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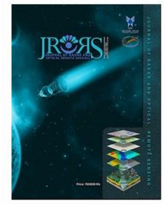

Spatial Suitability Analysis for Urban Waste Disposal Using GIS and AHP (Case Study: Aalishahr City)

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ABSTRACT

Objective: To assess the spatial suitability of landfill site locations in Aalishahr City using GIS and the Analytic Hierarchy Process (AHP), aiming to identify environmentally sound and socially acceptable alternatives to the current landfill.

Methods: A descriptive-analytical approach was used to evaluate seven spatial indicators: slope, elevation, distance from urban areas, villages, roads, rivers, and fault lines. Spatial data were obtained from USGS (30m DEM), OpenStreetMap, and Google Earth. GIS software (ArcGIS 10.8) was employed to generate and classify thematic layers. An expert-based AHP model was applied using pairwise comparisons to derive weights for each criterion, which were integrated into a weighted overlay analysis to produce a landfill suitability map.

Results: The AHP analysis revealed that slope and distance from settlements (urban >6000 m; village >3000 m) were the most critical factors, while proximity to fault lines and rivers had lower relative importance. The existing landfill site—located 1.9 km east of the city with steep slopes and high elevation—was deemed unsuitable due to risks of leachate runoff and proximity to growing residential areas. Two optimal locations were identified in the southern and southeastern regions of Aalishahr, meeting all environmental and infrastructural suitability thresholds.

Conclusion: Integrating GIS with AHP provides a robust framework for landfill site selection in rapidly developing urban areas like Aalishahr. The current landfill site fails to meet key suitability criteria, while the proposed locations offer environmentally safer and socioeconomically viable alternatives. Future waste management planning should consider long-term urban expansion and integrate scenario forecasting, environmental monitoring, and machine learning tools to enhance spatial decision-making accuracy.

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Introduction

Urbanization has significantly impacted the environment at local, regional, and global scales (Barredo & Demicheli, 2003). Cities worldwide have experienced population growth at various rates and times (Majumdar & Sivaramakrishnan, 2020), and currently, over half of the global population resides in urban areas (United Nations, 2014). This rapid urban expansion, especially in developing countries, has introduced new challenges and increasing demands on infrastructure and environmental management systems (Hadili et al, 2011; Kabir & Khan, 2020).

One of the most critical issues emerging from urban growth is the management of municipal solid waste (Chauhan & Singh, 2016). In many developing Asian countries, ineffective waste management has led to significant health, environmental, and economic risks (Sharholy et al, 2007). Improper disposal practices have also contributed to soil and water contamination, pest infestations, and decreased quality of life for nearby residents (Askarian et al, 2004). From a sanitary engineering standpoint, landfill development is a complex, multi-stage process that requires careful planning and design (Ajtamaei et al, 2018). However, in many municipalities, the concept of a "sanitary landfill" is often misinterpreted as merely digging a pit, filling it with waste, and covering it with soil-neglecting essential environmental and technical considerations.

Given these challenges, appropriate site selection for waste disposal has become a critical component of urban planning (Pasalari et al, 2016). By integrating spatial analysis and expert-driven criteria, cities can minimize environmental risks and reduce operational costs associated with waste management (Asefi et al, 2020; Alokhande et al, 2020).

Aalishahr city, located in Bushehr Province, Iran, faces serious challenges in the location and management of its waste disposal site. The existing landfill is poorly located, potentially increasing risks to nearby ecosystems and human settlements. An optimal landfill site should meet multiple criteria to minimize harm across environmental, social, and economic dimensions.

The purpose of this study is to conduct a comprehensive spatial assessment of landfill site suitability in Aalishahr using Geographic Information Systems (GIS) and the Analytic Hierarchy Process (AHP). Through literature review, field observation, and expert consultation, this research addresses the following objectives:

To evaluate and analyze the spatial suitability of the current waste disposal site in Aalishahr.

To propose optimal alternative locations for landfill development based on environmental and urban growth considerations.

Several prior studies have employed similar spatial and multi-criteria techniques. For example, Naibi and Moeen al-Dini (2023) applied a weighted pairwise comparison and

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TOPSIS model to select a transfer station in Karaj, Iran. Jalilian et al. (2021) used the SWARA, COPRAS, and GIS methods to identify optimal landfill sites in Kermanshah. Similarly, Al-Karadaghi et al. (2019) used WLC and GIS models in Sulaymaniyah, Iraq, while Aghdasi Zad et al. (2019) used AHP and GIS to identify 60% of Hamidieh County as suitable for landfilling.

Building on these approaches, this study applies a spatial multi-criteria analysis to support sustainable waste management planning in Aalishahr.

