J. Asiat. Soc. Bangladesh, Sci. **52**(1): 111-135, June 2026 **- Review article**
DOI: https://doi.org/10.64298/jasbsci.v52i.008

DECISION-MAKING TECHNIQUES AND CRITERIA FOR LANDFILL SITE SELECTION: A CONCISE REVIEW

KAMRUN NAHAR KHAN MUKTI, TONOY MAHMUD, MD. ZILLUR RAHMAN*, A. S. M. MAKSUD KAMAL AND MD. SHAKHAWAT HOSSAIN*

Department of Disaster Science and Climate Resilience, University of Dhaka, Dhaka, Bangladesh

Abstract

This review paper presents an inclusive analysis of the methodologies and conditions related to waste management system analysis, focused on landfill siting. Over 200 scientific journal papers were published since 2003, and 100 of the most prominent among them were reviewed. The study employs various statistical analyses to synthesize information and outcomes as methodology. This paper examines key parameters, including study area locations, publication periods, citation metrics, publishers, journal impact factors, and the qualitative and quantitative rankings of the articles. The investigations reveal that Geographical Information Systems (GIS) and Remote Sensing (RS), either independently or in combination with other techniques, are widely used in landfill siting. Additionally, Multicriteria Decision Support Systems (MCDS) and the Analytical Hierarchy Process (AHP) are the most commonly applied methodologies for ranking suitable landfill site. A detailed assessment of landfill site selection criteria highlights that environmental factors are the most significant, followed by social, climatological, geological, and hydrogeological patterns. The results and categories presented valuable understandings and direction for future researchers, supporting more accurate and sustainable decisions in the complex and multifaceted process of landfill site selection worldwide.

Key words: Suitable site for landfill, Procedure, Suitable site selecting measures, Multi-Criteria Decision Support System, GIS and RS.

Introduction

Effective landfill siting is a crucial aspect of managing unused materials, particularly in light of the pressures of population growth and urbanization (Sumathi *et al.,* 2008). Mismanagement of waste can lead to systemic failures and severe environmental difficulties. To address this issue, the application of environmental, economic, and social guidelines is important (Mohammed *et al.,* 2019). Around the world, various waste

*Corresponding author: E-mail: zillur@du.ac.bd and shakhawat.dsm@du.ac.bd

management systems have been developed to improve economic and technological outcomes (Pires *et al.,* 2011). While developed countries often succeed in establishing planned landfill areas, developing and underdeveloped regions face considerable challenges. Particularly, small cities with populations under 50,000 containing 6%-45% of the global population experience significant problems in tackling these issues (Oakley and Jimenez, 2012; Ibrahim Mohammed *et al.,* 2018; Unal *et al.,* 2020).

Landfill site selection is still challenging due to the complex man-environment connection and biological matters (Kemal Korucu and Erdagi, 2012). Population growth and urban development make the site selection process difficult, demanding a balance of economic, environmental, and social factors (Mussa and Suryabhagavan, 2021). Solid waste management, mainly by landfilling, remains a prominent method in both developed and developing countries (Kalina and Tilley, 2020). In China, while the reuse and recycling of construction waste are being promoted, landfilling remains the most common practice (Ding *et al.,* 2018). Similarly, developing regions like the Muscat Governorate in Oman rely heavily on landfill systems to manage unused materials, despite the country's challenging physiographic conditions that limit suitable landfill sites (Hereher *et al.,* 2020). In Kuwait, approximately 90% of solid waste is disposed of in landfills. This approach is prevalent throughout the Middle East as a primary waste management strategy (Abdullah *et al.,* 2019). Addressing illegal dumping is also vital for regional development. Ishii *et al.* (2013) and Sinden *et al.* (2013) demonstrate that strategic planning can significantly benefit urban and environmental sustainability.

The National Environment of Engineering Research Institute (NEERI) and the Pollution Control Board set criteria for site selection, considering ecological, hydrogeological, and public concerns in India (Turkyilmaz *et al.,* 2019). Assessing landfill impacts is crucial, as many sites risk pollution (Tenodi *et al.,* 2020). Leachate formation, influenced by precipitation, waste moisture, and infiltration, poses a significant challenge. Effective management and treatment systems are essential for sustainable landfill operations (Costa *et al.,* 2019).

Rapid urbanization and population growth in major Bangladeshi cities, particularly Dhaka, Chittagong, Khulna, and Rajshahi, have led to significant challenges in solid waste management. Several studies highlight the environmental and health impacts of inadequate waste disposal systems and poorly maintained landfill sites. Aminul Haque *et al.* (2013) investigated the chemical composition of landfill leachate from Dhaka's Matuail site, emphasizing the toxic contamination of surrounding soil and water due to a lack of proper treatment facilities. Similarly, Quantity *et al.* (2010) and David and Kopac

(2017) focused on Matuail's semi-aerobic system and leachate leakage, underscoring the site's environmental vulnerability during rainy seasons. Chowdhury *et al.* (2020) further confirmed environmental degradation using remote sensing techniques, reporting increased land surface temperature and reduced vegetation near landfill zones.

Serajul *et al.* (2017) analyzed the lowering of groundwater levels over four decades, while Islam *et al.* (2013) and Das *et al.* (2014) emphasized leachate's hostile effects on water quality in Khulna and Rajshahi, respectively. The decrease in water bodies due to rapid land transformation has been recognized by Habiba *et al.,* (2011) and Sultana *et al.,* (2009), who stated that there has been a severe loss of wetland and marshy areas in Dhaka, thereby deteriorating the risk of waterlogging and urban flooding. Hasan *et al.* (2009), Islam *et al.* (2020), and Dey *et al.* (2019) employed GIS and multicriteria decision analysis (MCDA) to identify suitable landfill locations in view of environmental, economic, and socio-technical criteria. Khandaker (2017) and Das *et al.* (2014) highlighted the importance of waste-to-energy conversion, offering sustainable alternatives to traditional discarding practices. Moreover, studies by Akther *et al.* (2016), Mujibor Rahman *et al.* (2008), and Ashik-Ur-Rahman *et al.* (2022) stressed the importance of optimizing collection routes, enhancing infrastructure, and incorporating GIS for better logistics and planning. Reports by JICA (Japan International Cooperation Agency) (2005) and Islam (2016) stressed the necessity for strategic master planning, institutional coordination, and policy reforms to address the long-lasting ineffectiveness in municipal solid waste management.

Roy *et al.* (2022) highlighted that open dumping in Bangladesh's unsanitary landfills poses severe environmental and health risks, while Waste-to-Energy (WTE), landfill gas recovery, recycling, and pyrolysis offer sustainable alternatives. Alam and Qiao (2019) noted energy recovery and economic benefits from reprocessing. Bangladesh generates ~23,688 tons/day of mostly organic MSW, with poor collection leading to dumping and burning, particularly in Dhaka (Chowdhury *et al.*, 2020). The Clean Dhaka Master Plan (2018–2032) promotes 3R strategies, composting, anaerobic digestion, and WTE to improve waste management (Khan and Hossain, 2024).

Despite existing studies on waste management, no comprehensive review has focused on landfill site selection in Bangladesh, a key gap given the country's rapid urbanization, rising waste volumes, and inadequate systems. Analysis of over 38 studies shows severe environmental and health risks from poorly managed landfills. A consolidated review of GIS- and MCDA-based methodologies would guide research, inform policy, and promote sustainable, context-specific waste management practices.

This study provides an inclusive evaluation of methodological outlines and measures used in landfill suitability exploration for solid waste management. It presents a sequential inspection of landfill placement procedures based on published journal papers accessible in previous records. The research follows a 3-stage procedure including information assemblage from scientific articles, detailed numerical inquiry, and demonstration results. The outputs of the article search were then reviewed and categorized by significance, followed by a final selection of more than 95 scientific articles.

Statistical analyses

Over 200 scientific journal papers were published since 2003 on this topic. This paper has reviewed 100 publications spanning from 2003 to 2025 (Fig. 1). Other papers were not included in this review due to them being of similar topic and were of lesser importance. The statistical analysis observed peak research activity in 2019, the other notable surges were in 2009 and 2016. The authors of all reviewed papers propose a landfill siting methodology and conduct their research on a case study. The figure illustrates the annual distribution of landfill site selection (LSS) research publications from 2003 to 2022. A gradual increase in research interest is observed from 2003, with a notable rise in 2009, reaching 16 publications. After a period of moderate consistency, the highest peak occurred in 2016 with 20 publications, reflecting heightened academic focus on sustainable waste management and spatial decision-making during that time. However, a severe deterioration followed in 2017, with only three papers published. The trend rebounded in 2019 with 15 publications, followed by a minor weak point in the following years.

Table 1 shows a country-wise analysis of landfill site selection (LSS) publications, with Bangladesh leading (28), followed by Iran (8), Turkey (7), and India (7). Other contributions come from Spain, Malaysia, the USA, Canada, and Portugal. The global distribution highlights the universal importance of LSS and the widespread application of GIS and MCDA in addressing environmental and socioeconomic waste management challenges.

