"IDENTIFICATION OF SUITABLE LAND FILLING SITE FOR MUNICIPAL SOLID WASTE OF RAICHUR CITY USING GIS"

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Abstract:

In growing nations like India, solid waste management is regarded as one of the most pressing and important environmental issues facing local authorities. In the modern world, solid waste management is a major environmental issue. The most frequent issues linked to poor solid waste management include the spread of infections, fire dangers, odour complaints, air and water pollution, aesthetic complaints, and financial losses. Trash disposal is a crucial component of the waste management system that needs to be handled carefully to prevent pollution of the environment. Solid waste can be disposed of using a variety of techniques, including land filling, composting, vermiculture, recycling, and incineration. The most flexible and appropriate way to dispose of solid waste is through sanitary land filling. The environmental requirements and characteristics of a potential disposal location must be met in order for the wastes to be segregated. The goal of the current study is to use GIS techniques to identify appropriate land filling locations for the city of Raichur. Using GIS-based overlay analysis, the suitability criteria for choosing the land filling locations were drawn out.

Keywords: *Solid Waste, Land fill site, ArcGIS, Spatial analyst tool.*

INTRODUCTION

Rapid population growth and urbanization are depleting non-renewable resources, and indiscriminate disposal of sewage and toxic waste has become a major environmental problem that threatens the survival of humankind According to Allen et al [1]. The most common problems associated with poor solid waste management include disease transmission, fire hazards, noxious odors, air and water pollution, aesthetic nuisances and economic losses According to Jilani et al [2]. Typically, municipal solid waste is collected and disposed of in sanitary landfills. This unscientific disposal attracts birds, rodents, and fleas to the dumping area, creating unsanitary conditions.

The decomposition of solid waste releases carbon dioxide (CO_2), methane (CH), and other trace gases. Unscientific runoff can reduce the quality of drinking water and cause diseases like jaundice, nausea, asthma etc. According to MeBean, E. A et al [3]; Amar M. Dhere et al [4]. This study aims to find suitable sites for disposal of municipal solid waste generated from Raichur City Municipality and its surrounding areas using GIS technology.

THE ROLE OF GIS IN LANDFILL SITING

The location of a controlled landfill requires a thorough assessment process to determine the optimal disposal site available. Evaluating a new waste disposal site is a complex process that takes into account parameters such as distance from roads, housing, key infrastructure and the soil's propensity to leach contaminants. Subsequently, the siting of a strong squander landfill must moreover include handling of a noteworthy sum of spatial information, directions and acknowledgment criteria, as well as an productive relationship between them. GIS has been found to play a critical part within the space of siting of squander transfer destinations. Many factors should be included in the solutions for landing, and GIS is ideal for such preliminary research from its ability to control large volumes of spatial data from various sources. GIS provides effective manipulations and data presentation.

LITERATURE REVIEW

Sanjeevi V, Shahabudeen P [5] Around US$410 billion is spent annually on managing four billion tonnes of municipal solid wastes, with transport cost accounting for over 50% of total expenditure in major developed cities and 85% in developing countries. To manage waste more efficiently, new technologies like Geographic Information Systems (GIS) and optimization software have been used since 2000. In Chennai, India, the city's expansion from 175 to 426 km2 in 2011 led to sub-optimum levels in solid waste transportation of 4840 tonnes per day.After creating a spatial database for the whole city, course optimization methods were run utilizing ArcGIS, decreasing separations voyage by 9.93%. The annual total cost for this segment alone is INR 226.1 million. The overall savings are significant and call for optimizing haul routes for the entire city.

Dutta, D., Goel, S [6] Solid waste, a by-product of civilization, has grown exponentially due to rapid population growth, industrial revolution, and consumerism. Economic development and population increase have contributed to the rise in waste volumes. The ease of movement of money, goods, and population has increased the generation and consumption of goods, resulting in increased waste production. This generation of waste indicates inefficient use of resources, making products less valuable. Effective waste management requires considering the waste type and its origin location.