Despite the growing body of research on waste disposal site selection, many studies highlight the necessity of adapting location criteria to local environmental, infrastructural, and socio-political contexts. The reviewed literature confirms that site suitability analysis commonly relies on multi-criteria decision-making (MCDM) techniques such as AHP, SWARA, COPRAS, and WLC, often integrated with Geographic Information Systems (GIS) for spatial analysis. These approaches allow for systematic evaluation of numerous environmental and logistical factors. Among the most frequently used indicators are slope, elevation, distance from settlements, proximity to roads and water bodies, and geological hazards such as fault lines-all of which play vital roles in environmental safety, accessibility, and public health. However, many previous studies focus either on large metropolitan areas or lack precision in aligning criteria weights with local development trends. In the case of Aalishahr, a rapidly expanding planned city, the absence of an appropriately located sanitary landfill poses an urgent challenge. This reinforces the need for a context-specific spatial evaluation model that prioritizes key physical and environmental indicators, accounts for projected urban growth, and integrates expert judgment through structured decision-making models such as AHP. The current study aims to address this gap by offering a replicable, GIS-based evaluation framework tailored to Aalishahr’s unique geographical and urban conditions.

Materials and Methods

2.1. Study Area

Alishahr is a city in the central district of Bushehr County in Bushehr Province. Alishahr is a contemporary city whose establishment (new city) dates back to 1986. The city is located 20 kilometers east of Bushehr Port. The limitations of the physical development of Bushehr on the peninsula, considering the deployment of various military units including the bases of the Air Force, Navy and Revolutionary Guards, as well as the protection of the Bushehr Nuclear Power Plant, necessitated the location and design of a new city in a suitable and accessible location. Accordingly, the new city of Alishahr was designed and prepared in 1986 with a projected capacity of about 100,000 people and an area of about 900 hectares (Figure 1).