The reviewed scientific papers were statistically analyzed and ranked based on their citation counts. Citation data were retrieved from Google Scholar on December 1, 2021, and used as a metric for impact analysis. Chang *et al.,* (2008) has the highest citation with 445 citations as of the date of data retrieval, followed by key works from Canada, China, India, Spain, and Portugal. Most studies focus on integrating GIS with MCDA

techniques. High readership across articles reflects strong global interest in sustainable landfill planning, particularly in rapidly urbanizing regions. Key landfill site selection studies using GIS and MCDA (Table 2) employ tools like AHP, TOPSIS, PROMETHEE, and DSS to assess environmental, technical, and socioeconomic criteria. Many integrate spatial analysis with decision models, considering cost, pollution, and stakeholder input. In Bangladesh (Table 3), remote sensing, system capacity, governance, environmental monitoring, and renewable energy potential guide data-driven, context-specific landfill planning.

This study uses statistical methods to evaluate and prioritize landfill site selection criteria covering environmental, social, economic, technical, and administrative factors. Data normalization and weighting help quantify the impact of each criterion. Multivariate analysis identifies key factors influencing site suitability, supporting an objective and balanced decision-making process for optimal landfill placement (Tables 4 and 5). Based on the comprehensive analysis of these datasets, this research proposes a set of informed recommendations.

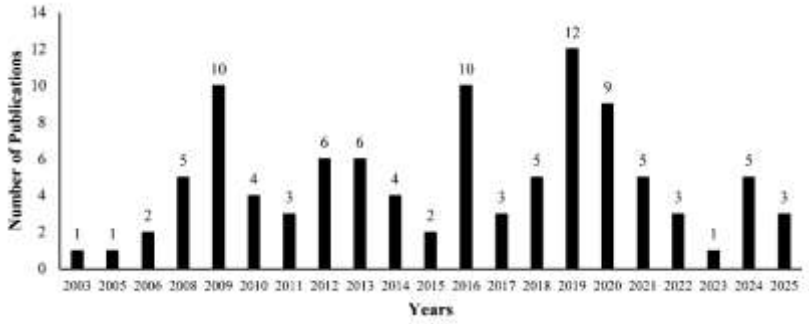


Fig. 1. Time-based distribution of research papers (yearly).

Landfill Siting Methodologies

The methodology for selecting optimal MSW landfill sites involves four stages: Stage 1 starts with a gap analysis based on international guidelines to ensure regulatory compliance. Stages 2 and 3 use GIS and remote sensing to analyze spatial data, environmental constraints, and land suitability. Stage 4 applies evaluative criteria such as environmental impact, accessibility, and economic feasibility to select the best site. Decision-making frameworks like AHP rank potential sites based on weighted criteria. Studies by Abdullah *et al.* (2019) in Kuwait and Wang *et al.* (2009), Şener *et al.* (2010) highlight the effectiveness of this approach.

Table 1. Countries and frequency of scientific articles considering landfill site selection

Sl. No.	Case study country	Frequency	Authors
1	Turkey	7	(Unal *et al.*, 2020; Kalina and Tilley, 2020; Coban, Ertis, and Cavdaroglu, 2018; Şener *et al.*, 2010; Yildirim, 2012; Çelik *et al.*, 2010)
2	Spain	3	(Kemal Korucu and Erdagi, 2012; Sánchez-Lozano *et al.* 2013; Aragonés-Beltrán *et al.*, 2010)
3	Japan	1	(Ishii *et al.*, 2013)
4	Iran	8	(Eskandari *et al.*, 2012; Sharifi *et al.*, 2009; Akbari *et al.*, 2008; Barzehkar *et al.*, 2019; Motlagh and Sayadi, 2015; Pasalari *et al.*, 2019; Torabi-Kaveh *et al.*, 2016; Eskandari *et al*., 2012)
5	Mexico	1	(Delgado *et al*., 2008)
6	Malaysia	3	(Mohammed *et al.*, 2019; Sin *et al.*, 2016; Yong *et al.*, 2018)
7	India	10	(Majid and Mir, 2021; Sumathi *et al.*, 2008; Singh, 2019; Shekdar 2009; Turkyilmaz *et al.*, 2019; Paul *et al.*, 2014; Singh *et al.*, 2009; Anusha *et al.* 2023;Vidya *et al*. 2024; Babu and Chitra 2025)
8	Iraq	3	(Alkaradaghi *et al*., 2019; Alanbari *et al.*, 2014; (Omar *et al.*, 2025)
9	Jordan	1	(Al-Jarrah and Abu-Qdais, 2006)
10	Greece	3	(Kontos *et al*., 2005; Demesouka, Anagnostopoulos, and Siskos 2019; Demesouka *et al*., 2013)
11	Ethiopia	1	(Mussa and Suryabhagavan, 2021)
12	Honduras	1	(Oakley and Jimenez, 2012)
13	Brazil	2	(Colvero *et al.*, 2018; Costa *et al.*, 2019)
14	Italy	1	(Feo and De Gisi, 2014)
15	Serbia	1	(Tenodi *et al.*, 2020;Rikalovic, Cosic, and Lazarevic, 2014)
16	USA	3	(Chang *et al.*, 2008; Gorsevski *et al.* 2012; Linkov *et al.* 2006)
17	Australia	1	(Sinden *et al.*, 2013)
18	China	3	(Wang *et al.* 2009; Ding *et al.*, 2018; Mojiri *et al.*, 2016)
19	Kuwait	2	(Ud din *et al*., 2009; Abdullah *et al*., 2019)
20	Canada	3	(Cheng *et al.* 2003; Cleary 2009; Karimi *et al.*, 2020)
21	Portugal	3	(Pires *et al.*, 2011; Tavares, Zsigraiová, and Semiao 2011; Avelino *et al.*, 2019)
22	Ghana	1	(Stemn and Kumi-Boateng, 2019)
23	Asia	1	(Turkyilmaz *et al.*, 2019)
24	Pakistan	1	(Asif *et al.*, 2020)
25	Nigeria	1	(Ibrahim Mohammed *et al.*, 2018)
26	Oman	1	(Hereher *et al.*, 2020)
27	Egypt	1	(Effat and Hegazy, 2012)
28	Hong Kong	1	(Lee *et al.*, 2016)
29	Tanzania	1	(Ally *et al.* 2024)
30	Algeria	1	(Bechroune *et al.* 2024)
31	South America	1	(Mohamed Salih, Khalid, and Hamid 2025)
32	Worldwide	1	(Bennett 2024)
33	Bangladesh	28	(Khan & Hossain, 2024; Aminul Haque *et al.*, 2013; Habiba *et al.*, 2011; Roy *et al.* 2022)

Landfill site selection is influenced by environmental and socioeconomic criteria (Unal *et al.,* 2020). A fuzzy logic system addresses decision-making doubts, whereas the Simos Method allocates weights to criteria in MCDA. GIS integration creates spatial suitability layers, and a SWOT analysis evaluates strengths, weaknesses, opportunities, and threats, as studied by Kalina & Tilley. Eskandari *et al.* (2012) and Kemal Korucu and Erdagi (2012) used a five-step methodology, including expert surveys and GIS-MCDA analysis. Additionally, Iran's Environmental Protection Organization (IEPO, 2009) provided landfill siting legislation as a guideline. An organized waste management approach includes PESTEL analysis to assess external factors and SWOT analysis for recognizing threats and weaknesses. The 3R Principles (reduce, reuse, recycle) develop resource proficiency (Turkyilmaz *et al.,* 2019). A GIS-based landfill suitability study in Muscat, Oman, used GIS tools to analyze population, land cover, and hydrological data for optimal site selection (Hereher *et al.,* 2020).

Central European countries focus on advancing waste management technologies (Pires *et al.,* 2011). Mathematical models (Lee *et al.,* 2016) facilitate the selection of techniques that strike a balance between environmental benefits and costs. The semi-mechanized trench method, Oakley and Jimenez (2012), is a sustainable option for small cities, involving waste burial and soil coverage for natural biodegradation. Key parameters: 11 ha area, 23,000–48,000 population, 0.2 m²/person/year land coverage, a cover-to-waste ratio of 0.2, 298,000 m³ soil surplus, a cost of USD 4.60/person, and a distance of≥2 km from water bodies. Anusha *et al.* (2023) used GIS and AHP for Land Suitability Analysis, providing a framework for sustainable agriculture. Ally *et al.* (2024) mapped groundwater potential in Tanzania, using RS, GIS, and F-AHP. Bennett (2024) reviewed 125 studies on groundwater mapping, highlighting field data as essential for validation. Vidya *et al.* (2024) identified groundwater potential zones in Kerala using GIS-based Weighted Overlay with AHP, showing that integrating surface and subsurface data supports sustainable management.

