ROUTE OPTIMIZATION FOR COLLECTION OF SOLID WASTE IN INAM-DHAMNI BY USIG QUANTUM GEOGRAPHICAL INFORMATION SYSTEM (QGIS)

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ABSTRACT

In today's scenario population is increasing day by day. As solid waste is related to population, it also increases as per population. In INDIA solid waste management of villages is not taken seriously. There is threat to human health due to non-engineering collection and disposal of waste. Collection and transportation are major part of management of solid waste. This paper deals with optimised path for collection of solid waste with the help of GIS. Initially from the survey, it became clear that there is lack of solid waste management. Generation of waste is calculated with initial surveys. By determining the scares and densely populated areas in the village the dustbins are strategically located for its optimal utilisation. Using the QGIS software for collection of waste from the dustbins, a route is provided linking all the dustbin locations using reference of Google earth. The map of INAM-DHAMNI was obtained from Google earth with the help software Terra incognita which geo-referenced in QGIS. From the various alternative routes available, the most efficient and economical route was finalised. After route selection, the collection vehicle capacity is determined; also work schedule for labours is computed. Thus use of QGIS is beneficial for accurately mapping dustbin position and also economically optimising the route.

Keyword : - *Solid waste, QGIS, Route optimisation*

1. INTRODUCTION

Today world is experiencing rapid increase in growth of population and living standards consequently and extra burden on the natural resources and release of solid waste products. Thus management of solid waste is important issue. Management of municipal solid waste involves (a) development of an insight into the impact of waste generation, collection, transportation and disposal methods adopted by a society on the environment and (b) adoption of new methods to reduce this impact. However, it is among the most poorly
Rendered service in the basket-the systems applied are unscientific
Among all the components of solid waste management the most important and costlier is collection and transportation. Cost of collection and transportation is about 85% of total cost of project. So small change in transportation plan may lead to large change in cost of project. Use of QGIS in planning transportation route gives economical and efficient route.

1.1 STUDY AREA: INAMDHAMNI

It is a village situated in SANGLI at 16049'44"N 74035'14"E. It has 523 households with population of 5424 as per census 2011. The average household size in village is 10. Rate of solid waste generation is 0.024 cubic meter per house. The total volume generated per day is 13 m3. Currently use of dustbins is not practiced and a vehicle
having capacity 3 m3 is available for door to door collection of waste which is insufficient. Furthermore transportation route followed presently is not efficient. The collected waste is dumped along the road side near

Vithal Polytechnique Collage, which is non- engineering way. Detailed supportive data on waste collection statistics is as follows:

Sr. No	Particulars of solid waste	Values
1	Solid waste generation rate	2017.10 Kg per day
2	Quantity of solid waste	13 m^3 per day
3	Total expenditure on SWM	Rs 150210/- per annum
4	No. of labours	2

The map used for study is

Fig -1 Satellite image of INAM DHAMNI

Data and resources used

1	Data used	025m/pixel resolution Google earth satellite image Data downloaded from Terra-Incognita Software
2	Software used	QGIS, Terra incognita, Google Earth

2. METHODOLOGY:

Methodology adopted for the research paper is as follows

• Data collection of present population, village topography, village boundary, rate of population growth, living standard, types of building producing waste

• Survey to determine rate of solid waste generation was conducted as well as current condition of solid waste management was observed

• Download map of village from Google earth using QGIS

• Geo-referencing of map using QGIS software

• Determining position of dustbin by following the norms in manual

• Plotting desired position of dustbins on QGIS map

• Plotting optimised route for waste transportation with the help of QGIS

• Determining ultimate cost for entire solid waste management programme

3. ANALYSIS AND RESULT

After the determination of solid waste generation rate, population and number of households the map study was done for finalizing the route of transportation for collection of waste from dustbins. The

position of dustbins were updated in map with the help of QGIS which was decided by considering norms in manual of solid waste and conditions in village

Fig-2: Dust bin Position

The size of dustbin was determined by considering the houses which were contributing the waste for the respective dustbin. The map showing zones of dustbin is as

Fig-3: zoning of a dustbin

Residential and commercial waste

Dust bins	No. of house	Waste generation rate in cubic per house	volume of dustbin in m^3
1	1	0.024	0.024
2	8	0.024	0.192
3	11	0.024	0.264
4	9	0.024	0.216
5	15	0.024	0.36
6	11	0.024	0.264
7	8	0.024	0.192
8	11	0.024	0.264
9	9	0.024	0.216
10	13	0.024	0.312
11	11	0.024	0.264
12	11	0.024	0.264
13	8	0.024	0.192
14	8	0.024	0.192
15	14	0.024	0.336
16	1	0.024	0.024
17	10	0.024	0.24
18	10	0.024	0.24
19	7	0.024	0.168
20	10	0.024	0.24

Dust bins	No. of houses	Waste generation rate in cubic per house	Volume of dustbin in m^3
21	15	0.024	0.36
22	11	0.024	0.264
23	9	0.024	0.216
24	9	0.024	0.216
25	3	0.024	0.072
26	10	0.024	0.24
27	10	0.024	0.24
28	9	0.024	0.216
29	11	0.024	0.264
30	13	0.024	0.312
31	11	0.024	0.264
32	10	0.024	0.24
33	10	0.024	0.24
34	7	0.024	0.168
35	8	0.024	0.192
36	12	0.024	0.288
37	9	0.024	0.216
38	8	0.024	0.192
39	7	0.024	0.168
40	8	0.024	0.192

Thus dustbin of size 0.336 m3 selected, and separate dustbins of size 0.18m3 were provided at a point for dry and wet waste collection.