Singh, A [7] The global population and rapid urbanization have led to a significant increase in municipal solid waste production, which has led to poor management and improper disposal, causing environmental problems in urban ecosystems. The lack of quality data, particularly in developing countries, has stalled waste management problems. Remote sensing and GIS techniques have made regional waste management studies easier, allowing for prompt and proper information capture and transmission. These techniques are also useful for acquiring information directly from remote sites at a low cost. This paper provides an overview of remote sensing and GIS techniques used for managing environmental problems in waste disposal. It discusses the background and rationale of waste disposal problems, presents applications of remote sensing and GIS in waste management modelling, and describes applications of these techniques in diverse case studies worldwide. The study reveals that the efficiency of waste management systems can be maximized by proper use of these techniques, with them being most commonly used for landfill and waste bin siting and evaluating the environmental impact of buried waste.

Sharma, K. D & Jain, S [8] India's rapid industrialization and urbanization have led to increased waste generation, causing ecosystem degradation and pollution. In 2015, Indian cities generated 62 million tonnes of solid waste, with 82% collected and 18% garbage. Treatment waste accounts for only 28%, with 72% dumped in the open. Waste collection efficiency varies between 70% and 95% in major cities. Challenges include source segregation, door-to-door collection, recycling, reuse options, treatment technologies, land availability, and disposal expertise. This article discusses current government policies, financial support, and waste management regulations, providing a comparative perspective.

STUDY AREA

Raichur town is the district headquarters with 35 wards and a population of 234,073. The municipal council area covers an area of 60 square kilometres. Raichur is situated between the Krishna and Tungabhadra rivers, which flow 20-30 kilometres from the city. The city is home to the largest and most profitable power generating facility, the 8-unit Raichur Thermal Power Plant with a capacity of 210 MW. In addition, there are a number of small and medium enterprises in and around the city. In the northeastern part of Karnataka is the district of Raichur. It is situated between latitudes 15º 12' North and longitudes 77º 21' East, in the northern median region. The location is 400 meters above mean sea level.

METHODOLOGY

In this study, 9 input map layers including topography, settlements, county maps, roads (highways and local roads), drainage, slope, geology, land use, and surface water characteristics are evaluated and prepared for use in the analysis in a GIS environment. After creating a spatial database for the whole city, course optimization Topical maps of the selected criteria were created within the worldview of standard GIS program. All data layers are obtained and prepared from the corresponding maps by scanning, georeferencing, geocorrection and digitization of relevant information. Information collected from literature on safe distances to waste disposal sites is used to determine the buffer zones for each layer. After creation of classes for each layer using buffers, each layer is converted into a separate raster map. After preparing all the input data layers, select the analysis hierarchy processing method from the decision rules to analyze the data for final disposal site selection in GIS and create the output map.