Methodological Framework

The methodological approaches for landfill site selection (LSS) have undergone significant evolution over the last two decades. Incorporating Geographic Information Systems (GIS) and Multicriteria Decision Analysis (MCDA) has been established as effective in merging spatial data with structured decision making. The methodologies fluctuate by decision guidelines, weight assignment, stakeholder input, and evaluation

criteria. Table 2 presents a compilation of key studies that have applied GIS and MCDA frameworks to identify suitable landfill sites worldwide.

GIS and Spatial Data Integration: GIS provides a full-bodied platform for handling spatial datasets such as land use, topography, geology, hydrology, and infrastructure. Many studies (e.g., Sharifi *et al.,* (2009); Chang *et al.,* 2008); Alkaradaghi *et al.,* (2019)) used buffer zones, overlay analysis, and raster modeling to describe exclusion zones and rank suitability based on predefined thresholds. Satellite imagery, remote sensing (RS), and topographic maps were regularly used to extract environmental constraints such as slope, elevation, and vegetation cover.

Multicriteria Decision-Making (MCDM) Techniques: Various MCDM techniques have been adopted to prioritize alternatives by integrating stakeholder preferences, environmental thresholds, and legal criteria. The most commonly used methods include:

- *Analytic Hierarchy Process (AHP) and Analytic Network Process (ANP):* Applied for weight derivation based on pairwise comparisons of criteria (e.g., Aragonés-Beltrán *et al.,* 2010; Gorsevski *et al.,* 2012).
- *Simple Additive Weighting (SAW) and Simple Weighted Addition (SWA):* Offer computational simplicity by summing weighted scores (e.g., Kontos *et al.,* 2005).
- *TOPSIS and PROMETHEE:* Rank alternatives based on their proximity to ideal solutions (e.g., Coban, Ertis, and Cavdaroglu, 2018; Demesouka *et al.,* 2013).
- *ELECTRE, OWA, and UTASTAR*: These include more sophisticated rule-based and utility-based ranking models (e.g., Cheng *et al.,* 2003)
- *Delphi Method and DSS*: Useful for integrating expert judgment and stakeholder feedback, especially in uncertain or socially sensitive contexts (e.g., Turkyilmaz *et al.,* 2019).

Several studies incorporated GIS and MCDA for evaluating and ranking landfill locations: Dey *et al.* (2019) applied GIS-based MCDA in Chattogram, identifying health hazards from open dumping and leachate leakage. Mujibor Rahman *et al.* (2008) developed a three-phase (intelligence, design, choice) GIS model for Khulna city, finalizing one optimal landfill site from seven based on land cover, religious structures, and infrastructure. Akther *et al.* (2016) designed a GIS-based model integrating road networks, illegal dumping zones, and waste segregation patterns to propose a central dumping zone in Dhaka. Rahman and Ershad (2022) employed GIS for satellite town planning, applying physical and socioeconomic criteria to classify suitability levels. Ashik-Ur-Rahman *et al.* (2022) utilized road network analysis in Khulna to optimize landfill routes, resulting in a 17 km reduction in travel distance and a 30-liter daily

reduction in fuel consumption. Mohamed Salih, Khalid, and Hamid (2025) introduce a hybrid framework (QuFS–FUCOM) for landfill site selection, combining fuzzy logic and consistency methods to prioritize criteria and COPRAS for site ranking. Babu and Chitra (2025) present a landscape-centric approach to landfill site selection in Kerala, India, using GIS and Analytic Hierarchy Process (AHP). Bechroune *et al.* (2024) use an integrated GIS–MCDM approach with AHP to select optimal landfill sites in Bejaia province, Algeria. (Omar *et al.,* 2025) evaluates the existing Erbil Landfill Site (ELS) and identifies a sustainable location for a new site using Remote Sensing (RS), GIS, and Analytic Hierarchy Process (AHP).

Leachate and Environmental Impact Assessments: Aminul Haque *et al.* (2013) reported significant soil and water contamination from leachate at Matuail landfill, exceeding standard limits. Quantity *et al.* (2010) noted seasonal issues in a semi-aerobic treatment system, while David and Kopac (2017) highlighted groundwater risks due to soil permeability. Islam *et al.* (2013) confirmed similar leachate-related contamination at Khulna's Rajbandh landfill.

Land Use, Urbanization, and Environmental Change: Ullah and Enan (2016) tracked the conversion of vegetation and waterbodies to built-up areas in Dhaka using LULC analysis from 1991 to 2016. Chowdhury *et al.* (2020) used LST, NDVI, SAVI, and MSAVI via Landsat imagery to show increasing temperatures and decreasing vegetation around Matuail landfill. Islam (2021) and Kabir (2015) analyzed urban land use pressures and informal SWM practices, noting disparities between DNCC and DSCC.

Waste Generation, Composition, and Management Trends: Islam (2016) performed a trend analysis of Dhaka's waste generation (1771–2002), identifying irregularities like insufficient waste vehicles, illegal dumping, and improper landfill conditions. Hasan, R. M., Tetsuo, K., and Islam (2009) projected waste trends from 2007–2025 and used GIS-MCDA to rank six landfill sites based on multicriteria analysis. Islam *et al.* (2020) applied AHP-GIS techniques in Savar, identifying 12 suitable landfill locations, categorizing areas as highly suitable, moderately suitable, and unsuitable. Das *et al.* (2014) assessed methane generation potential in Rajshahi's landfill, estimating 7549 tons of CH_4 annually, supporting waste-to-energy conversion feasibility.

Energy Recovery and Resource Optimization: Khandaker (2017) studied the potential of waste-to-energy conversion by analyzing landfill samples for organic content, proposing incineration and CH_4 capture as solutions. Habib *et al.* (2021) supported anaerobic digestion for Rajshahi's increasing waste load, linking it to energy and environmental sustainability.

Table 2. Summary of Selected Landfill Site Selection Studies Using GIS and MCDA.

Sl. No.	Authors (Year)	Methods/Tools	Study area	Key focus / findings	Remarks
1	Cheng *et al.,* (2003)	SWA, WP, CGT, TOPSIS, ELECTRE	Prairie City, USA	Cost minimization via integrated MCDM	Combined game theory and MCDA
2	Effat and Hegazy, (2012)	GIS, MCDA	Sinai, Egypt	Suitability mapping using spatial layers	Used thematic evaluation criteria
3	Coban, Ertis, and Cavdaroglu, 2018)	TOPSIS, PROMETHEE	Turkey	Prioritized landfill alternatives	Effective in comparative ranking
4	Demesouka, Anagnostopoulos, and Siskos, (2019);	UTASTAR	NE Greece	Utility-based structured evaluation	Hybrid utility-based method
5	Sharifi *et al.* (2009); Akbari *et al.* (2008)	GIS, AHP	Iran	Elevation, slope, hydrogeology	Applied exclusion buffers and overlays
6	Chang *et al.,* (2008); Mohammed *et al.,* (2019)	GIS, AHP, Field Validation	China, Sudan	Validated GIS-MCDA with field surveys	Included stakeholder-grounded assessments
7	Kontos *et al.,* (2005)	SAW, Spatial Clustering	Greece	Suitability classification (5 levels)	Integrated local policy constraints
8	Gorsevski *et al.* (2012)	AHP, OWA, GIS	Macedonia	Sensitivity to risk preferences	Optimistic vs. pessimistic weights
9	Alanbari *et al.,* (2014)	GIS, MCDA	Iraq	Developed ranking-based suitability maps	Comprehensive overlay and buffer analysis
10	Sumathi *et al.,* (2008); Colvero *et al.,* (2018)	GIS, MCDA	India, Brazil	Integrated spatial + decision models	Identified feasible landfill zones
11	Rikalovic, Cosic, and Lazarevic, (2014); Kemal Korucu & Erdagi, 2012	DSS, GIS	Serbia, Turkey	Industrial site evaluation	Factored road distance, water proximity
12	Aragonés-Beltrán *et al.,* (2010)	AHP, ANP	Spain	21 criteria in 6 site alternatives	Included legal and ecological factors
13	Turkyilmaz *et al.,* (2019); (Paul *et al.,* 2014)	Delphi, GIS, RS	India	Multi-round expert judgment	Applied in metropolitan contexts
14	Tenodi *et al.,* (2020)	Igeo, LWPI, ERi	Croatia	Groundwater/soil contamination indices	Used long-term monitoring data
15	Costa *et al.,* (2019); Mojiri *et al.,* (2016)	Water Quality Analysis	Brazil, Malaysia	Pollution source and leachate treatment	Chemical indicators in site impact evaluation
16	Çelik *et al.,* (2010)	DSS + Criteria Evaluation	Turkey	Two-phase DSS for site design	Linked performance and suitability
17	Delgado *et al.,* (2008)	GIS, Boolean Logic, MCDA	Spain	Site identification using three models	Compared simple and complex MCDM

Table 3. The methodological design derived from national studies on landfill siting.

