

GIS as an effective tool in waste management-a case study of Allahabad city India.

SIG como una herramienta eficaz en la gestión de residuos: un estudio de caso de la ciudad de Allahabad, India.

Dr Shikha Verma¹, Dr Om Prakash Bawane ²

¹Assistant Professor RV College of Architecture, India. Email: shikhaverma.rvca@rvei.edu.in

²Principal, RV College of Architecture, Bengaluru, India. Email: principal.rvca@rvei.edu.in

ABSTRACT

Environmental management is a broad area which comes into the domain of multidisciplinary fields including Architecture and Planning. It requires vast amounts of data collection, data retrieval and its analysis. GIS can fulfill this purpose with its multi-analytical and spatial capabilities. It can be used for analysis and study of various aspects of waste management including site selection for municipal solid waste landfills. GIS facilitates the storage of vast amounts of data in the form of raster data and vector data which can serve an important and efficient method for depicting various aspects of waste management. The current study shows the application of GIS spatial analytical tools in finding landfill sites for Allahabad City for Municipal Solid Waste.

Keywords: Site Selection, Spatial Analyst Tool, Waste Management, Landfills, Environmental Pollution, Open Dumps.

RESUMEN

La gestión ambiental es un área amplia que entra en el dominio de campos multidisciplinarios que incluyen Arquitectura y Planificación. Requiere grandes cantidades de recopilación de datos, recuperación de datos y su análisis. GIS puede cumplir este propósito con sus capacidades multianalíticas y espaciales. Se puede utilizar para el análisis y el estudio de varios aspectos de la gestión de residuos, incluida la selección del sitio para vertederos de residuos sólidos municipales. Los SIG facilitan el almacenamiento de grandes cantidades de datos en forma de datos de trama y datos vectoriales que pueden ser un método importante y eficiente para representar varios aspectos de la gestión de residuos. El estudio actual muestra la aplicación de herramientas analíticas espaciales GIS para encontrar vertederos para la ciudad de Allahabad para desechos sólidos municipales.

Palabras clave: Selección de sitios, Herramienta de análisis espacial, Gestión de residuos, Rellenos sanitarios, Contaminación ambiental, Vertederos a cielo abierto.

INTRODUCTION

Applications of GIS are growing at a very fast rate beyond traditionally thought of areas. Effective Management Strategies can be worked out using sophisticated analytical capabilities of GIS (Bennett 1997, Malczewski 2004). The contribution of GIS is in a variety of fields (remote sensing, cadastral mapping, geology, agriculture, photogrammetry, structural engineering, transportation engineering etc. Various researchers have utilized GIS in various fields including site selection for municipal solid waste landfill (Saxena et al. 2010, Saxena and Srivastava 2011). A model in the GIS platform has been developed integrating GPS, GIS, WAN (wide area technology) by Li et al. 2005 and Javaheri et al. 2006 for construction waste management. The current study comprises the application of GIS for finding potential sites for landfill for Allahabad City for the purpose of solid waste management.

MATERIAL AND METHODS

Study Area: Geographical location of Allahabad City lies at 25.30° N Latitude and 81.55°E Longitude (Figure 1) The City shares the border with Kaushambi district in the east and is well known city for its 'Kumbh Mela' in the state of Uttar Pradesh and has massive inflow of floating population during this period. As per Allahabad Nagar Nigam, presently the city has municipal waste collection efficiency of 84.5% with only 3.7% waste segregation. Also there are no engineered landfill and waste dumping sites which are mere open dumps are creating nuisance to the environment. Thus there is an urgent need of finding suitable sites for developing proper waste disposal facilities in the form of engineered landfills.