Results and Discussion

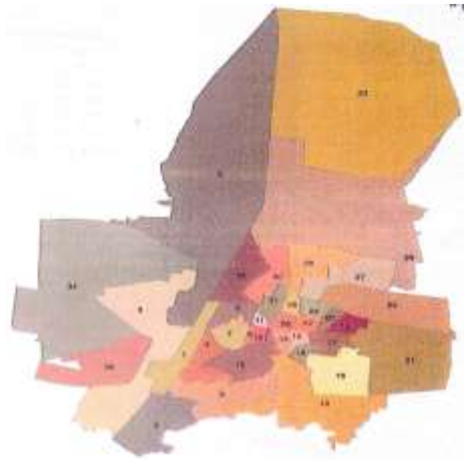

Fig 1: Ward wise Map of Raichur City

Fig 1 shows the Thematic Map of Raichur city CMC wards generated from ArcGIS

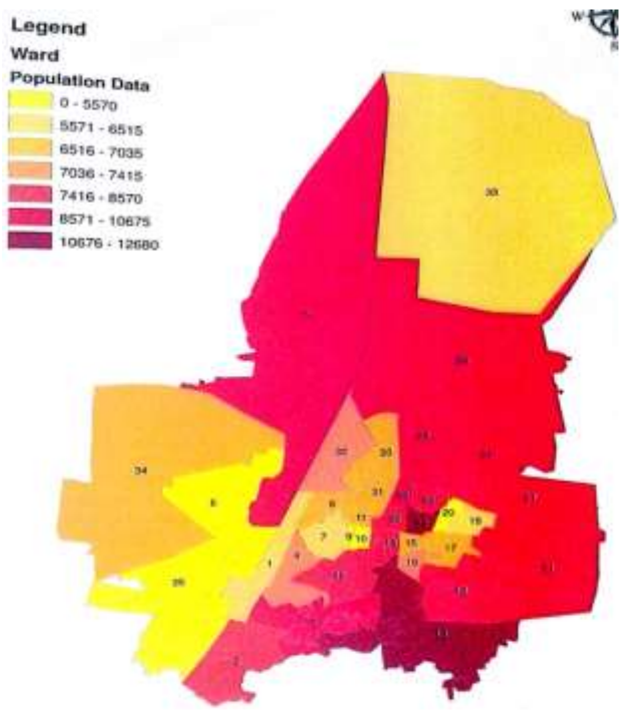

Fig 2: Map Showing Ward wise Population Of Raichur City

Fig 2 shows the Thematic map for Raichur city CMC ward wise population density.

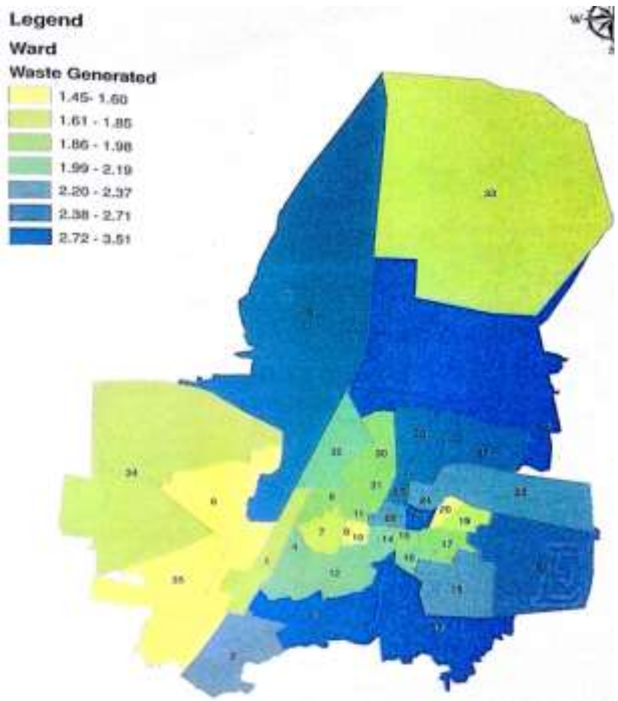

Fig 3: Map Showing Ward wise Waste Generated In Raichur City

Fig 3. shows the Thematic map for Raichur city CMC ward wise waste generated.