Sl. No.	Examples from Literature	Application
1	Soil permeability, groundwater depth, proximity to wetlands (Aminul Haque *et al.* (2013) ; Islam *et al.* (2013)	Risk assessment for contamination
2	Population density, informal settlements, health hazards (Dey *et al.* (2019); Urme *et al.* (2021)	Buffer zones and risk zones
3	Road access, distance to residential zones, fuel use Ashik-Ur-Rahman *et al.* (2022)	Transport optimization
4	LULC maps, SPOT and Landsat imagery (Chowdhury *et al.* (2020); Ullah and Enan (2016)	Overlay analysis and classification
5	Waste vehicle count, treatment facility availability Islam (2016)	System capacity analysis
6	Landfill policy frameworks JICA - (Japan International Cooperation Agency), (2005)	Governance gap assessment
7	LST, NDVI, SAVI Chowdhury *et al.* (2020)	Impact monitoring
8	CH_4 generation, anaerobic digestion (Das *et al.* (2014); Khandaker (2017)	Renewable energy planning

Institutional and Policy Frameworks: JICA (Japan International Cooperation Agency), (2005) developed a master plan for Dhaka's waste management, addressing human resources, transportation, and policy gaps. Islam (2016) identified 14 specific operational issues, calling for improved planning, CH_4 management, and stricter enforcement of laws. Urme *et al.* (2021) proposed policy enforcement and socioeconomic penalties to improve compliance among waste workers and stakeholders.

Adopted Methodology: This study integrates the following methodological tools adapted to the Bangladeshi context:

- *GIS Spatial Analysis:* Buffer zones, weighted overlay, slope, and hydrological analysis using satellite imagery and field data.
- *MCDA (AHP Method):* Pairwise comparison of key criteria derived from literature and expert consultations to assign normalized weights.
- *Data Sources:* Bangladesh Bureau of Statistics (BBS), Dhaka North/South City Corporation reports, BWDB maps, USGS Landsat imagery, and field-collected water/soil samples.
- *Field Validation:* On-site verification of spatial data, infrastructure accessibility, and leachate dispersion through physical observation and sample analysis.

International studies show that landfill site selection (LSS) benefits from a hybrid approach combining GIS, MCDA, and field validation, with model choice (e.g., AHP, TOPSIS, ELECTRE) influencing outcomes. In urban Bangladesh, the methodology integrates spatial analysis, environmental chemistry, policy, and engineering, adapting global techniques to local contexts in Dhaka, Khulna, Rajshahi, and Chattogram for data-driven, sustainable waste management.

Landfill Site Selection Criteria

Landfill site selection is complex, influenced by various criteria, with key challenges being groundwater pollution and socioeconomic impacts. Cheng *et al.*,(2003) emphasized addressing these issues comprehensively. Coban, Ertis, and Cavdaroglu. (2018) evaluated solid waste disposal scenarios using expert-determined criteria. The selection process occurs in phases, starting with environmental, ecological, and social criteria to assess impacts on air quality, soil, water pollution, noise pollution, biodiversity, and community acceptance. The second phase introduces public health and safety criteria, focusing on disease control, odor management, proximity to sensitive facilities, and health protection (Kemal Korucu and Erdagi, 2012; Effat and Hegazy, 2012; Eskandari *et al.*, 2012).

Hazardous waste site selection involves 35 criteria, classified as exclusionary (e.g., aquifers, rivers, steep slopes, protected areas) and non-exclusionary (e.g., proximity to industry, land use, soil type, climate) (Sharifi *et al.*, 2009). Akbari *et al.*, (2008) and Barzehkar *et al.*, (2019) highlighted environmental, geological, and socioeconomic factors, including distance from settlements, rivers, faults, slope, groundwater depth, and wetlands, to minimize environmental impact and ensure ecological safety.

Landfill site selection is influenced by environmental, economic, and social factors (Majid and Mir, 2021). Alkaradaghi *et al.*, (2019) categorized decision-making criteria into natural and artificial factors. Natural factors include soil type, land use, elevation, slope, proximity to rivers, groundwater depth, and geology. Artificial factors include proximity to roads, urban areas, villages, archaeological sites, oil and gas fields, and power lines. Feo and De Gisi, (2014) created a land-use map to identify suitable areas for different plant types, considering factors like population, groundwater risks, agriculture, transport, economics, and safety zones. Motlagh and Sayadi, (2015) used Multicriteria Evaluation (MCE) for landfill site selection, considering environmental and socioeconomic factors like hydrology, land use, proximity to urban areas, roads, and

industries. Mussa and Suryabhagavan, (2021) and Demesouka *et al.,* (2013) also applied GIS-based MCE to identify landfill sites using spatial data.

Chang *et al.,* (2008) proposed a two-step landfill selection method using GIS for thematic mapping and MCDA for site ranking. Asif *et al.,* (2020) integrated diverse GIS datasets, while Abdullah *et al.,* (2019) stressed socioeconomic factors and landfill lifespan. Ibrahim Mohammed *et al.,* (2018) highlighted the importance of spatial data analysis and regulatory guidelines, while Wang *et al.,* (2009) emphasized economic and land-use considerations. Şener *et al.,* (2010) identified geology, hydrology, and proximity to water bodies as key factors. Tavares, Zsigraiová, and Semiao, (2011) used AHP and GIS to select a site for a municipal solid waste incineration plant on Santiago Island, Cape Verde, centering on minimizing economic, environmental, health, and social costs. Their analysis involved a global screening and two local phases: non-environmental feasibility and environmental impact assessments. Gorsevski *et al.,* (2012) conducted a suitability analysis for landfill site selection in Macedonia, balancing economic and ecological factors. Sánchez-Lozano *et al.* (2013) highlighted the importance of weighting criteria, considering location, geomorphology, environment, and climate for comprehensive site evaluation.

Pasalari *et al.,* (2019) identified 15 sub-criteria for landfill site selection, while Torabi-Kaveh *et al.,* 2016 grouped key factors into geology, eco-sociology, technical/economic and hydrology/climate. Mohammed *et al.,* (2019) , Yildirim, (2012), and Sumathi *et al.,* (2008) used maps and multicriteria approaches, considering land use, water, geology, slope, and infrastructure, to determine suitability levels. Colvero *et al.,* (2018) assessed landfill suitability based on land use and population trends, while Cleary (2009) emphasized transparent LCA for environmental and economic impacts. Çelik *et al.,* (2010) considered slope, safety, and cost, and Al-Jarrah and Abu-Qdais, (2006) applied fuzzy inference with topographic, geological, socio-cultural, and economic factors. Ishii *et al.,* (2013) addressed illegal dumping restoration by land-use groups, and Delgado *et al.,* (2008) evaluated land cover, soil, geomorphology, and highways for landfill siting.

Karimi *et al.,* (2020) applied a 40 km buffer for landfill site selection, considering environmental and economic factors. Stemn and Kumi-Boateng, (2019) categorized criteria as exclusionary (e.g., protected areas, proximity to schools/hospitals) and non-exclusionary (geo-environmental, economic, social). The EVIAVE method assessed impacts via the Global Landfill Risk Index. Avelino *et al.,* (2019) and Paul *et al.,* (2014) used MCDA to evaluate landfill sites, focusing on environmental, economic, and regulatory risks. Tables 4 and 5 summarize the criteria and sub-criteria identified. Anusha

et al. (2023) analyzed soils, geology, slope, drainage, land use, and soil nutrients for agricultural land suitability. Ally *et al.* (2024) combined seven layers, including lithology, soil, drainage, and slope, to map groundwater potential zones. Bennett (2024) reviewed 125 studies, highlighting the importance of field data (e.g., well yield, discharge, transmissivity) and ten validation methods for reliable groundwater mapping.

Vidya *et al.* (2024) demonstrate that combining surface and subsurface data enhances groundwater management, whereas Roy *et al.* (2022) report toxic metal contamination (Pb, Cd, Cr) in Kuakata, Bangladesh, highlighting health risks and the need for ongoing monitoring. Case studies highlight key factors for landfill site selection: population impact was critical in southwestern Colombia (Mohamed Salih, Khalid, and Hamid 2025), while Babu and Chitra (2025) emphasized geology, hydrology, and vegetation in Kerala. Bechroune *et al.* (2024) used 14 weighted environmental, geological, and accessibility criteria to calculate a Landfill Site Suitability Index, and (Omar *et al.*, 2025) assessed Erbil's current landfill, considering urban areas, roads, streams, slope, and elevation to identify an optimal site.

