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RS and GIS Based Site Suitability Analysis for Solid Waste Disposal in Hosur Municipality, KrishnagiriDistrict

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Abstract:Solid waste management is a global environmental problem at present. There is an increase in commercial, residential and infrastructure development due to the population growth and this has negative impact on the environment. Urban solid waste management is considered as one of the most serious environmental challenge confronting municipal authorities in developing countries. One of these impacts is due to location of dumping site in unsuitable areas. The present study deals with selecting suitable sites for disposal of Solid Waste generated from Hosur Municipality by integrating RS and GIS. It is observed, that suitable site identified for disposal of Solid Waste is the Chennathur region of Hosur.

Keywords:Solid Waste, Analytical Hierarchy Process, Weight Linear Combination, RS, GIS

I. INTRODUCTION

The rapid growth of urbanization decreases the non-renewable resources and disposal of effluent and toxic waste indiscriminately, are the major environmental issues disturbs threats to the existence of human being (Allen et al; 1997)[2]. The most common problems associated with improper management of solid waste include diseases transmission, fire hazards, odour nuisance, atmospheric and water pollution, aesthetic nuisance and economic losses (Jilani et al)[4]. There has been a significant increase in solid waste generation in India over the years from 100 gm per person per day in small towns to 500 grams per persons per day in large towns. Presently most of the municipal solid waste in India is being disposed unscientifically (Akolkar; 2005)[1]. Generally municipal solid waste is collected and deposited in sanitary landfill, such unscientific disposal attract birds, rodents and fleas to the waste dumping site and create unhygienic conditions (Suchitra, et al)[8]. The degradation of the solid waste results in the emission of carbon dioxide (CO_2), methane (CH_4) and other trace gases (MeBean, E.A et al ; Amar M. Dhere et al ;1995)[4]. The present study is intend to find out suitable sites for the disposal of urban solid waste generated from Hosur municipality and surrounding areas with the help ofRemote sensing and GIS techniques.

II. STUDY AREA

Hosur Municipality is a town located in the western corner part of Tamil Nadu state. TheMunicipality lies inlongitudes77°49’48 North and Latitudes 12°43’58 East. The total area of the municipality is 72.41sq.km. It has more than twenty thousand families as residents and a host of business and office establishments and educational institutions. The boundaries of the municipality isEluvapalli and Marasandiram Panchayath (North), Mookandapalli Panchayath (East), Poonapalli Panchayath (South) and Karnataka State (West). Hosur municipality is the headquarters of Hosur Taluk; With a population of 2,44,518. The Average annual rain fall is around 840mm. Theamount of solid waste generatedis approximately 82tons per day.The study area is shown in the Figure1

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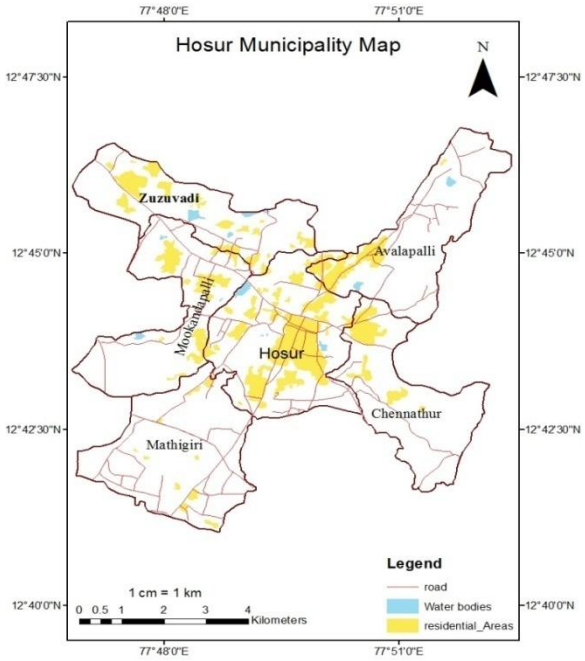

Figure 1: Base map of the study area

III. MATERIALS AND METHODS

LISS IV images of IRS P6 satellite acquired during March 2012, was processedfrom National Remote Sensing Centre (NRSC). It was geocorrected in Erdas imagine Package using UTM Projection and WGS 84datum and then co registered with the Survey of India Topographical map of the study area using Ground Control Points(GCP's). LISS IV derived thematic maps, SRTM derived Digital Elevation Model and secondary data were integrated in GIS domain.The methodology utilizes GIS to evaluate the entire region based on certain evaluation criteria for the analysis of landfill site suitability.These Criteria are grouped into two main categories including physical and social economical information. The criteria were selected according to study areas local characteristics (Ozeair and Mohesn. 2009)[7]. The sub criteria that were used for spatial analysis are slope, drainage, population, and distance from major roads, distance from major residential area and distance from drainage. The Criteria and sub criterias used in development of GIS database as shown in the Table 1.