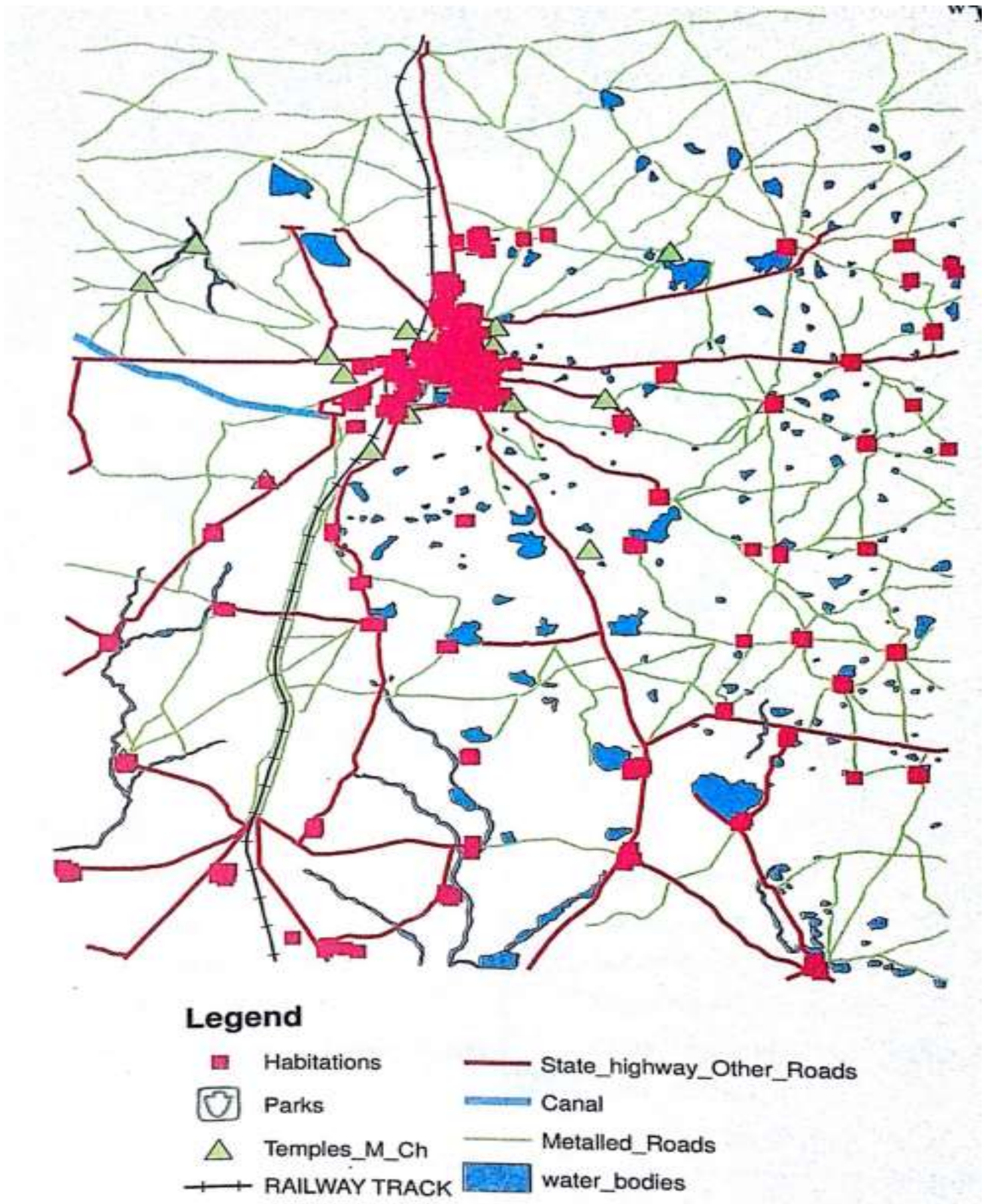

Fig 4: shows Map before applying the Factors

Fig 4. Shows the map before applying the criteria for the ideal site location for land filling.