Table 4. The 17 most used criteria and their frequency

Sl. No.	Criteria	Frequency
1	Environmental Criteria	26
2	Social Criteria	23
3	Land use	18
4	Economic Criteria	17
5	Hydrological Criteria	17
6	Geological Criteria	16
7	Road Network	13
8	Hydrogeological Criteria	8
9	Cultural Criteria	8
10	Ecological Criteria	7
11	Topographic Structure	7
12	Climatological Criteria	7
13	Geomorphological Criteria	6
14	Demographic Criteria	5
15	Public Health and Safety Criteria	5
16	Administrative Impacts	5
17	Technical Criteria	4

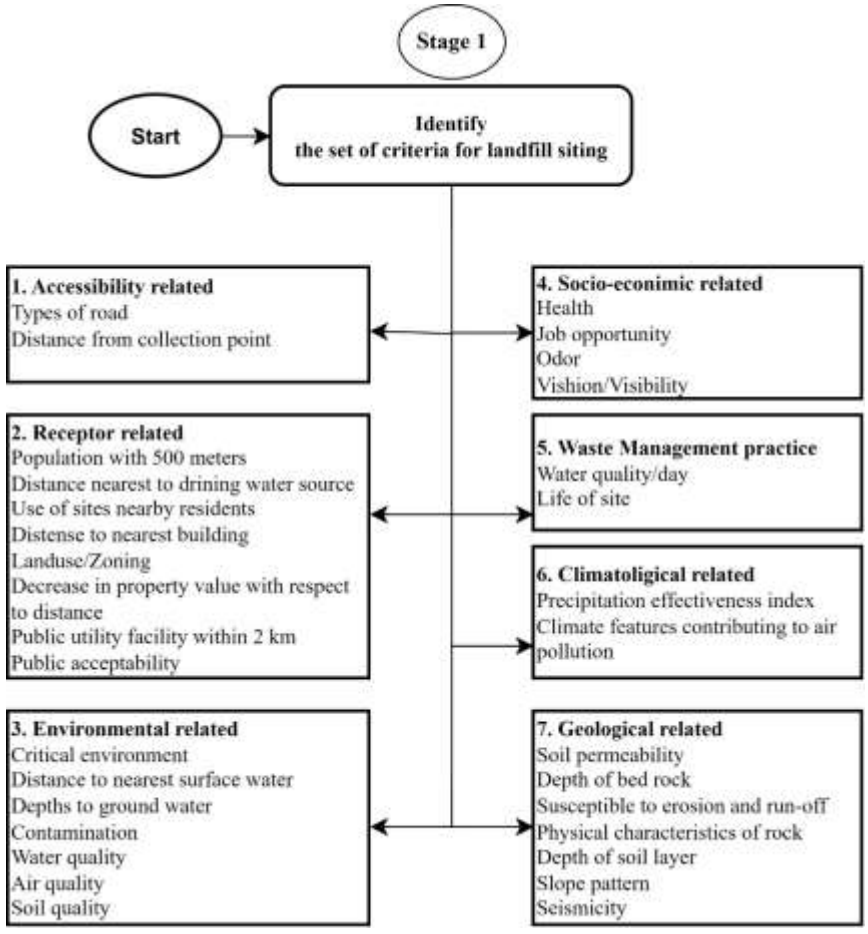
Table 5. Table of Criteria and Sub-Criteria

Sl. No.	Main Criteria	Sub-Criteria
1	Environmental Criteria	Air quality, noise pollution, ecosystem sensitivity, visual impact, contamination risk
2	Social Criteria	Population density, proximity to settlements, community acceptance, public perception, land ownership
3	Land Use	Land use compatibility, distance from agriculture/urban areas, and industrial zones
4	Economic Criteria	Land cost, transportation cost, operation & maintenance cost, compensation, potential revenue
5	Hydrological Criteria	Distance to surface water, drainage pattern, flood risk, catchment sensitivity
6	Geological Criteria	Soil stability, seismic risk, permeability, slope failure potential
7	Road Network	Proximity to roads, access for trucks, road quality, congestion level
8	Hydrogeological Criteria	Depth to groundwater, groundwater flow direction, aquifer vulnerability, leachate risk
9	Cultural Criteria	Proximity to heritage/religious sites, archaeological sensitivity, and social zones
10	Ecological Criteria	Distance to protected areas, endangered species, and biodiversity hotspots
11	Topographic Structure	Elevation, slope gradient, ruggedness, and site leveling feasibility
12	Climatological Criteria	Rainfall, wind direction, temperature, and evaporation rate
13	Geomorphological Criteria	Landform type, erosion potential, landslide risk, rock structure
14	Demographic Criteria	Growth rate, urban-rural ratio, migration, projections
15	Public Health & Safety	Disease risk, odor, proximity to sensitive facilities (schools/hospitals), emergency access
16	Administrative Impacts	Legal/zoning policy, jurisdiction, planning regulation, approval ease
17	Technical Criteria	Engineering suitability, availability of utilities, proximity to treatment facilities, and landfill lifespan

After the inclusive analysis of the existing landfill site selection methods and evaluation criteria stated in the literature, this study recognized and confirmed the most relevant criteria for the research area. The selection process considered accessibility, receptor, environmental, socio-economic, waste management practice, climatological and geological related factors to ensure a stable and sustainable method to landfill site suitability assessment. The finalized criteria accepted in this study are presented in the following flowchart (Figure 2).

Table 6. Sub-criteria of spatial attributes.

Criteria	Sub-criteria	
Spatial Attributes	Distance from the waste generation source	Distance from protected areas and hot spots
	Distance to residential, religious, and archeological sites	Distance from human settlement
	Distance from the Power transmission line	Location of nearest surface water
	The site is far from the population center	Position of nearest fault
	Location far from the wetland and the lake	Distance from the aquifer
	Distance from permanent and seasonal rivers	Locations of Military areas
	Industrial area's location	Locations of Leisure areas
	Locations of agricultural areas	Locations of Natural springs
	Positions of flight paths	Burial yard's location



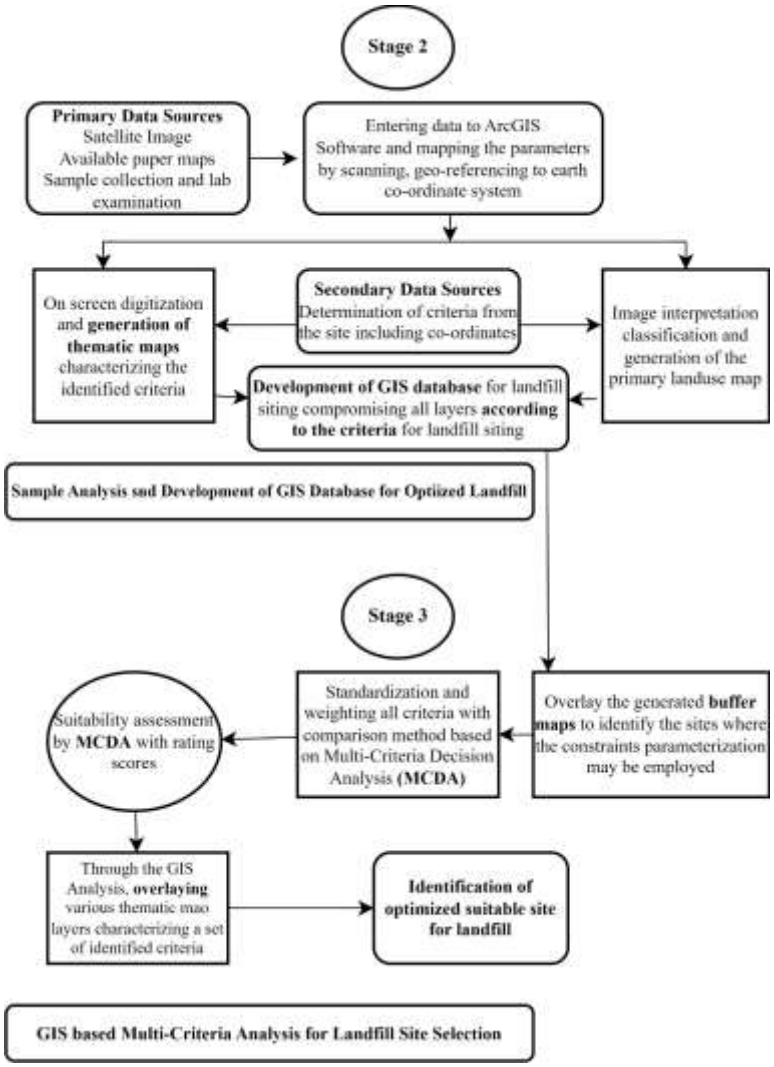


Fig. 2. Flowchart Illustrating the Stages of MSW Landfill Site Selection Methodology

Challenges and Future Perspective

A series of unique factors complicate the landfill site selection and management process in Bangladesh. Being among the countries with the highest population density, Bangladesh experiences great difficulty in allocating enough land for waste disposal. In addition, there is no land available anywhere without competing residential, agricultural

or commercial activities being performed there. Besides, the process of rapid urbanization further limits the availability of available peripheral lands, which at the same time produces increasing amounts of municipal solid wastes. As far as the country's geography is concerned, it is rather flat and therefore prone to floods. In other words, poor drainage makes the majority of lowlands unsuitable for landfill establishment unless some costly construction measures are undertaken. Related to the first problem is the presence of high groundwater table which imposes additional difficulties by increasing the risk of pollution of drinking water sources. Last but not least, there are significant social barriers which are encountered while establishing landfills near communities which fear odours, health risks, and decreased property value. Financial shortages, however, are considered the main reason behind all of the discussed issues.