Table 1: The Criteria and sub criteria used in development of GIS database

Physical Criteria	Slope
	Drainage
	Water bodies
	Residential Areas
Social Economic Criteria	Population
	Distance from major roads
	Distance from drainage
	Distance from Water bodies
	Distance from residential Areas

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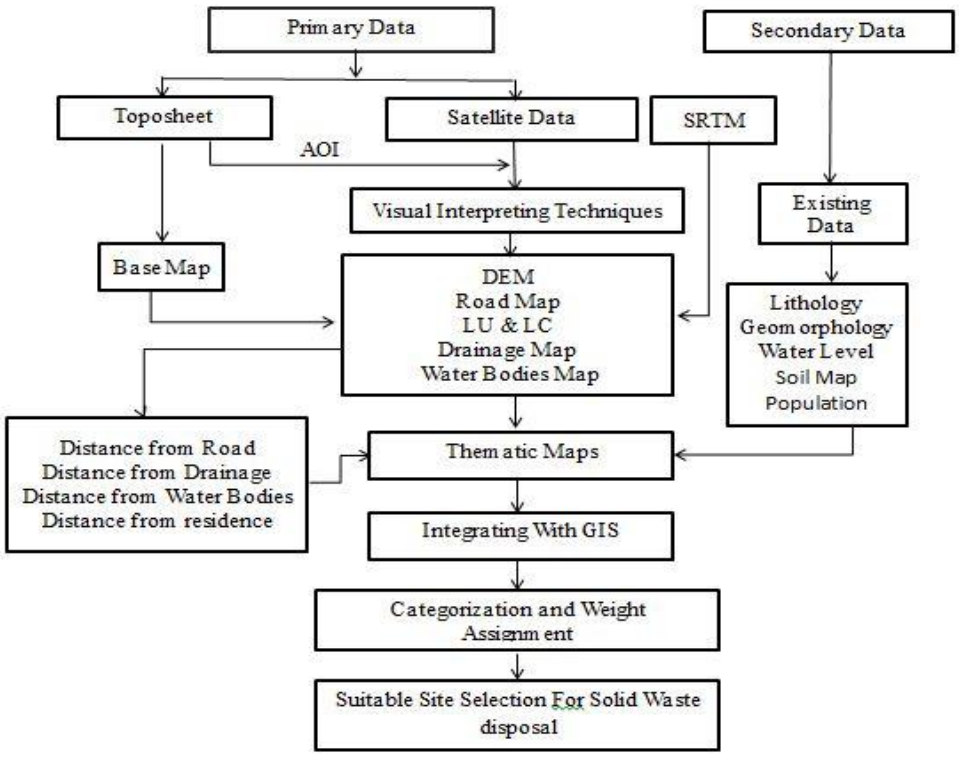

Figure2: Flow Chart Showing Methodology

Topology is the mathematical relationship built between objects and it makes an explicit bond between geographic features in the data base. After attributing the data base map was created and there after various thematic maps like Drainage, Slope, water Bodies, populations and road map were created and weightage allocate to them based on the key parameter. The weightage assigned for different themes are shown the Table 2. For identifying a suitable site for the disposal of solid waste buffer zones were created around the Municipality area. Various coverages in these themes were assigned a suitable score and converted in to raster format using Spatial Analyst in the Arc Map. The methodology of this study covers some sequential steps; The detailed methodology is shown in Figure 2.

Table 2: Weightage Assigned for Each Theme

Themes	Weightages
Slope	8
Drainage	6
Water bodies	6
Population	5
Road	4
Residential Area	5

a) Weighting the Criteria

The pair wise comparisons associated with the Analytical Hierarchy Process (AHP) the factors havebeen used to Weight the themes. Pair wise comparison matrix is created by setting out one row and one column for each factor in

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theproblem.This Matrix Judgment was made about the relative importance of factors involved, judgment 9 point scaling system Method was used in scientific study of referencesshown in Table 3

Table 3: Relative Importance Factor

Extremely Less Important	1/9
Very Strongly Less Important	1/7
Strongly Less Important	1/5
Moderately Less Important	1/3
Equally Less Important	1
Moderately More Important	3
Strongly More Important	5
Very Strongly More Important	7
Extremely More Important	9

IV. Results and Discussions

Drainageis one of the important criteria for selecting a suitable site, because the drainage areas are having much more infiltration capacity. During flood time water spills over drainage and the whole plain will be submergedunder water. So the buffer zones were created and based on zone limits weightages were assigned. Shown in Table the population map was derived based on their own boundaries and the suitability score given for population zone in Shown in Figure 4 and Table 5 respectively.Slope class map of the study area and its suitability score are represented inFigure 5 and Table 6 respectively.From the slope ranges the weightages were assigned. In slope map the low elevated area is best suitable for disposing the solid wastes.