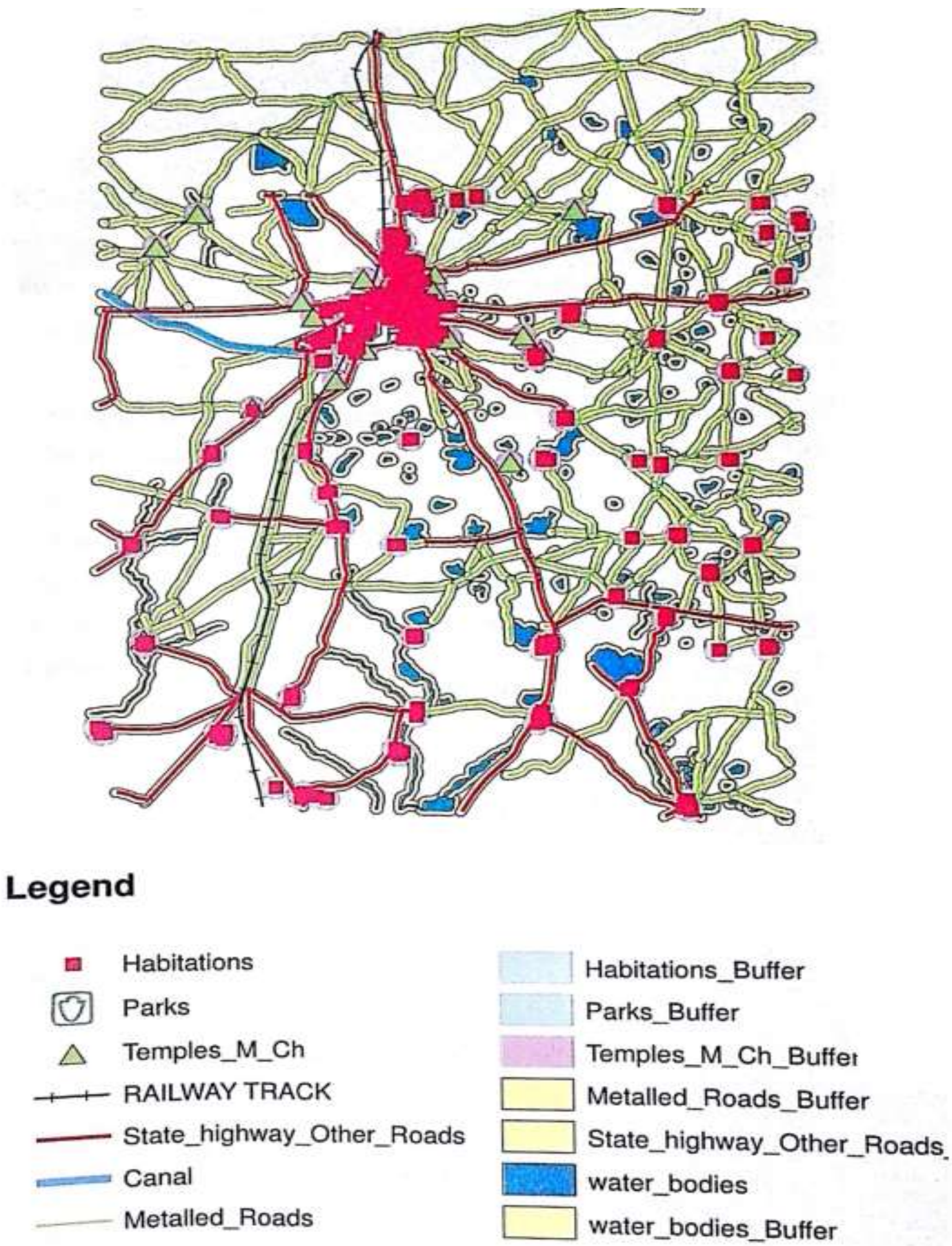
Legend
Habitations
Parks
Temples_M_Ch
RAILWAY TRACK
State_highway_Other_Roads
Canal
Metalled_Roads
Habitations_Buffer
Parks_Buffer
Temples_M_Ch_Buffer
Metalled_Roads_Buffer
State_highway_Other_Roads_
water_bodies
water_bodies_Buffer

Fig 5: Suitability Map Based on Buffering Factors

Fig 5 shows suitability map based on the criteria/constraints as the Sanitary landfills must be located at a safe distance from water bodies, natural vegetation and residential areas, therefore, in the next step, buffer zones were created around them, with numerical weights assigned to them in order of increasing distance. The landfill must be located in an area deep enough that it does not affect the quality of the groundwater table. Taking this into account, areas with different groundwater depths were identified and weights were assigned such that the area with maximum depth received maximum value and vice versa. However, the possibility of the use of transportation networks must be strictly considered in the fate of landfills. Needless to say, the site needed to be as close as possible to transport networks, so the transportation cost was minimal.

However, the landfill cannot be located directly along the road or rail network, although there are still buffer zones around the roads and railroads. After preparing the spatial data, we developed a GIS model in ArcGIS using spatial analysis tools. In this model, all layers were used as inputs: all previously defined criteria/constraints were overlaid on top of each other, and the white patches on the map after buffering indicate the ideal locations of the backfill sites.

CONCLUSION

This study used an integrated standard GIS methodology to select suitable sites for solid waste disposal. This methodology includes a number of environmental and economic factors required to identify sites that will have no or minimal adverse environmental impacts. This study shows the importance of GIS technology today. GIS aided in the analysis of research that would have been difficult to carry out manually using traditional methods. The meaning of such factors and criteria requires an appropriate database of different measures, therefore, to perfect a methodologically based solution, due attention must be paid to data management. Although GIS-based methodologies are highly sophisticated, developed or standardized, their success depends on their correct and careful application. Thus, with the use of these technologies, urban waste management is no longer a problem for municipal managers.

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