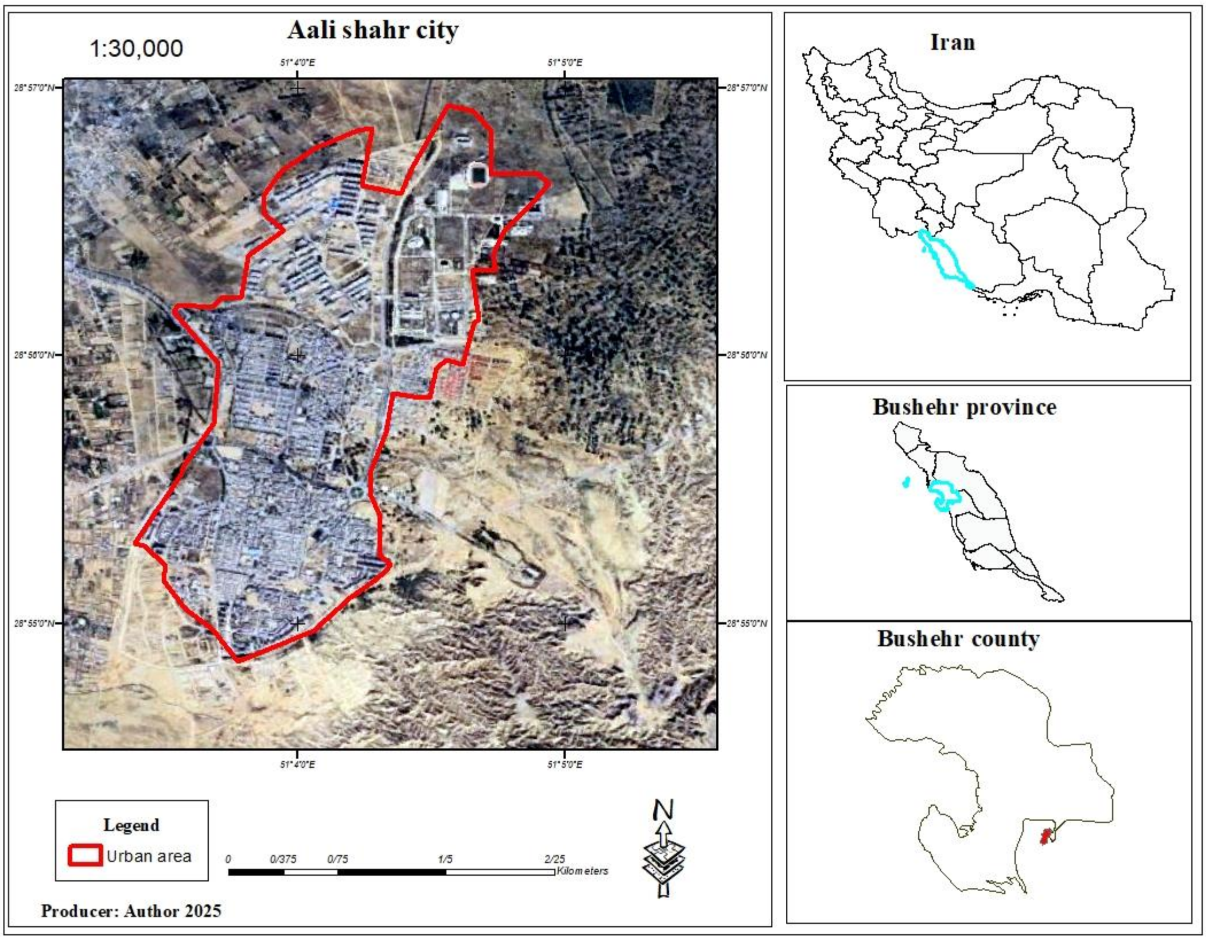

Figure 1- Location of Bushehr city

2.2. Method

The present study is classified as descriptive-analytical in terms of methodology. Data collection was carried out through both library research and field investigations. Relevant quantitative and spatial information was obtained from municipal departments, environmental agencies, and national and global geospatial databases. According to data provided by Aalishahr Municipality, the city currently generates approximately 35–40 tons of municipal solid waste per day, consisting mainly of household organic waste (≈65%), plastics (≈15%), paper and cardboard (≈10%), and other materials such as glass, metal, and hazardous substances (≈10%). Waste is primarily collected through curbside pickup and transported to a landfill site located east of the city, which lacks proper environmental safeguards and monitoring.

To obtain topographic data such as elevation, slope, and watercourse lines, a 30-meter resolution Digital Elevation Model (DEM) from the United States Geological Survey (USGS)

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was utilized. Road network data was extracted from OpenStreetMap (OSM), while satellite imagery from Google Earth was used to determine land use and the spatial extent of urban development. GIS software (ArcGIS 10.8) was employed to generate spatial layers and analyze suitability zones.

For the spatial evaluation of the landfill site, seven key environmental and infrastructural indicators were selected based on literature review and standard environmental regulations (see Figure 2). These indicators included: slope, elevation, distance from urban and rural settlements, distance from roads, proximity to rivers, and distance from active fault lines. Each indicator was classified and standardized in GIS, and an expert questionnaire using a 1 to 7 Saaty scale was distributed to specialists in environmental planning and waste management. The Analytic Hierarchy Process (AHP) was used to derive the weights of each criterion through Expert Choice software, allowing for multi-criteria evaluation and prioritization in the final suitability mapping.

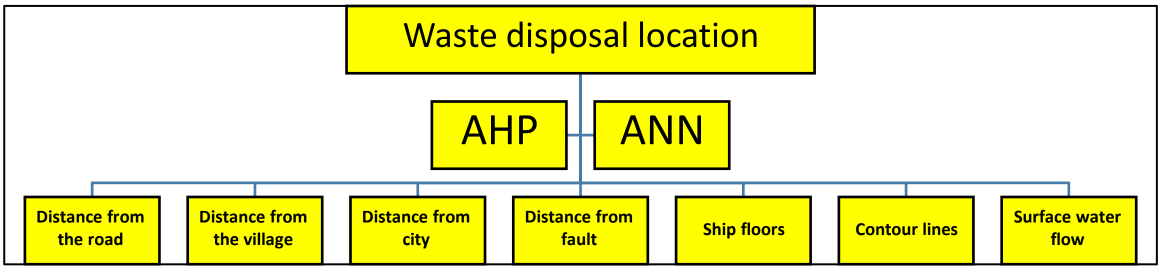

Figure 2- Indicators considered for waste landfill location

Results

3.1. Survey of the location of the waste site

The current waste site and landfill of Aalishahr city is located at 42 54 28 North and 05 05 16 East, approximately 1.9 kilometers from the current area and to the east of the city. Considering the development of the city from the east, the survey and new location of this site is important.