Methodology for finding potential sites for Engineered landfill: The methodology for site selection for engineered landfills using GIS platform has been done using concept of elimination criterion. As applicable to study area this methodology comprises of first fixing the search area which has been considered at a distance of 1Km from the municipal boundary of Allahabad City. The width of search area has been further constrained to one Km from the municipal boundary of the city. Various features which are falling within the search area where there can be no landfill has been subtracted after creating appropriate buffer area as per site selection criterion provided by Ministry of Environment and Forest (MoEF), Government of India. Various parameters that have been considered for site selection in the current study are Geotechnical, Hydrological and some other parameters as shown in table 1 as also considered by MoEF.

Further various features whose specific buffer areas have been created in GIS and then subtracted from the search area to get the potential sites are Lake, Pond, River, Highway, Habitation areas, Powerlines, High water table zones and Lesser bedrock depth areas (Figure 2).

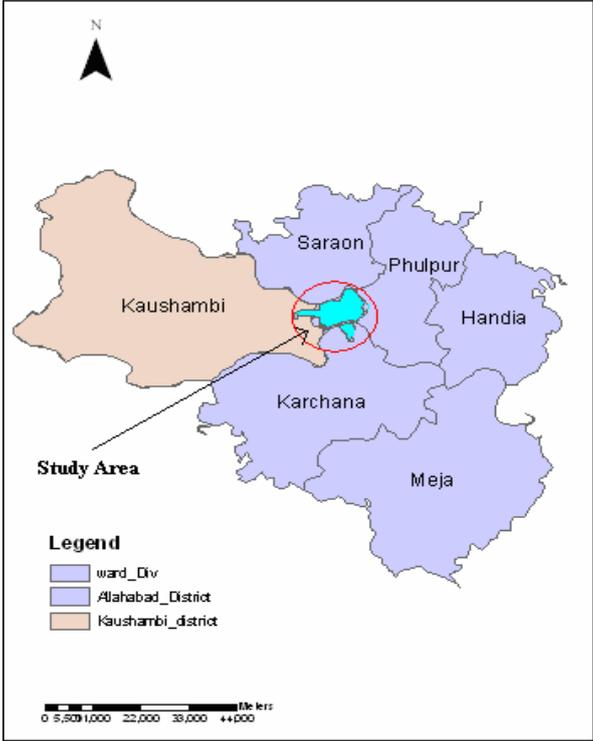


Figure 1: Study Area Location (Allahabad District, Uttar Pradesh, India).

