Decentralized Model for Solid Waste Management in Basavanagudi Ward by using GIS Technique

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Abstract— Solid waste generation is growing at an alarming rate with increase in population and changing lifestyles of people. Unscientific way of waste handling, lack of infrastructure, co-ordination between the municipal authorities in creating awareness among the public leads to waste management problems. An attempt has been made to divert the organic waste to biogas plants and inorganic waste to nearby recycling units generated in Basavanagudi ward by using ARC GIS 10 software. This study works on 'waste to wealth' concept. If waste segregation at the source is practiced, then this is the best suited model for zero waste management.

Key words: Municipal solid waste management, geographical information system, survey of India

I. Introduction

Municipal solid waste is a waste which is no longer considered as an asset to be retained which includes solid or semisolid materials in residential, institutional or commercial establishments [1].A significant impact on human health and the environment can be caused by improper management of municipal solid waste by a community [2].As the civilization progressed the generation of waste becomes more and more complex. [3].

The drastic increase in the population and the fastest growth of industrialization has made MSWM an important issue [4]. This resulted in the migration of village people to metropolitan cities which in turn responsible for the generation of huge quantity of municipal solid waste every day [5].

A. Study area:

Basavanagudi is one among the oldest areas of Bangalore and it is a residential and commercial locality**.** The ward number is 154.The population of the ward is 37650. The total quantity of waste generated in the ward is 17.3tons. In that contribution from the households and commercial establishment is 16.16 tons and 1.14 tons respectively. The total organic waste generated in the ward is 13.84 tons.

II. Materials and Methodology

A. Materials:

ArcGIS 10 software
Google earth
Toposheet of Bangalore urban district (SOI)
BBMP maps

B. Methodology:

The methodologies which were adopted to carry out the project are quantification and characterization, selecting the feasible site for efficient operation of the biogas plant using GIS techniques, creation of road network, designing a biogas plant.

1) Quantification & characterization

a) Household Survey:

A reconnaissance survey was carried out for 16156 households for 4 months. The study area was categorized into residential, commercial, institutional area. Residential area was divided based on the income of people as low, medium and high income houses. The time period for the collection of solid waste from each household was 24hrs.

2) Selecting the feasible site for efficient operation of the biogas plant using GIS techniques

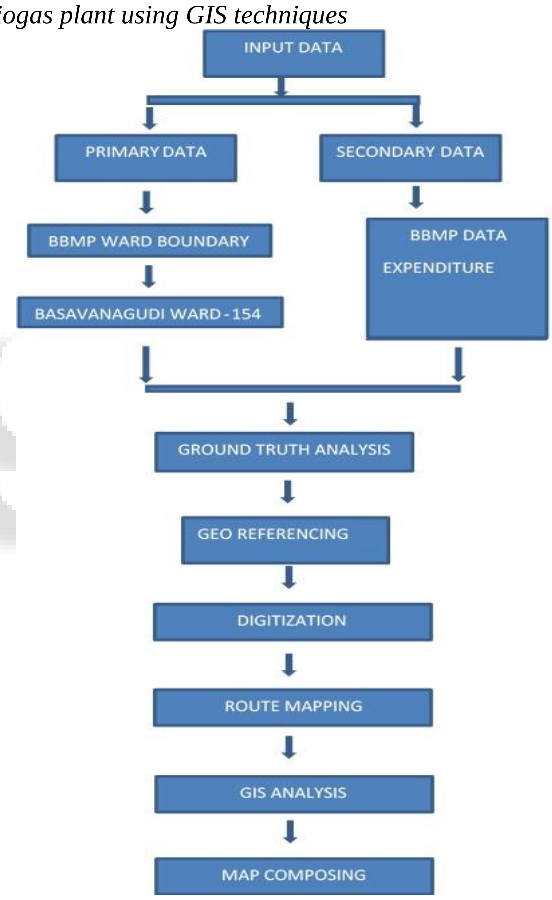

Fig. 2.1: Methodology

The above flow chart illustrates the use of remote sensing and GIS in solid waste management. The primary data includes Toposheet of south zone of Bangalore **(D43X9)** obtained from SOI. The toposheet of Bangalore urban district was geo referenced and digitized in GIS to get the study area boundary. Geo referencing is the process of aligning a raster or vector to its exact geographical location with known coordinates or geographically referenced data.

The extracted boundary was then used to compose maps. After creating the boundary of the study area, biogas plant sites within the study area were selected.

3) Creation of road network

Fig 2.2 Creation of road network

GPS survey was done as the preliminary step in this process. A GPS instrument **(etrex 30)** was used in creating the road network.