Bio medical waste

dust bins	no. of patients	waste generation rate in cubic meter per patient	volume of dustbin in m^3
1	43	0.00016	0.0068
2	35	0.00016	0.0056
3	60	0.00016	0.01
4	29	0.00016	0.00464
5	30	0.00016	0.05

For collection of biomedical waste dustbin of size 0.01m3 was provided to each hospitalFor deciding route following norms were broadly considered

• Existing companies' policies and regulations related to such items as the point of collections and frequency of collection must be identified

• Existing system condition must be coordinated

• Waste generated at traffic-congested location should be collected as early in day as possible

• Sources at which extremely large quantities of waste are generated should be serviced during first part of day

• Scattered pick up location where small quantities of waste are generated should, if possible, be served during one trip or on the same day

• Last location should near to disposal point. dust bins no. of point

For the finalization of route various alternatives were considered and finally selected more economic and efficient alternative.

First alternative: The calculations for alternative 1 are as follows it contains two trips

TRIP 1

Route no.	Length (meter)	Vehicle Speed (m/s)	Time (s)
18	125	5.55	22.52
19	85	5.55	15.31
20	56	5.55	10.09
21	86	5.55	15.49
22	135	5.55	24.32
23	75	5.55	13.51
24	76	5.55	13.69
25	115	5.55	20.72
26	99	5.55	17.83
27	44	5.55	7.92
28	58	5.55	10.45
29	66	5.55	11.89
30	49	5.55	8.82
31	230	5.55	41.44
32	111	5.55	20
33	63	5.55	11.35
34	91	5.55	16.39
35	121	5.55	21.8
36	93	5.55	16.75
37	333	5.55	60
38	91	5.55	16.39
40	133	5.55	23.96
39	109	5.55	19.63
disposal point 2	1715	5.55	309

Fig 4 image showing trip 1 in alternative 1

Trip 2

Route map	Length (meter)	Vehicle Speed (m/s)	Time (seconds)
2	520	5.55	93.69
3	362	5.55	65.22
4	503	5.55	90.63
5	177	5.55	31.89
6	239	5.55	43.06
7	201	5.55	36.21
8	188	5.55	33.87
9	265	5.55	47.74
10	290	5.55	52.25
11	132	5.55	23.78
12	127	5.55	22.88
13	142	5.55	25.58
14	232	5.55	41.8
15	171	5.55	30.8
16	381	5.55	68.64
disposal point	550	5.55	99.09

The total distance covered during trip1 is 4159 m time 12.48 min and in trip 2 with distance of 4480 m in time 13.45 min

Fig 5 image showing trip 2 in alternative

Alternative 2

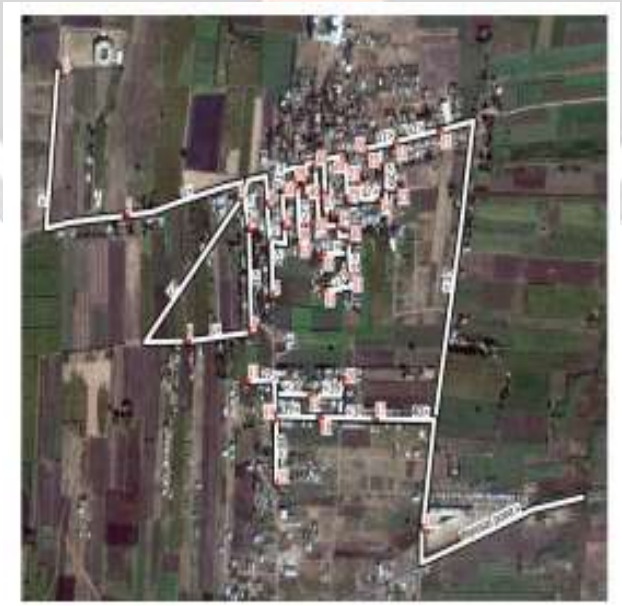

Figure 6 image showing route of alternative 2

Route no.	Length (meter)	Vehicle Speed(m/s)	Time(s)
2	560	5.5	101.8182
3	376	5.5	68.36364
4	514	5.5	93.45455
5	174	5.5	31.63636
6	216	5.5	39.27273
7	216	5.5	39.27273
8	190	5.5	34.54545
9	187	5.5	34
10	76	5.5	13.81818
11	110	5.5	20
12	122	5.5	22.18182
13	51	5.5	9.272727
14	56	5.5	10.18182
15	39	5.5	7.090909
16	65	5.5	11.81818
17	187	5.5	34
18	60	5.5	10.90909
19	91	5.5	16.54545
20	118	5.5	21.45455
21	95	5.5	17.27273
22	273	5.5	49.63636
23	48	5.5	8.727273
24	144	5.5	26.18182
25	86	5.5	15.63636
26	77	5.5	14
27	93	5.5	16.90909
28	74	5.5	13.45455
29	88	5.5	16
30	87	5.5	15.81818
31	85	5.5	15.45455
32	124	5.5	22.54545
33	888	5.5	161.4545
34	175	5.5	31.81818
35	104	5.5	18.90909
36	201	5.5	36.54545
37	150	5.5	27.27273
38	135	5.5	24.54545
39	264	5.5	48
40	543	5.5	98.72727
disposal point	533	5.5	96.90909

For alternative 2 the total distance of 8775 m is covered within time 26.28min

4. CONCLUSIONS

In this project an attempt has been made to design and develop an appropriate collection, transportation and disposal plan of SW for INAM DHAMNI village. Also using QGIS optimal rote is decided on the parameters such as population density, waste generation capacity, road network and the type of road and collection vehicles, etc.,
is developed and used to trace the minimum cost/distance efficient collection route for transporting it to composting site. The alternative1 is suggested to village as volume required to truck is less as it contains two trips also the distance travel is minimum.

5. REFERENCES

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