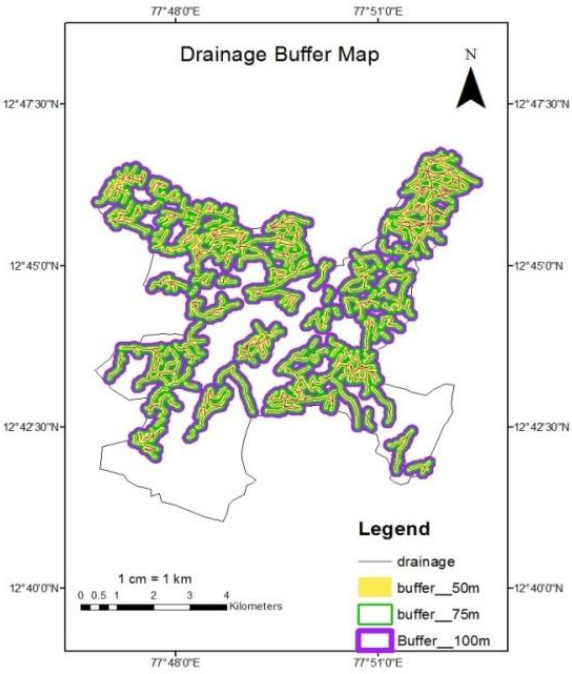

Figure 3: Drainage map of the study area

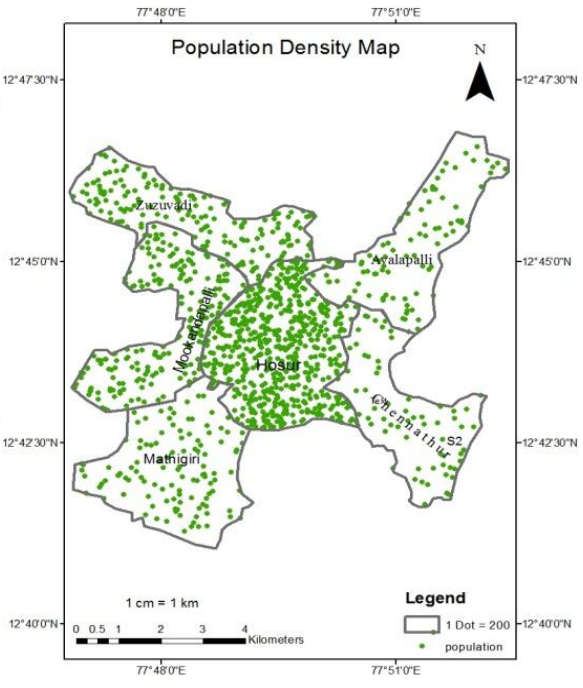

Figure 4: Population map of the study area

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Table 4: Suitability scores given for Drainage

Distance from Drainage	Suitability Scores
0-50	1
50-75	4
75- 100	6

Table 5: Suitability scores given for Population

Location	Population	Suitability score
Hosur Town	118505	1
Mathigiri	22874	3
Avalapalli	17280	3
Mookandapalli	39348	2
Zuzuvadi	33383	2
Chennathur	12723	5