III. RESULTS & DISCUSSIONS

A. Characterization and quantification:

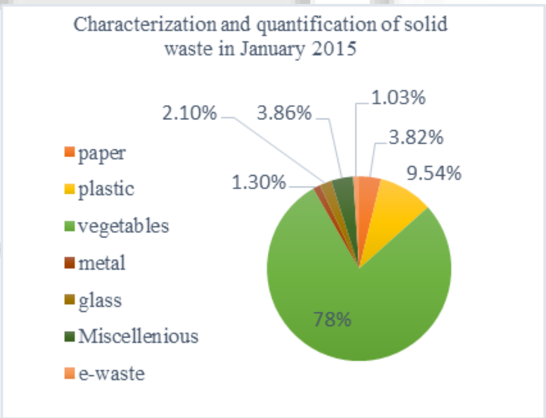

Fig. 3.1.1:

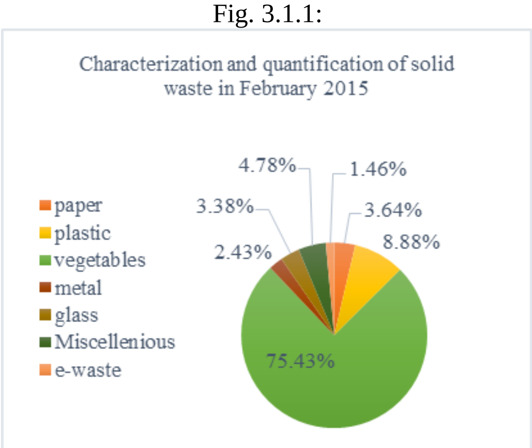

Fig. 3.1.2:

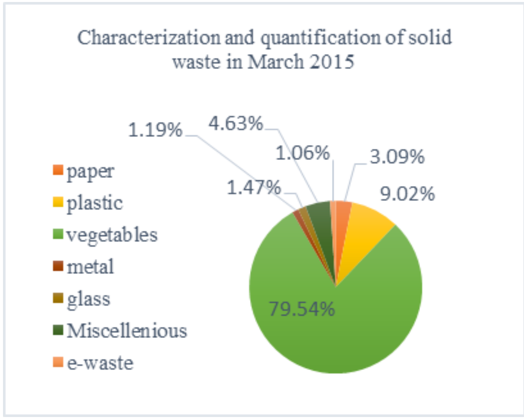

Fig. 3.1.3:

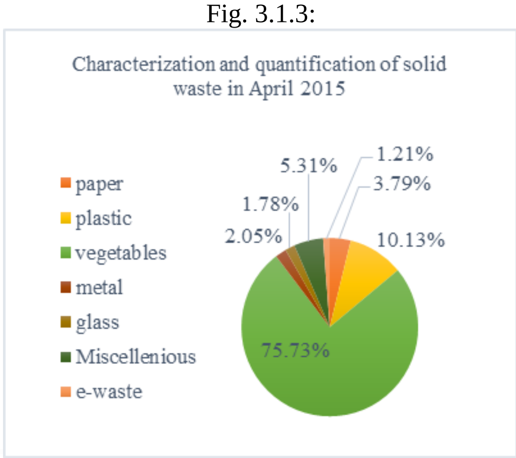

Fig. 3.1.4:

The Fig 3.1.1, Fig 3.1.2, Fig 3.1.3 and Fig 3.1.4 gives the characterization and quantifications results of January, February, March and April months respectively. Among all the characterized waste the percentage of food waste i.e., vegetables is more. So if utilize this waste in an effective manner majority of the wastes can be eliminated from the system.

	domestic waste(g)
waste generation	36235.41
waste generation/day	1575.45
waste generation/capita/day	315.09

Table 3.1 total waste generation /capita/day in January 2015

	domestic waste(g)
waste generation	38618.4
waste generation/day	1679.06
waste generation/capita/day	335.81

Table 3.2 Total waste generation /capita/day in February 2015

	domestic waste(g)
waste generation	39416.84
waste generation/day	1713.77
waste generation/capita/day	342.75

Table 3.3 Total waste generation /capita/day in March 2015

	domestic waste(g)
waste generation	38828.48
waste generation/day	1553.13
waste generation/capita/day	310.62

Table 3.4 Total waste generation/capita/day in April 2015

The per capita domestic waste generation in Bangalore is 350grams/capita/day. The results obtained from the characterization and quantification of the waste is found out to be which is less compared to the actual generation of waste without segregation.

Total number of days of collection in January, February and March is 23 and number of persons is 5. But in the month of April, total number of days of collection of solid waste was 25. And the number of persons is 5.