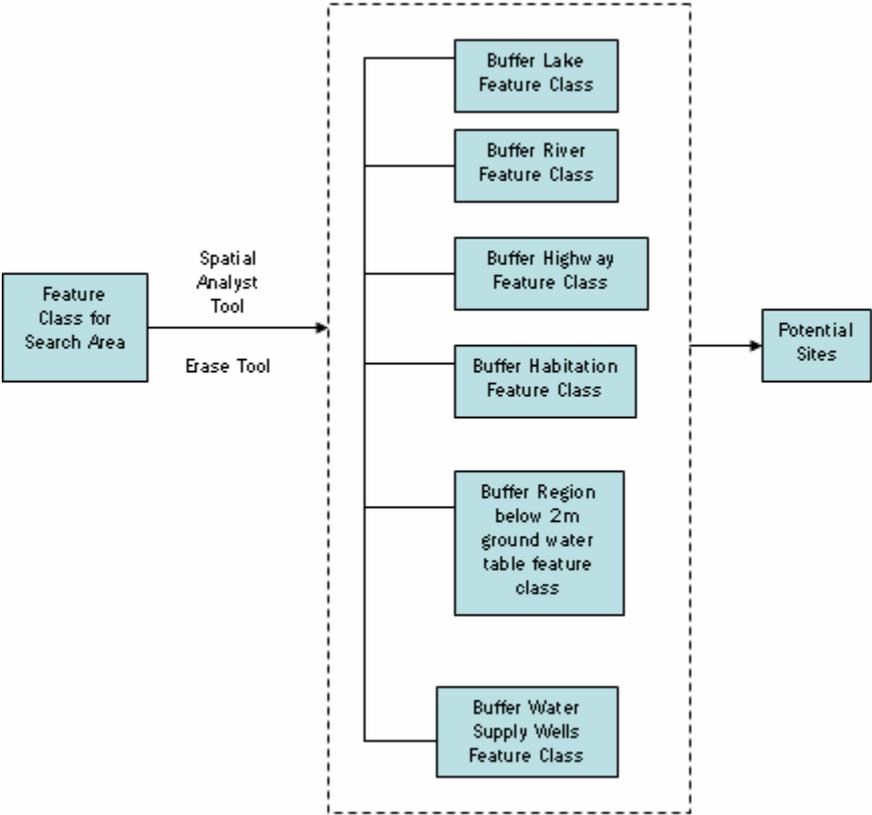


Figure 2: Methodology for eliminating the unwanted area for finding potential sites using ArcGIS

Collection of preliminary data was the first step which consisted of required toposheets (63G/15 ,63G/14 and 63G/11) containing different regions of Allahabad district for digitizing various features falling in the search area. Finally the potential landfill sites have been found outside the municipal boundary at a peripheral distance of 1Km. Figure 3 depicts various steps of finding the Potential sites using GIS spatial analytical ‘Eraser tool’ in the form of screenshots of the digitized features within the search area, buffer zones to be subtracted from the search area as well the resulting potential sites after subtraction.



Figure 3: Use of GIS in Potential Sites section using GIS Spatial Analytical Eraser Tool

Table 1: Various parameters considered for Site Selection as per MoEF considering the sensitivity

Sensitivity	Low	moderate	High	Very High
Geological parameters	>100m	100-60m	60-20m	<20m
Hydrological Parameters (Water Table depth in m)	>30	30-20	20-10	<10
Population within 1Km radius	negligible completely	Low	Moderate	High

RESULTS AND DISCUSSION

GIS has been used as a digital tool for identification of potential sites for municipal waste landfills for Allahabad City which is urgently required as currently there are no engineered landfill. The site selection has been done using GIS ‘Buffering’ and ‘Eraser’ tools . Finding new potential sites requires vast amount of data processing as knowledge of various field like soil science, engineering, hydrology, topography, land use etc shall be incorporated in order to get the desired result. The GIS based method has proved to be very effective in terms of accurate and fast achievement of the intended result as compared to traditional methods. These potential landfill sites can be considered in preparing various waste management strategies by environmentalists, urban planners and various other stakeholders.

ACKNOWLEDGEMENTS

Due acknowledgements to Prof. R.K Srivastava, Professor (Retd.) MNNIT Allahabad, Ground Water Board Allahabad, Pollution Control Board, Jhusi, Allahabad District and Geological Survey of India, Allahabad Division for their continuous support during the entire research.

REFERENCES

- Bennett, D. A. 1997. A framework for the integration of geographical information systems and modelbase management. *Int. J. GIS*: 337– 357.
- Javaheri, H, Nasrabadi, T, Jafarian, M. H, Rowshan, G. R, Khoshnam, H. 2006. Site Selection of Municipal Solid Waste Landfills using Analytical Hierarchy Process Method in a Geographical Information Technology Environment in Geroft Iran. *J. Environ. Health. Sci. Eng* 3:177-184.
- Lin, H, Kao, J 1998. Enhanced spatial model for landfill siting analysis. *Journal of Environmental Engineering* 125: 845–851.
- Malczewski, J 2004. GIS-based land-use suitability analysis: a critical overview. *Progress in Planning* 62: 3–65.
- Saxena, S., R.K. Srivastava and A.B. Samaddar 2010. Towards Sustainable Municipal Solid Waste Management in Allahabad City (India). *International Journal Management of Environmental Quality* 21:308-323.
- Saxena, S., R.K. Srivastava 2011. Assessment and disposal issues of biomedical waste-case study Allahabad city. *Int. J. Biomedical Engineering and Technology* 7: 97-104.

Received: 20th October 2022; Accepted: 20th October 2022; First distribution: 05th November 2022

Special edition procedure.