Several future research directions have been revealed based on the analysis of literature presented above. Firstly, current scientific literature pays little attention to the analysis of governance structures and policy development for landfills. Thus, in order to ensure landfill sustainability, the impact of policy, governance, and institutional interactions needs to be further investigated.

Secondly, current research mainly uses GIS-based approach and MCDA techniques such as AHP, TOPSIS, and PROMETHEE to analyze the suitability of sites for landfill construction. It seems quite promising to design more sophisticated hybrid approaches and even AI-driven approaches that involve machine learning algorithms, fuzzy logic, and neural network models.

Thirdly, there has been relatively little effort made to integrate climate change issues into landfill site assessment criteria. Therefore, the use of such factors as excessive rainfall, flooding, and temperature increase needs to be further explored.

Fourth issue is, there have been few researches conducted in relation to policy and administrative matters. In spite of this, the literature analyzed above provides many relevant aspects of landfills. This may be helpful for future research and addressing some challenges facing solid waste management.

Moreover, the long-term performance of the systems installed for landfill leachate management and methane emission reduction needs further exploration, especially in countries like Bangladesh. Finally, the social aspects of landfill siting remain understudied, namely, community attitudes, public participation, health impact assessment, socio-economic issues, etc. Besides, secondary cities need greater attention regarding waste management issues.

Conclusion

This paper brings together literature on landfill site selection procedures and solid waste management systems from all around the world written between 2003 to 2024. It covers major environmental considerations involved, methods used, and several real-life examples of sites from across different countries. Among the reviewed papers, the most commonly used methodology is Geographic Information System (GIS), often combined with Remote Sensing (RS). The incorporation of GIS with Multicriteria Decision Support Systems (MCDS) stands out as the principal method, adopted by 85.4% of the studies. Within this group, 43% of the researchers who employed the Analytical Hierarchy Process (AHP) also utilized MCDS to make the final decision. Other methods highlighted in the literature include Comparative Risk Assessment (CRA), Life Cycle Assessment (LCA), Need Analysis Method and a Multi-Pronged Integrated Approach is also present. When it comes to landfill site selection, the combination of GIS, RS, and Multicriteria Decision Analysis (MCDA) is most commonly chosen, as demonstrated in Table 3. These methods are chosen because they enable the efficient handling of large datasets while providing a simplified yet meaningful approach for making informed, sustainable decisions. Criteria that need to be considered when selecting a dumpsite for wastes can be classified into environmental, social, economic, and technical criteria. In the environmental criterion, efforts should be made to minimize air, water, and soil pollution. Social criteria comprise issues related to social acceptance, population, among others. Economic criteria involve land, transport, construction, and operation cost. Hydrological, hydrogeological, geological, and geomorphological criteria are useful for preventing contamination and promoting the stability of the selected site. Other criteria include land use, topography, climate, ecology, culture, demography, public health, and safety.

Road access and waste management criteria, which fall under the technical category, are important for effective management of dumpsites. Other sub-criteria that enhance site suitability include distance from water, roads, residences, environmentally sensitive areas, and other protected areas (Tables 4–6). An appropriate weight of these criteria is important for achieving environmental sustainability and protecting public health and safety.

In summary, it is evident that effective site selection for landfill sites necessitates a balanced approach that takes into account multiple considerations, including environmental, social, economic, and technical aspects. From the studies examined in this paper, it can be observed that GIS-based site selection techniques, coupled with Remote Sensing and Multicriteria Decision Analysis tools, especially AHP analysis, prove to be

the most appropriate approach to address the complexities involved in the process. This technique allows for the systematic evaluation and weighting of a broad range of criteria including hydrology and other environmental factors as well as socio-economic factors such as access to healthcare services and infrastructure facilities. With global rates of urbanization increasing every year, there is a need for adoption of scientific methods for site selection.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the author(s) utilized ChatGPT and Grammarly to enhance readability and refine language. All content was subsequently reviewed and edited by the authors, who take full responsibility for the final manuscript.

References

Abdullah, M.M., S. Al-Jenaid, W.K. Zubari, J. Al-Ali, 2019. An Integrated Method for the Selection of Optimum Locations for Landfilling Utilizing GIS: A Case Study of the State of Kuwait. *J. Environ. Prot.* (Irvine, Calif). **10**: 260–275.

Akbari, V., M.A. Rajabi, S.H. Chavoshi, R. Shams, 2008. Landfill Site Selection by Combining GIS and Fuzzy Multi Criteria Decision Analysis, Case Study: Bandar Abbas, Iran. *World Appl. Sci. J.* **3**: 39–47.

Akther, A., T. Ahamed, T. Takigawa, R. Noguchi, 2016. GIS-based Multi-criteria Analysis for Urban Waste Management. *J. Japan Inst. Energy* **95**: 457–467.

Al-Jarrah, O., H. Abu-Qdais, 2006. Municipal solid waste landfill siting using intelligent system. *Waste Manag.* **26**: 299–306.

Alam, O., X. Qiao, 2019. An in-depth review on municipal solid waste management, treatment and disposal in Bangladesh. *Sustain. Cities Soc.* **52**: 101775.

Alanbari, M.A., N. Al-Ansari, H.K. Jasim, 2014. GIS and Multicriteria Decision Analysis for Landfill Site Selection in Al-Hashimyah Qadaa. *Nat. Sci.* **06**: 282–304.

Alkaradaghi, K., S.S. Ali, N. Al-Ansari, J. Laue, A. Chabuk, 2019. Landfill site selection using MCDM methods and GIS in the Sulaimaniyah Governorate, Iraq. *Sustain.* **11**: 4530.

Ally, A.M., J. Yan, G. Bennett, N.N. Lyimo, S.D. Mayunga, 2024. Assessment of groundwater potential zones using remote sensing and GIS-based fuzzy analytical hierarchy process (F-AHP) in Mpwapwa District, Dodoma, Tanzania. *Geosystems and Geoenvironment* **3**: 100232.

Aminul Haque, M., M.A. Hoque, M.S.A. Modal, M. Tauhid-Ur-Rahman, 2013. Characterization of Leachate and Solid Waste of Dhaka City Corporation Landfill Site for Solid Waste Stabilization. *Am. J. Civ. Eng. Archit.* **1**: 39–42.

Anusha, B.N., K.R. Babu, B.P. Kumar, P.P. Sree, G. Veeraswamy, C. Swarnapriya, M. Rajasekhar, 2023. Integrated studies for land suitability analysis towards sustainable agricultural development in semi-arid regions of AP, India. *Geosystems and Geoenvironment* **2**: 100131.

Aragonés-Beltrán, P., J.P. Pastor-Ferrando, F. García-García, A. Pascual-Agulló, 2010. An Analytic Network Process approach for siting a municipal solid waste plant in the Metropolitan Area of Valencia (Spain). *J. Environ. Manage.* **91**: 1071–1086.

Ashik-Ur-Rahman, M., M. Waheduzzaman, M. Waresul Hassan Nipun, 2022. Optimized municipal solid waste transportation with landfill requirement in a coastal city of Bangladesh. *Environ. Qual. Manag.* **31**: 197–210.

Asif, K., M.N. Chaudhry, U. Ashraf, I. Ali, M. Ali, 2020. A GIS-based multi-criteria evaluation of landfill site selection in lahore, Pakistan. *Polish J. Environ. Stud.* **29**: 1511–1521.

Avelino, C., C. Monteiro, C. Teixeira, F. Ferreira, 2019. Environmental and administrative EVIAVE-based approach for landfill siting. *Waste Manag. Res.* **37**: 941–950.

Babu, A.K., M.B. Chitra, 2025. Landfill Site Selection Directives: A Landscape-Centric Perspective in the Context of Kerala, in: Dashora, L.K., M. Firoz C, R. Shaw (Eds.), *Urban Sustainability: Navigating Environmental Transition Challenges in Global South. Springer Nature Singapore, Singapore* 339–361. https://doi.org/10.1007/978-981-96-4890-0_14

Barzehkar, M., N.M. Dinan, S. Mazaheri, R.M. Tayebi, G.I. Brodie, 2019. Landfill site selection using GIS-based multi-criteria evaluation (case study: SaharKhiz Region located in Gilan Province in Iran). *SN Appl. Sci.* **1**: 1–11.

Bechroune, W., L. Kherrour, L. Belaid, A. Goumrasa, 2024. GIS-MCDM integrated approach for suitable landfill site selection: a case study of the southwestern part of Bejaia Province, Algeria. *Environ. Monit. Assess.* **196**: 1262.

Bennett, G., 2024. Analysis of methods used to validate remote sensing and GIS-based groundwater potential maps in the last two decades: A review. *Geosystems and Geoenvironment* **3:** 100245.

Çelik, B., S. Girgin, A. Yazici, K. Ünlü, 2010. A decision support system for assessing landfill performance. *Waste Manag.* **30**: 72–81.