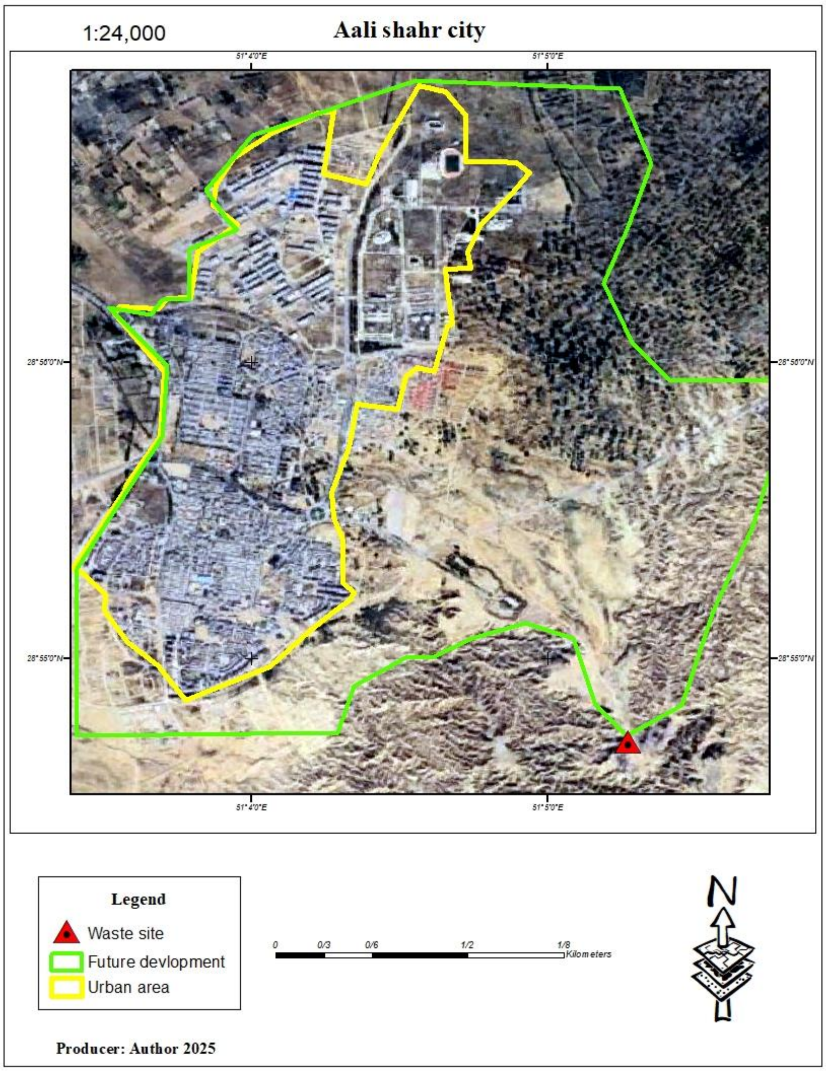

Figure 3- Map of the current situation of Aalishahr city

3.2. Investigation of waste site location indicators

In terms of topography, the city of Aalishahr exhibits higher elevations in its eastern sectors, which gradually decrease toward the northern and western parts. The current waste disposal site is located in the eastern uplands, approximately 1,000 meters higher in elevation than the city center (Figure 4). From a hydrological standpoint, slope plays a significant role in surface runoff dynamics: as slope increases, time of concentration decreases, leading to higher runoff velocity and greater peak discharge (Adinehvand et al, 2006). For landfill siting, slope is a critical constraint, as steep terrains complicate leachate management during rainfall and increase the cost of road and infrastructure construction (Farhoudi et al, 2005). Consequently, the steep eastern zones of Aalishahr are deemed unsuitable for landfill development due to physical and economic limitations (Figure 5).

Additionally, the Tangestan Heights fault, located 2,000–3,000 meters from the landfill site, poses a latent geotechnical risk. Although this distance is currently within acceptable safety margins (Figure 6), long-term tectonic activity and groundwater infiltration risks require future monitoring. The area’s elevated eastern zones also contain numerous natural

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waterways draining toward the city's southern and western surroundings, intensifying concerns over potential leachate dispersion (Figure 7).

From an infrastructural and public health perspective, the landfill must maintain optimal proximity to road networks-ideally between 750 meters and 1,000 meters-to minimize transportation costs without causing visual intrusion or odor-related discomfort (Keshavarzi Shirazi et al, 2012; Figure 8). Moreover, the site should maintain sufficient buffer zones from residential and rural settlements to mitigate health hazards, air and water pollution, vermin infestation, and land devaluation (Keshavarzi Shirazi et al, 2012). Current spatial analysis shows that population centers are more concentrated in the northwest and east of Aalishahr, reinforcing the unsuitability of these zones for waste disposal (Figures 9 and 10, Table 1).

Looking ahead to 2045, projected urban growth patterns and population expansion suggest increasing development pressure toward the northwest and southern belts of the city. Therefore, the strategic foresight in landfill siting requires selecting zones with minimal conflict potential, resilient topography, and long-term hydrological and geological stability. Future site suitability must integrate dynamic risk modeling, buffer expansion, and adaptive infrastructure planning to ensure environmental compliance and urban livability for decades to come.

