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# "GIS - BASED SOLID WASTE MANAGEMENT GENERATION RATES & ROUTE OPTIMIZATION"

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## ABSTRACT

Solid waste collection is a major section of the process of solid waste management (SWM), and it is estimated to consume up to two-thirds of the entire SWM budget. The functional element of collection includes not only the gathering of solid waste and recyclable materials but also the transport of these materials, after collection, to the location where the collection vehicle is emptied. The Bidar Municipal Corporation is responsible for the collection, transportation, treatment, and disposal of municipal solid waste generated. During the analysis of literature review, we found that QGIS software is much more suitable for route optimisation of MSW collection and transportation. During this project, we tried to create the shortest route possible for waste collection from households to transportation station and processing unit with the help of QGIS software.


**KEYWORDS:** Route optimization, Route Analysis, QGIS, Travel Time and Fuel Consumption

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## INTRODUCTION

Solid waste collection is a major section of the process of solid waste management (SWM), and it is estimated to consume up to two-thirds of the entire SWM budget. The functional element of collection includes not only the gathering of solid waste and recyclable materials but also the transport of these materials, after collection, to the location where the collection vehicle is emptied. The location of MSW generation is houses and is generally a mixed dry and wet waste, which is to be collected and transported to the processing unit's land fill. This responsibility is tasked by Bidar CMC, and each household member is expected to cooperate with CMC workers. The use of "Quantum Geographic systems" (QGIS) is recognised as one of the most promising approaches to analysing MSW collection and transportation systems. The use of QGIS for collection and transportation optimisation can provide economic and environmental gains by reducing travel time, distance, fuel consumption, and pollutant emissions.

## MATERIALS AND METHOD

- Data Collection: Collect data on population, waste generation, bin locations, and road networks from surveys and records.
- Data Integration in GIS: Combine all data in GIS software like QGIS or ArcGIS to create layers (waste sources, roads, collection points).
- Waste Generation Rates: Use GIS to estimate how much waste is produced in different areas and identify high-generation zones.
- Optimization Scenarios: Analyze and design the most efficient routes for waste collection to save time, fuel, and cost.
- Result Visualization: Display maps showing waste distribution and optimized routes for better decision-making.
- Cost-Benefit Analysis: Compare

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current vs optimized system to show savings in fuel, time, and operational efficiency.

## RESULTS AND DISCUSSION

In the present work, an effort has been made to design and develop an appropriate collection and transportation plan for the Bidar City Municipality Corporation. Here, a GIS based optimal model is developed and used to trace the least cost. This minimum cost is with respect to a distance-efficient collection path in transferring the MSW to the processing unit. The shortest route is designed for Door-To-Door collection and transportation of MSW to the processing unit.

Implementing QGIS software helps to recreate the shortest route for waste collection and transportation, which is more efficient in comparison to the previous system.

The increase in efficiency in percentage is shown below.

- Total travel distance by 2.351 km/day.
- Each day 1-1.25 hrs/day
- Fuel consumption by 540 ltr/Year
- Fuel cost by 49140/- Rs/Year

## CONCLUSIONS:

- Implementation of QGIS software for route optimisation has been very effective, and the work has been done remotely, which is much better than working at site. This can also be implemented for many other works in the MSW management system.
- By creating the shortest route for households MSW collection and transportation, we are able to reduce the overall time distance and fuel consumption, which makes the work more efficient.
- By creating the shortest route for MSW management, we were able to reduce the overall cost of the system, which will reduce the overall budget of municipal solid waste management and make the process more economical.

Thus, the proposed model can be adopted by the concerned authority. Further use of GIS can be adopted as a decision-support tool by the municipal authorities for efficient solid waste management with respect to transportation issues.

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## Tables and Figures

**3.8 Collection and analysation of available data:**

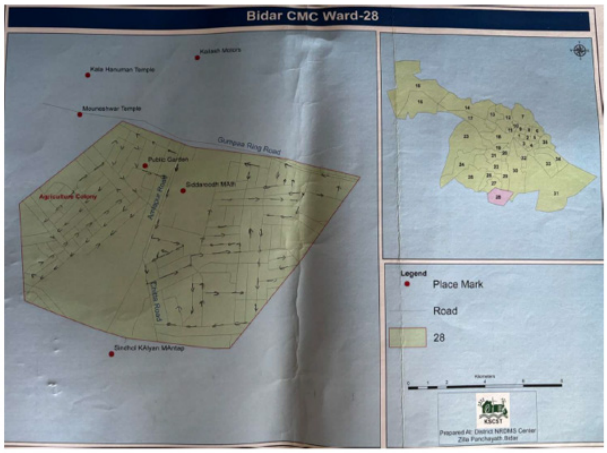


Fig . 1

**Vehicular and collection work details ( Ward-28 )**
**( Existing Route )**

| Vehicular and collection work details ( Ward-28 ) | |
|---|---|
| Number of vehicles | 1 |
| Number of labours | 2 |
| Fuel Consumption | 6-6.5 ltr/day |
| Time Required For Collection Of Waste | 3.5-4 hrs/day |
| Daily Travelling Distance | 7.5-8 km/day |

Table no. 1

**Satellite Image Road Of Ward-28**

**OPTIMISED ROUTE USING ORS TOOLS**

Fig . 4

**SHORTEST ROUTE INFORMATION USING QGIS**

| Vehicular and collection work details ( Ward-28 ) | |
|---|---|
| Number of vehicles | 1 |
| Number of labours | 2 |
| Fuel Consumption | 4.5-5 ltr/day |
| Time Required For Collection Of Waste | 2.5-3 hrs/day |
| Daily Travelling Distance | 5.649 km/day |

Table no. 2

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