B. Selection of feasible site and creation of road network for biogas plant using GIS

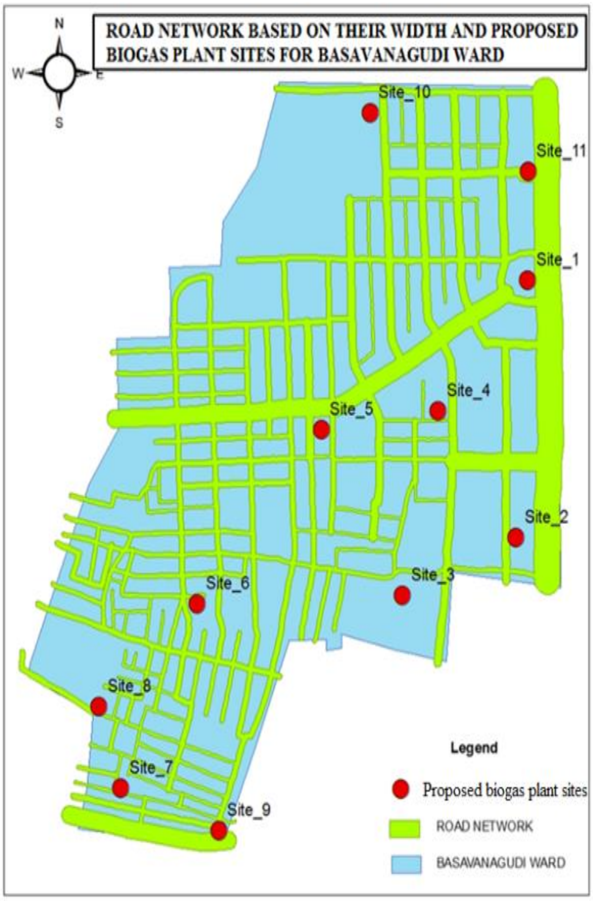

Fig. 3.2.1: Road network base on their width and proposed biogas sites for Basavanagudi ward.

Fig. 3.2.1 illustrates the accessibility to the proposed biogas plant site.

a) Voronoi maps

Voronoi maps were created from the non-spatially distributed sites of proposed biogas plant sites by mean method. Voronoi polygons are created in such a way that, every location within a polygon is closer to the sample point in that polygon than any other sample point.

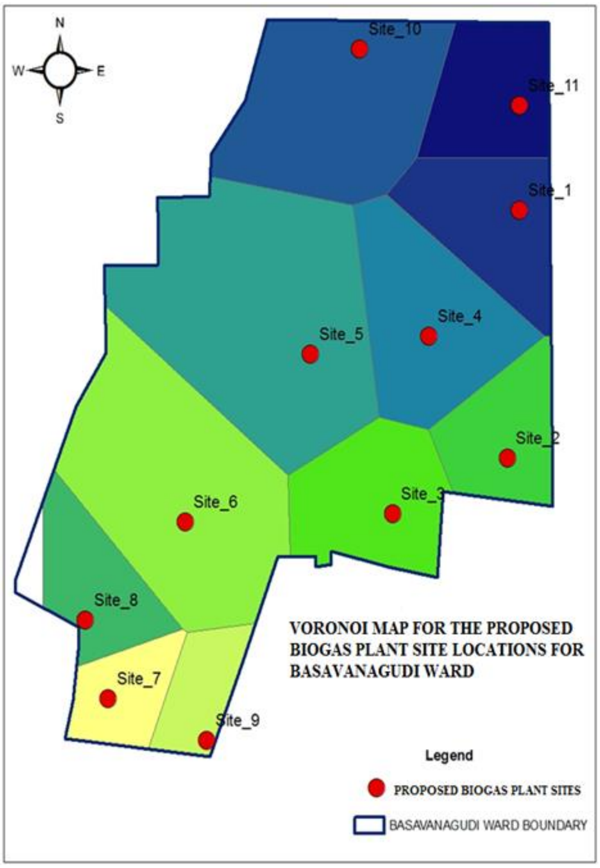

Fig. 3.2.1: voronoi map for the proposed biogas site locations for Basavanagudi ward

Fig 3.2.1 shows the Voronoi map for the Basavanagudi ward with the proposed biogas plant site. A dedicated polygon for each biogas plant site was created

C. Design a biogas plant

The biogas plant size is dependent mainly on the quantity, quality and the kind of available biomass, daily average feed stock and the hydraulic retention time of the material in the biogas system. [6]

The weight of the feedstock (solid waste) is taken as 1000kg/day and the average temperature is considered to be 30°C [7]. The hydraulic retention time and total solids are considered to be 40 days and 0.27 respectively. From the calculations, volume of digester is 72.72m^3.Volume of the gas collecting chamber is, Height of the digester and Diameter of digester are 3.636m^3, 2.20m and 5.5m respectively.

IV. Conclusion

The use of GIS techniques in this study has saved time, man power and cost. This study has empowered the use of the GIS in solving man's day to day problem. Any decision maker opting this GIS technique can obtain quicker decisions which helps to solve the common man's problem at the earliest.

- All the 11 proposed biogas plants site identified belongs to the BBMP i.e. government of Karnataka (GOK), hence no purchasing of land is required.
- The solid waste collection vehicle has to move in the dedicated path within the dedicated Voronoi polygon to

collect the solid waste and dispose it off to the respective biogas plant site.

- The road network, the Voronoi polygon, proposed biogas plant site all belong to a different geometric features but has been over laid for visualization. This may not be possible by any other conventional methods but this is made possible by using GIS technique.

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