Table 1: Indicator Classification and Threshold Values for GIS & AHP-Based Landfill Site Selection

Situation	Height (Elevation above sea level) to meters	Distance from Slope percentage (meters)	Distance from Fault (meters)	Distance from river (meters)	Distance from road (meters)	Distance from city (meters)	Distance from village (meters)
Perfectly suitable	Below 1000	0-5	Above 3000	Above 6000	Above 1000	Above 6000	Above 3000
Suitable	1200-1000	10-5	2000-3000	4000-6000	750-1000	4000-6000	3000-2000
Unsuitable	1500-1200 meters	15-10	1000-2000	2000-4000	500-750	2000-4000	1000-2000
Completely unsuitable	Above 1500	Above 15	0-1000	0-2000	0-500	0-2000	1000-0

Source: Jafari et al, 2012; Hejazi, 2015; and Firouzi and Amanpour, 2011

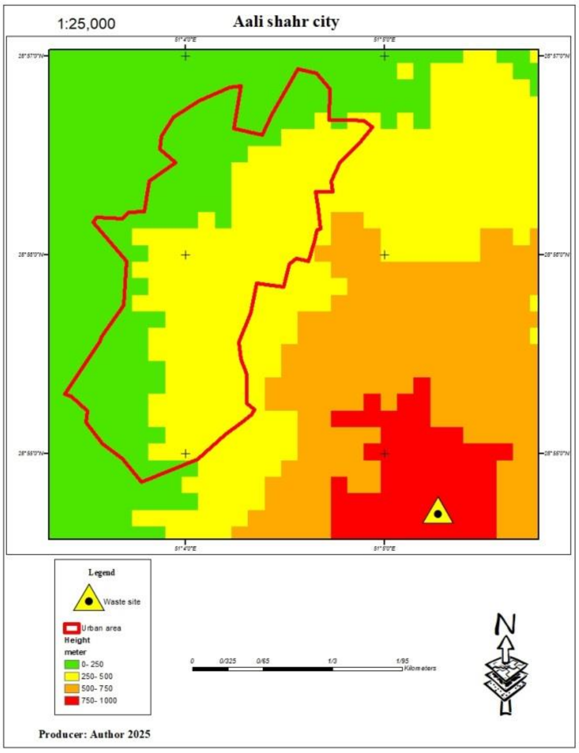

Figure 4- Altitude classes

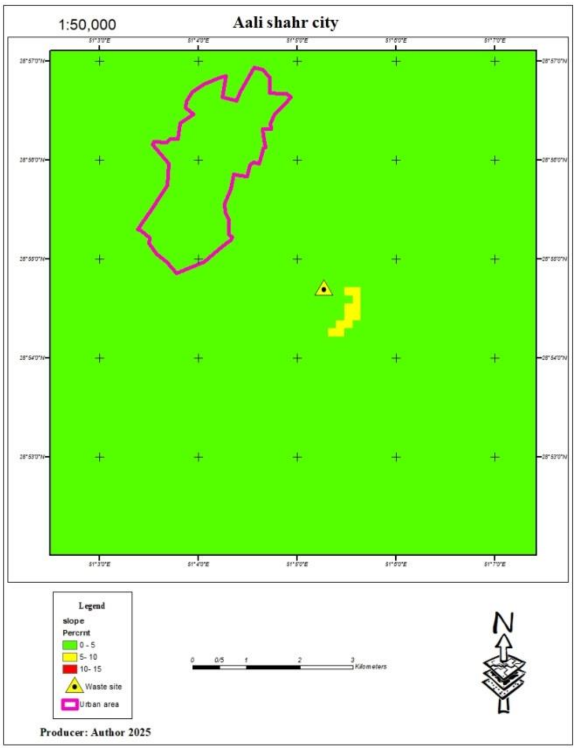

Figure 5- Slope percentage

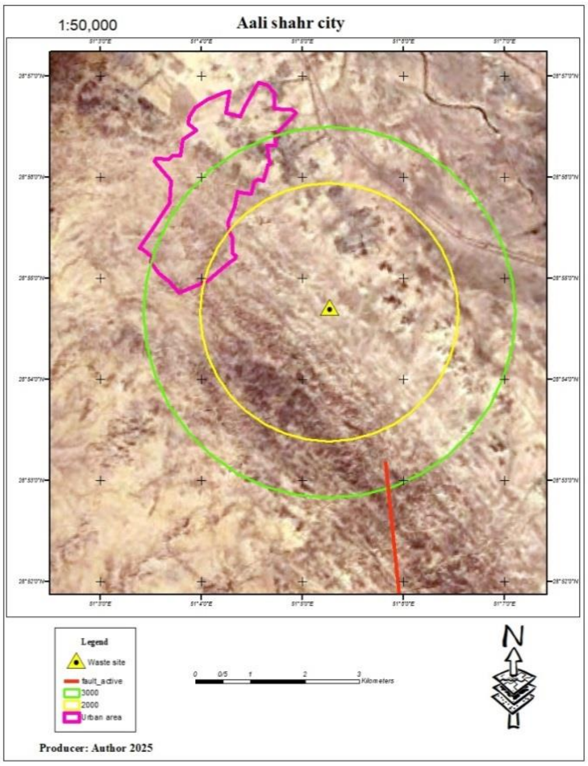

Figure 6- Distance from the fault in the study area

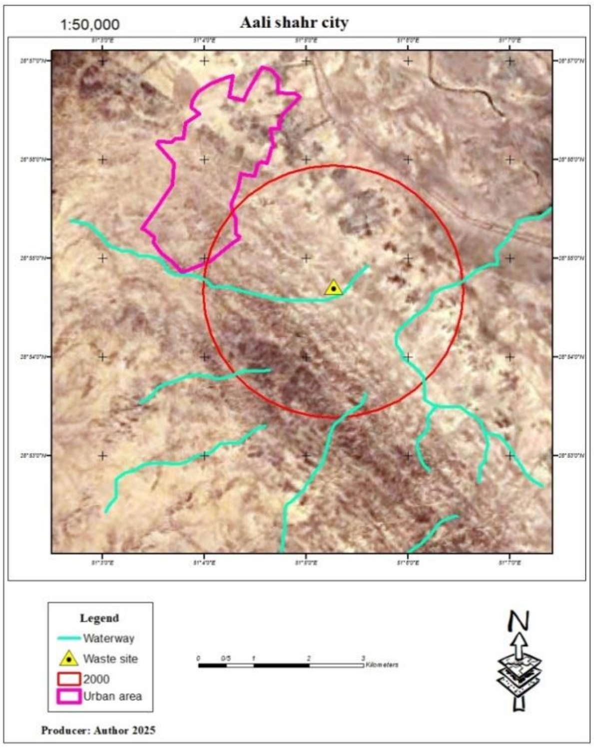

Figure 7- Distance from the waterway in the study area

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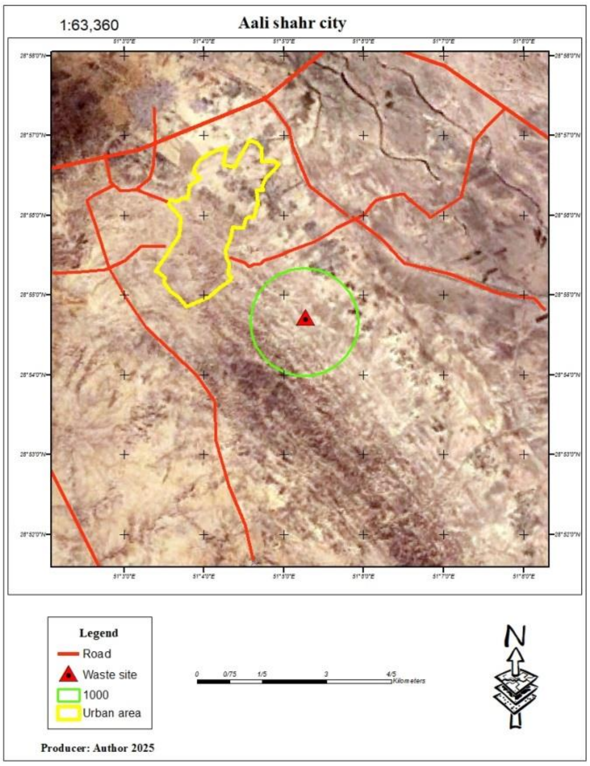

