delivered stream and in many cases it can be significantly below 5%.
- A Dirty MRF, accepts a mixed solid waste stream and then proceeds to separate out designated recyclable materials through a combination of manual and mechanical sorting. Also it recovers between 5% and 45% of the incoming material as recyclables.

MAINTAINABILITY

We are starting a new repository in GitHub and save all these data in the repository so that we can open our project for everyone which will help them to further develop the data analysis. Since GitHub is an open platform every data can be accessed and also the data analysing software is also a open software which help the developers further. For impact analysis, the survey card which are used, are digitised and stored in GitHub Repository. This ensures that any further projects done on a bigger scale are properly implemented and documented.

RESOURCES REQUIREMENTS

- Manual data collection over the whole corporation requires about 30-35 days to complete.
- Preparation and analysis of data and creation of maps and other graphical presentation takes 15-20 days.
- Estimated time for completion is around 2 Months

STANDARDS

[ISO 11932:1996](#)

Solid wastes

[ISO 15270:2008](#)

Plastics -- Guidelines for the recovery and recycling of plastics waste

[ISO/TC 297](#)

Waste collection and transportation management

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