Chang, N. Bin, G. Parvathinathan, J.B. Breeden, 2008. Combining GIS with fuzzy multicriteria decision-making for landfill siting in a fast-growing urban region. *J. Environ. Manage.* **87**: 139–153.

Cheng, S., C.W. Chan, G.H. Huang, 2003. An integrated multi-criteria decision analysis and inexact mixed integer linear programming approach for solid waste management. *Eng. Appl. Artif. Intell.* **16:** 543–554.

Chowdhury, N.A., R. Ahmad, A. Ahmed, 2020b. Environmental Monitoring At and Around the Matuail **12**: 1–10.

Cleary, J., 2009. Life cycle assessments of municipal solid waste management systems: A comparative analysis of selected peer-reviewed literature. *Environ. Int.* **35**: 1256–1266.

Coban, A., I.F. Ertis, N.A. Cavdaroglu, 2018. Municipal solid waste management via multi-criteria decision making methods: A case study in Istanbul, Turkey. *J. Clean. Prod.* **180**: 159–167.

Colvero, D.A., A.P.D. Gomes, L.A. da C. Tarelho, M.A.A. de Matos, K.A. dos Santos, 2018. Use of a geographic information system to find areas for locating of municipal solid waste management facilities. *Waste Manag.* **77**: 500–515.

Costa, A.M., R.G. de S.M. Alfaia, J.C. Campos, 2019. Landfill leachate treatment in Brazil – An overview. *J. Environ. Manage.* **232**: 110–116.

Das, B.K., M.A. Kader, S.M.N. Hoque, 2014. Energy recovery potential from municipal solid waste in Rajshahi City by landfill technique. *Int. J. Renew. Energy Res.* **4**: 349–354.

David, E., J. Kopac, 2017. Recycling approaches of the aluminum dross to obtain useful products and to preserve raw material sources. *Int. J. Waste Resour.* **7**: 5211.

Delgado, O.B., M. Mendoza, E.L. Granados, D. Geneletti, 2008. Analysis of land suitability for the siting of inter-municipal landfills in the Cuitzeo Lake Basin, Mexico. *Waste Manag.* **28**: 1137–1146.

Demesouka, O.E., K.P. Anagnostopoulos, E. Siskos, 2019. Spatial multicriteria decision support for robust land-use suitability: The case of landfill site selection in Northeastern Greece. *Eur. J. Oper. Res.* **272**: 574–586.

Demesouka, O.E., A.P. Vavatsikos, K.P. Anagnostopoulos, 2013. Suitability analysis for siting MSW landfills and its multicriteria spatial decision support system: Method, implementation and case study. *Waste Manag.* **33**: 1190–1206.

Dey, A., S. Siddiqua, M.Z. Rahman, 2019. Suitability assessment using multicriteria spatial decision support system for the existing landfill sites of Chittagong City, Bangladesh. *Environ. Earth Sci.* **78**: 8707.

Ding, Z., M. Zhu, Z. Wu, Y. Fu, X. Liu, 2018. Combining AHP-entropy approach with GIS for construction waste landfill selection—A case study of Shenzhen. *Int. J. Environ. Res. Public Health* **15:** 2254.

Effat, H.A., M.N. Hegazy, 2012. Mapping potential landfill sites for North Sinai cities using spatial multicriteria evaluation. *Egypt. J. Remote Sens. Sp. Sci.* **15**: 125–133.

Eskandari, M., M. Homaee, S. Mahmodi, 2012. An integrated multi criteria approach for landfill siting in a conflicting environmental, economical and socio-cultural area. *Waste Manag.* **32**: 1528–1538.

Feo, G. De, S. De Gisi, 2014. Using MCDA and GIS for hazardous waste landfill siting considering land scarcity for waste disposal. *Waste Manag.* **34**: 2225–2238.

Gorsevski, P.V., K.R. Donevska, C.D. Mitrovski, J.P. Frizado, 2012. Integrating multi-criteria evaluation techniques with geographic information systems for landfill site selection: A case study using ordered weighted average. *Waste Manag.* **32**: 287–296.

Habib, M.A., M.M. Ahmed, M. Aziz, M.R.A. Beg, M.E. Hoque, 2021. Municipal solid waste management and waste-to-energy potential from Rajshahi City Corporation in Bangladesh. *Appl. Sci.* **11**: 3744.

Habiba, U., F. Haider, A. Ishtiaque, M.S. Mahmud, A. Masrur, 2011. Remote Sensing & GIS Based Spatio-Temporal Change Analysis of Wetland in Dhaka City, Bangladesh. *J. Water Resour. Prot.* **03**: 781–787.

Hasan, R.M., K. Tetsuo, A.S. Islam, 2009. Landfill demand and allocation for municipal solid waste disposal in Dhaka city-an assessment in a GIS environment. *J. Civ. Eng. Dhaka Univ. Dhaka* **1**: 18–26.

Hereher, M.E., T. Al-Awadhi, S.A. Mansour, 2020. Assessment of the optimized sanitary landfill sites in Muscat, Oman. *Egypt. J. Remote Sens. Sp. Sci.* **23**: 355–362.

Ibrahim Mohammed, H., Z. Majid, N. Bin Yusof, Y. Bello Yamusa, 2018. Analysis of Multi-Criteria Evaluation Method of Landfill Site Selection for Municipal Solid Waste Management. *E3S Web Conf.* **34:** 02010.

Ishii, K., T. Furuichi, Y. Nagao, 2013. A needs analysis method for land-use planning of illegal dumping sites: A case study in Aomori-Iwate, Japan. *Waste Manag.* **33:** 445–455.

Islam, F.A.S., 2016a. Solid Waste Management in Dhaka City. *J. Mod. Sci. Technol.* **4**: 192–209.

Islam, F.A.S., 2016b. Solid Waste Management in Dhaka City. *J. Mod. Sci. Technol.* **4**: 192–209.

Islam, M.A., S. Murshed, M. Hasan, 2020. Selecting suitable landfill site with multi-criteria evaluation and GIS: a case of Savar upazila in Bangladesh. *Arab. J. Geosci.* **13**: 5925.

Islam, R., K. Alim, A. Razi, R. Hasan, H. Hasan, S. Alam, 2013. Effect of Leachate on Surrounding Surface. *Glob. J. Res. Eng. Civ. Struct. Eng.* **13:** 10–17.

Islam, S., 2021. Urban Waste Management in Bangladesh: An Overview with a Focus on Dhaka. Presented at the 23rd ASEF Summer Univ.

JICA - (Japan International Cooperation Agency), 2005. The study on the solid waste management in dhaka city-clean Dhaka master plan 1–98.

Kabir, M.R., 2015. Municipal Solid Waste Management System: A Study on Dhaka North and South City Corporations. *J. Bangladesh Inst. Planners* **8**: 35–48.

Kalina, M., E. Tilley, 2020. Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19.

Karimi, N., A. Richter, K.T.W. Ng, 2020. Siting and ranking municipal landfill sites in regional scale using nighttime satellite imagery. *J. Environ. Manage.* **256**: 109942.

Kemal Korucu, M., B. Erdagi, 2012. A criticism of applications with multi-criteria decision analysis that are used for the site selection for the disposal of municipal solid wastes. *Waste Manag.* **32:** 2315–2323.

Khan, R., M.A. Hossain, 2024. A Critical Review on Solid Waste Management in Dhaka City. Proceedings of the 7th Int. Conf. Adv. Civ. Eng.

Khandaker, K.A.B.A.N.R., 2017. Municipal Solid Waste Landfill in Dhaka: A Sustainable Approach for Energy Generation. *Int. J. Sci. Res.* **6**: 377–381.

Kontos, T.D., D.P. Komilis, C.P. Halvadakis, 2005. Siting MSW landfills with a spatial multiple criteria analysis methodology. *Waste Manag.* **25**: 818–832.

Lee, C.K.M., C.L. Yeung, Z.R. Xiong, S.H. Chung, 2016. A mathematical model for municipal solid waste management – A case study in Hong Kong. *Waste Manag.* **58**: 430–441.

Linkov, I., F.K. Satterstrom, G. Kiker, C. Batchelor, T. Bridges, E. Ferguson, 2006. From comparative risk assessment to multi-criteria decision analysis and adaptive management: Recent developments and applications. *Environ. Int.* **32:** 1072–1093.

Majid, M., B.A. Mir, 2021. Landfill site selection using GIS based multi criteria evaluation technique. A case study of Srinagar city, India. *Environ. Challenges* **3**: 100031.

Mohamed Salih, Z.Q., R.W. Khalid, Q.I. Hamid, 2025. Decision Support Framework for Regional Landfill Site Selection Under Quintic Fuzzy Sets. *Oper. Res. Forum* **6**: 60.

Mohammed, H.I., Z. Majid, Y.B. Yamusa, 2019. GIS based sanitary landfill suitability analysis for sustainable solid waste disposal. *IOP Conf. Ser. Earth Environ. Sci.* **220:** 012056.