Figure 8- Distance from the road in the study area

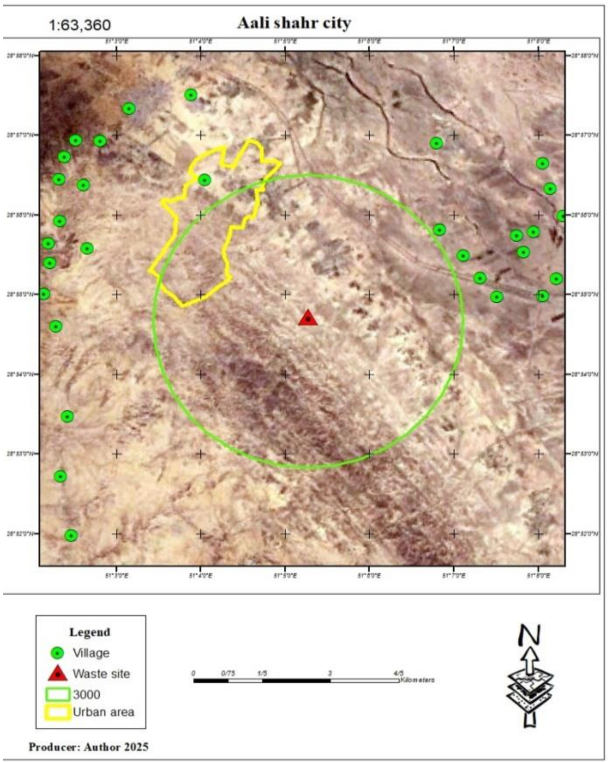

Figure 10- Distance from the village in the study area

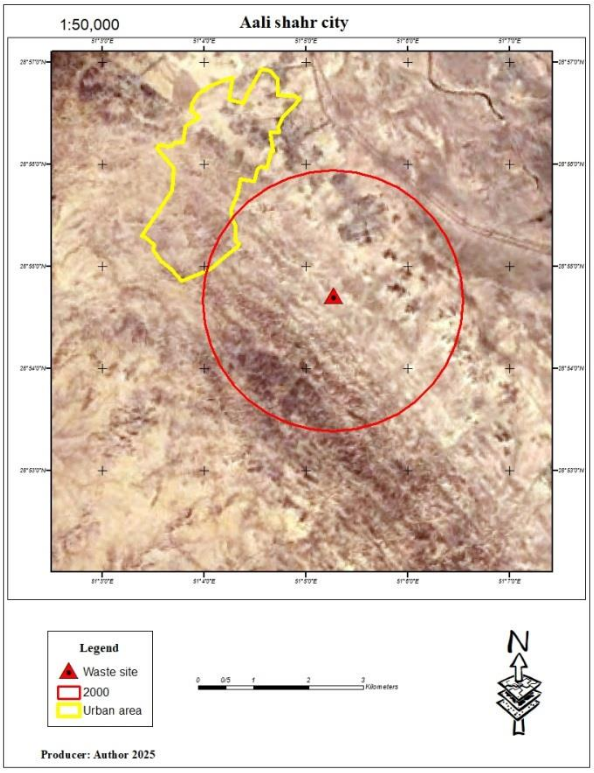

Figure 9- Distance from the city in the study area

3.3. Hierarchical Hierarchy Technique (AHP)

According to the results obtained from the experts in the AHP model, the two factors slope and distance from the city and village are respectively in the highest priority and distance from the fault and distance from the river are in the lowest priority (Table 2 and Figure 11).

Table 2: Prioritization of the indicators in the AHP model by experts

Elevation	**1**						
Slope percentage	**1**	**1**					
Fault	**4**	**4.1**	**1**				
Distance from river	**3.2**	**2.3**	**6**	**1**			
Distance from road	**1.6**	**1.5**	**5**	**2.3**	**1**		
Distance from city	**1.2**	**2.2**	**2.1**	**2.1**	**1**	**1**	
Distance from village	**1.3**	**3.1**	**3**	**2**	**1**	**1**	**1**
	Elevation	**Slope percentage**	**Fault**	**Distance from river**	**Distance from road**	**Distance from city**	**Distance from village**

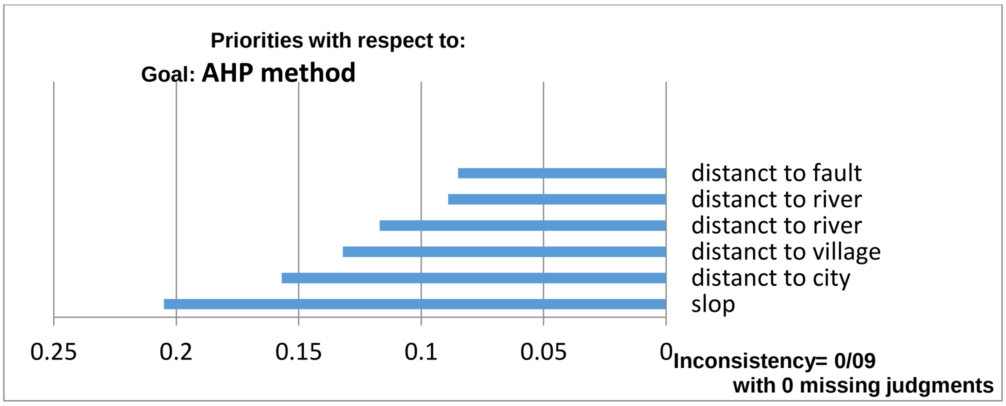

Figure 11- Weighting resulting from the AHP model

In the results obtained from the AHP analysis, although slope and elevation are considered significant indicators in the landfill site selection process, the relative weight assigned to slope does not singularly determine site suitability. Despite the generally favorable slope and elevation conditions in the eastern, northern, and western surroundings of Alishahr, these areas were ultimately deemed unsuitable for landfill development. This unsuitability stems from several compounding factors-namely, the presence of watercourses, high rural

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settlement density, and proximity to populated areas-each of which carries considerable weight in the AHP decision-making structure.