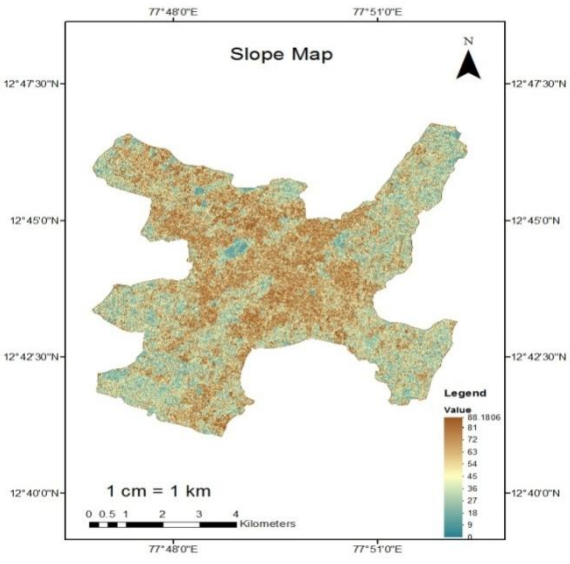

Figure 5: Slope map of the study area

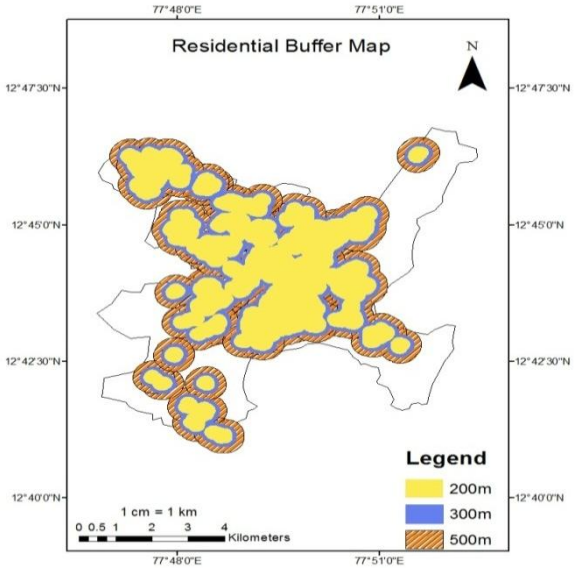

Figure 6: Residential map of the study area

Table 6: Suitability scores given for Slope

Slope Range	Suitability score
0 – 9	1
10– 18	8
19 – 27	6
28 – 36	4
40 – 88	1

Table 7: Suitability scores given for Residents

Distance from Residential Area	Suitability Scores
0 – 200m	1
200 -300m	3
300 – 500m	5

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Maps likedistance from Residence, distance from Major roads and their suitability scores are given in the Figures 6, 7 and Table7, 8respectively. After projection and Topology creation all feature classes like slope,drainage, water bodies, population and road were converted to Raster files and separate datasets were created using weightage and rank.For the analysis all the raster datasets fordifferent layers having different score were over laid and the scores of each compositeclass were added using raster calculator tool of spatial analyst extension of Arc Map. The final scores were reclassified to generate the output map showing various classes of suitable site for waste dumping. The degree of suitabilityfor findingsuitable land areas are given in the Table 9.

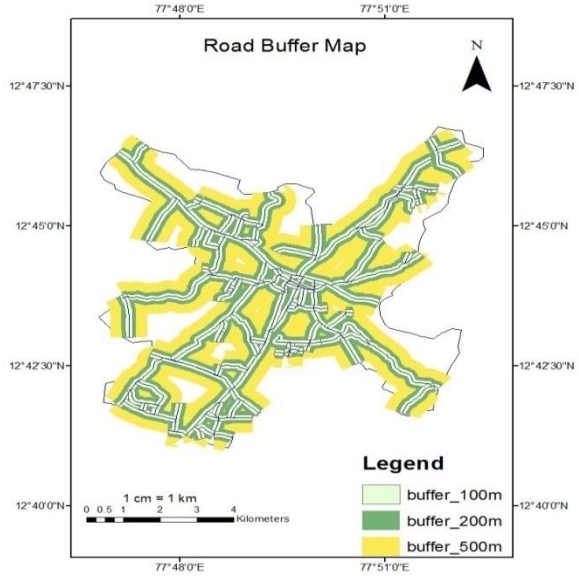

Figure 7: Road Network of the study area

Table 8: Suitability scores given for Road

Distance from Road	Suitability Score
0 – 100m	3
100- 200m	4
200- 500m	2

Table 9: Degree of Suitability

Criteria		Suitability Class		
		Highly Suitable	**Moderately Suitable**	**Less Suitable**
Planning	Population Density	Low Dense	Moderate Dense	High Dense
	Proximity to Road	100m	200m	500m
	Residential Area	500m	300m	100m
	Elevation Criteria	Slope < 9°	Slope 9°-15°	Slope > 15°
Environment	Surface Water	200m	100m	50m
	Drainage	100m	75m	50m
	Soil	Non subsidence Area	----------	----------
Resource	Land Use	Barren Land	Agricultural Land	----------

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The outcome generated through the GIS analysis is given below. From the GIS analysis, the result shows that 6.9393Sq.kmarea is less suitable, 3.4513 Sq.km areas is moderately suitable and 1.7059 Sq.km area is highly suitable for dumping waste identified.