Mojiri, A., L. Ziyang, R.M. Tajuddin, H. Farraji, N. Alifar, 2016. Co-treatment of landfill leachate and municipal wastewater using the ZELIAC/zeolite constructed wetland system. *J. Environ. Manage.* **166:** 124–130.

Motlagh, Z.K., M.H. Sayadi, 2015. Siting MSW landfills using MCE methodology in GIS environment (Case study: Birjand plain, Iran). *Waste Manag.* **46**: 322–337.

Mujibor Rahman, M., K. Ruksana Sultana, M. Ahasanul Hoque, 2008. Suitable Sites for Urban Solid Waste Disposal Using Gis Approach in Khulna City, Bangladesh. *Proc. Pakistan Acad. Sci* **45**: 11–22.

Mussa, A., K.V. Suryabhagavan, 2021. Solid waste dumping site selection using GIS-based multi-criteria spatial modeling: a case study in Logia town, Afar region, Ethiopia. *Geol. Ecol. Landscapes* **5:** 186–198.

Oakley, S.M., R. Jimenez, 2012. Sustainable sanitary landfills for neglected small cities in developing countries: The semi-mechanized trench method from Villanueva, Honduras. *Waste Manag.* **32**: 2535–2551.

Omar, N.Q., S.M. Ali, I.J. Naser, S.Q. Aziz, I.A. Omar, 2025. Integrating Remote Sensing, GIS, and AHP Analysis for Sustainable Erbil Landfill Site Selection, in: Karkush, M., D. Choudhury, M. Fattah (Eds.), *Current Trends in Civil Engineering and Engineering Sciences 2024, Springer Nature Singapore, Singapore* **1**: 405–415.

Pasalari, H., R.N. Nodehi, A.H. Mahvi, K. Yaghmaeian, Z. Charrahi, 2019. Landfill site selection using a hybrid system of AHP-Fuzzy in GIS environment: A case study in Shiraz city, Iran. *MethodsX* **6**: 1454–1466.

Paul, K., A. Dutta, A.P. Krishna, 2014. A comprehensive study on landfill site selection for Kolkata City, India. *J. Air Waste Manag. Assoc.* **64**: 846–861.

Pires, A., G. Martinho, N. Bin Chang, 2011. Solid waste management in European countries: A review of systems analysis techniques. *J. Environ. Manage.* **92**: 1033–1050.

Quantity, A.S.O.N., Q.O.F. Leachate, O.F. Matuail, S. Landfill, 2010. A Study on Quantity and Quality of Leachate of Matuail Sanitary Landfill.

Rahman, M.M., D.M. Ershad, 2022. Site Suitability Analysis for a Satellite Town of Khulna City Using Gis: a Case Study. *Khulna Univ. Stud.* **8**: 79–86.

Rikalovic, A., I. Cosic, D. Lazarevic, 2014. GIS based multi-criteria analysis for industrial site selection. *Procedia Eng.* **69**: 1054–1063.

Roy, H., S.R. Alam, R. Bin-Masud, T.R. Prantika, M.N. Pervez, M.S. Islam, V. Naddeo, 2022. A Review on Characteristics, Techniques, and Waste-to-Energy Aspects of Municipal Solid Waste Management: Bangladesh Perspective. *Sustain.* **14**: 10265.

Sánchez-Lozano, J.M., J. Teruel-Solano, P.L. Soto-Elvira, M. Socorro García-Cascales, 2013. Geographical Information Systems (GIS) and Multi-Criteria Decision Making (MCDM) methods for the evaluation of solar farms locations: Case study in south-eastern Spain. *Renew. Sustain. Energy Rev.* **24**: 544–556.

Şener, Ş., E. Şener, B. Nas, R. Karagüzel, 2010. Combining AHP with GIS for landfill site selection: A case study in the Lake Beyşehir catchment area (Konya, Turkey). *Waste Manag.* **30:** 2037–2046.

Serajul, M., I. Farzeen, F. Islam, 2017. Spatial Disparity of Groundwater Depletion in Dhaka City. Presented at the 15th Int. Conf. Environ. Sci. Technol.

Sharifi, M., M. Hadidi, E. Vessali, P. Mosstafakhani, K. Taheri, S. Shahoie, M. Khodamoradpour, 2009. Integrating multi-criteria decision analysis for a GIS-based hazardous waste landfill sitting in Kurdistan Province, western Iran. *Waste Manag.* **29**: 2740–2758.

Shekdar, A.V., 2009. Sustainable solid waste management: An integrated approach for Asian countries. *Waste Manag.* **29**: 1438–1448.

Sin, T.J., G.K. Chen, G.H. Hwang, 2016. Challenges in selecting a sustainable landfill site in Malaysia. *MATEC Web Conf.* **47**: 05021.

Sinden, J., P. Downey, O. Cacho, S. Hester, 2013. Cost effectiveness in site selection to protect native plant communities from the weed, bitou bush, in New South Wales, Australia. *J. Environ. Manage.* **128**: 1071–1080.

Singh, A., 2019. Remote sensing and GIS applications for municipal waste management. *J. Environ. Manage.* **243**: 22–29.

Singh, R.K., M. Datta, A.K. Nema, 2009. A new system for groundwater contamination hazard rating of landfills. *J. Environ. Manage.* **91**: 344–357.

Stemn, E., B. Kumi-Boateng, 2019. Hazardous waste landfill site selection in Western Ghana: An integration of multi-criteria decision analysis and geographic information system. *Waste Manag. Res.* **37:** 723–736.

Sultana, M.S., G.M. Tarekul Islam, Z. Islam, 2009. Pre- and Post-Urban Wetland Area in Dhaka City,Bangladesh: A Remote Sensing and GIS Analysis. *J. Water Resour. Prot.* **01:** 414–421.

Sumathi, V.R., U. Natesan, C. Sarkar, 2008. GIS-based approach for optimized siting of municipal solid waste landfill. *Waste Manag.* **28**: 2146–2160.

Tavares, G., Z. Zsigraiová, V. Semiao, 2011. Multi-criteria GIS-based siting of an incineration plant for municipal solid waste. *Waste Manag.* **31**: 1960–1972.

Tenodi, S., D. Krčmar, J. Agbaba, K. Zrnić, M. Radenović, D. Ubavin, B. Dalmacija, 2020. Assessment of the environmental impact of sanitary and unsanitary parts of a municipal solid waste landfill. *J. Environ. Manage.* **258**: 110019.

Torabi-Kaveh, M., R. Babazadeh, S.D. Mohammadi, M. Zaresefat, 2016. Landfill site selection using combination of GIS and fuzzy AHP, a case study: Iranshahr, Iran. *Waste Manag. Res.* **34**: 438–448.

Turkyilmaz, A., M. Guney, F. Karaca, Z. Bagdatkyzy, A. Sandybayeva, G. Sirenova, 2019. A comprehensive construction and demolition waste management model using PESTEL and 3R for construction companies operating in central Asia. *Sustain.* **11**: 1593.

Ud din, S., R.P. Oskui, M.B. Dusseault, A.N. Al Ghadban, 2009. Multi-criteria evaluation technique for SFI site identification of NORMS and oil industry waste disposal - Possibilities in Kuwait. *J. Environ. Manage.* **91**: 186–194.

Ullah, M.S., M.E. Enan, 2016. Landuse and Land Cover Change in Dhaka Metropolitan Area During 1991-2022. *Orient. Geogr*. **60**: 1–18.

Unal, M., A. Cilek, E.D. Guner, 2020. Implementation of fuzzy, Simos and strengths, weaknesses, opportunities and threats analysis for municipal solid waste landfill site selection: Adana City case study. *Waste Manag. Res.* **38**: 45–64.

Urme, S.A., M.A. Radia, R. Alam, M.U. Chowdhury, S. Ahmed, 2021. Europe PMC Funders Group Dhaka landfill waste practices: addressing urban pollution and health hazards **2**: 700–716.

Vidya, K.M., A.N. Manoharan, B. Suchitra, M. Shyni, 2024. Combination of remote sensing, GIS, AHP techniques and geophysical data to delineate groundwater potential zones in the Shiriya River Basin, South India. *Geosystems and Geoenvironment* **3**: 100294.

Wang, G., L. Qin, G. Li, L. Chen, 2009a. Landfill site selection using spatial information technologies and AHP: A case study in Beijing, China. *J. Environ. Manage.* **90**: 2414–2421.

Wang, G., L. Qin, G. Li, L. Chen, 2009b. Landfill site selection using spatial information technologies and AHP: A case study in Beijing, China. *J. Environ. Manage.* **90**: 2414–2421.

Yildirim, V., 2012. Application of raster-based GIS techniques in the siting of landfills in Trabzon Province, Turkey: A case study. *Waste Manag. Res.* **30**: 949–960.

Yong, Z.J., M.J.K. Bashir, C.A. Ng, S. Sethupathi, J.W. Lim, 2018. A sequential treatment of intermediate tropical landfill leachate using a sequencing batch reactor (SBR) and coagulation. *J. Environ. Manage.* **205**: 244–252.

(Revised copy received on 28/06/2026)