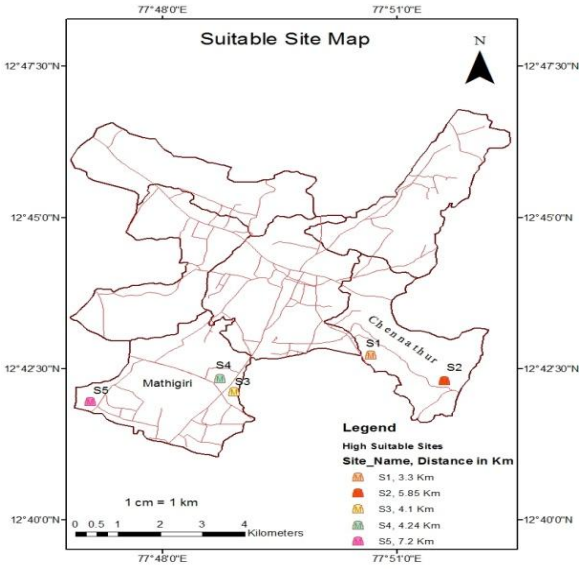

Figure 8: Suitable Site map

Table 10: Suitable Sites

Place	High in Km^2	Moderate in Km^2	Low in Km^2
Chennathur	1.2619	1.9048	2.7948
Mathigiri	0.444	1.19554	3.0091
Moorkandapalli	0	0.351	1.1354
Avalapalli	0	0	0
Zuzuvadi	0	0	0
Hosur Town	0	0	0
Total	1.7059	3.45143	6.9393

The Suitable sites for Solid Waste Disposal were identified, based on Theme Weightages and Rankings.From the result of various themes, the most Suitable Sites are S1, S2, S3, S4 and S5 as shown in Figure 8.High Suitabilityzones were identified in the North Eastern part of Chennathur village and South Western part of Mathigiri town Panchayat.These sites are selected as most suitable site because oflow Urban Growth Factor compared to other sites and also has a barren land for waste disposal. The proposed method for site selection processes in otherconditions and locations where the intensity of introduced parameters shows discrepancies.

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V. Conclusion

The present study was to identify the potential waste disposal sites using Remote Sensing and GIS techniques for Hosur Municipality. Selection of suitable sites for waste disposal is based on several factors. GIS technology using Weighted overlay analysis is used to select the suitable solid waste disposal sites and are categorized in to three category. There are Good, Moderate and Poor. Accordingly the appropriate sites which were mightbe suitable from environmental, transportation and economic point of view.

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REFERENCES

1) Akolkar AB., 2005. Status of Solid Waste Management in India, Implementation Status of Municipal Solid Wastes, Management and Handling Rules 2000, Central Pollution Control Board, New Delhi.
2) Allen AR, Dillon AM, O'Brien M. 1997. Approaches to landfill site selection in Ireland. Engineering Geology and the Environment. Balkema, Rotterdam pp1569-1574.
3) Amar M Dhere, Chandrasekhar B Pawar, Pratapsingh B Pardeshi and Dhanraj A Patil, 2008. Municipal solid waste disposal in Pune city – An analysis of air and groundwater pollution Current science 95, 6,773-777.
4) Jilani T, 2002. State of Solid Waste Management in Khulna City. Unpublished Undergraduate thesis, Environmental Science Discipline, Khulna University Khulna, pp. 2585.
5) Bie, C.A.J.M. 2000. Comparative performance analysis of agro-systems. ITC dissertation 2000, no 75, 232p;
6) Arinola, A.G. &Arinola, A.M. (1995). Solid wastes in urban and rural areas of Ibadan, Nigeria: composition, treatment and public health concerns. Compost Science and Utilization, 3(3), pp. 80-83.
7) Ozeair Abessi, Mohesn Saeedi, 2009. Site Selection of a Hazardous Waste Landfill Using GIS Technique and Priority Processing, a Power Plant Waste in Qazvin Province Case Example. Environmental sciences,6,4,121 - 134.
8) Suchitra M, 2007. Outside: Burnt or buried, garbage needs land. Down To Earth, 15 March, pp. 22–24.
9) Daneshvar, R., Fernandes, L., Warith, M., and Danesh far, B. (2005). Customizing Arcmap interface to generate a user- friendly landfill site selection GIS tool. Journal of Solid Waste Technology and Management, 31(1), 1-12.