In the AHP model, slope is assigned a meaningful weight due to its direct impact on leachate flow, erosion, and construction costs. Steeper slopes can accelerate leachate runoff and increase environmental risks, while flat or gently sloped areas provide better containment and infrastructural feasibility. However, when slope is analyzed in conjunction with other spatial and environmental criteria-such as proximity to fault lines, settlements, water resources, and road access-its overall influence on the final site suitability ranking can be moderated.

Therefore, although slope alone might classify certain regions as topographically suitable, their closeness to villages, active water networks, and fault lines-as observed in the eastern, northern, and western sectors-renders them inappropriate. Conversely, the southeastern and parts of the southern and southwestern zones exhibit a combination of favorable slope, sufficient distance from critical environmental and human features, and suitable elevation, making them optimal zones for landfill siting. Furthermore, the evaluation of the existing landfill location, as interpreted through the AHP model, confirms that it fails to meet the multi-criteria suitability standards required for environmentally sound waste disposal (Figure 12).

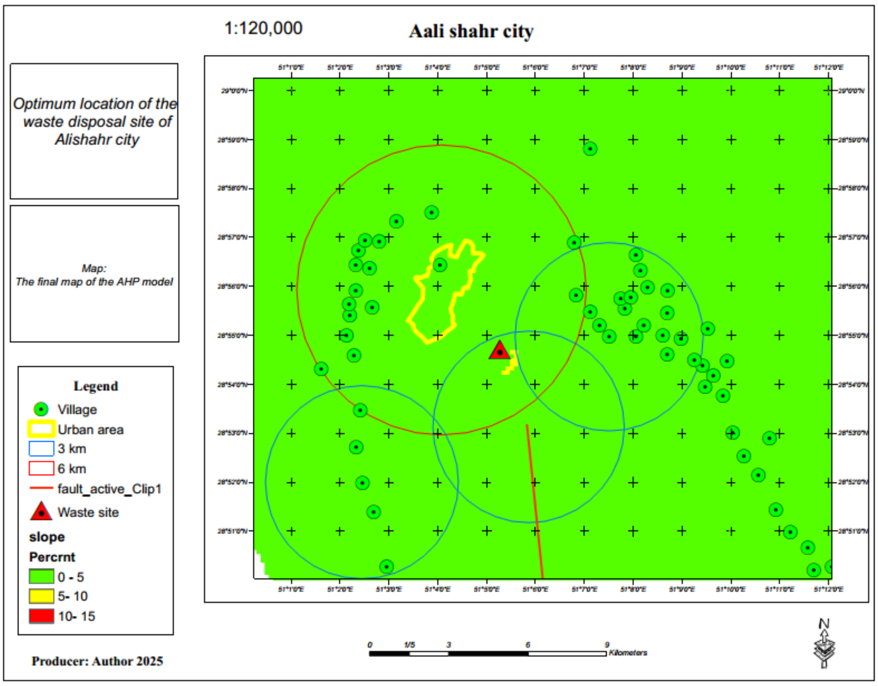

Figure 12- Final map resulting from the AHP technique

3.4. Suggested points resulting from the AHP technique

A: Spatial Prioritization and Suitability Analysis

Based on the outputs of the Analytical Hierarchy Process (AHP), the most suitable areas for waste landfill location in Alishahr were identified primarily in the southern and southeastern regions of the city. These areas were selected due to their optimal combination of physical, environmental, and socio-economic criteria, such as appropriate elevation levels, lower population density, distance from residential areas and watercourses, and minimal proximity to fault lines. Compared to other parts of the city, these zones demonstrated a balanced topographical structure with manageable slope gradients, which reduces the risk of leachate contamination and supports the development of necessary infrastructure.

B: Inadequacy of the Current Landfill Site

The AHP-based spatial analysis further revealed that the current waste disposal site—located in the eastern highlands of Alishahr—is highly unsuitable. Although the site benefits from higher elevations, the steep slope classes, proximity to rural settlements, and presence of multiple water channels render it environmentally and economically unviable. The analysis indicated that the leachate from this elevated area could potentially flow towards urban or agricultural zones, especially during heavy rainfall, posing a threat to groundwater and surface water resources. Additionally, the long transportation distance from the main access roads increases the operational cost of waste transfer.

C: Long-term Planning and Development Orientation

The proposed sites align with the city's future development trajectory, which is expected to expand toward the southern and eastern directions by 2045. Therefore, strategic site selection based on the AHP model not only resolves the current inadequacies of waste disposal but also ensures long-term compatibility with urban growth, transportation planning, and land use policies. The chosen zones are situated at a safe distance—typically 1000 to 3000 meters—from villages and geological fault lines, adhering to national and international standards. These findings emphasize the importance of integrating multi-criteria decision-making methods such as AHP into municipal waste management planning to achieve sustainable and resilient urban systems.

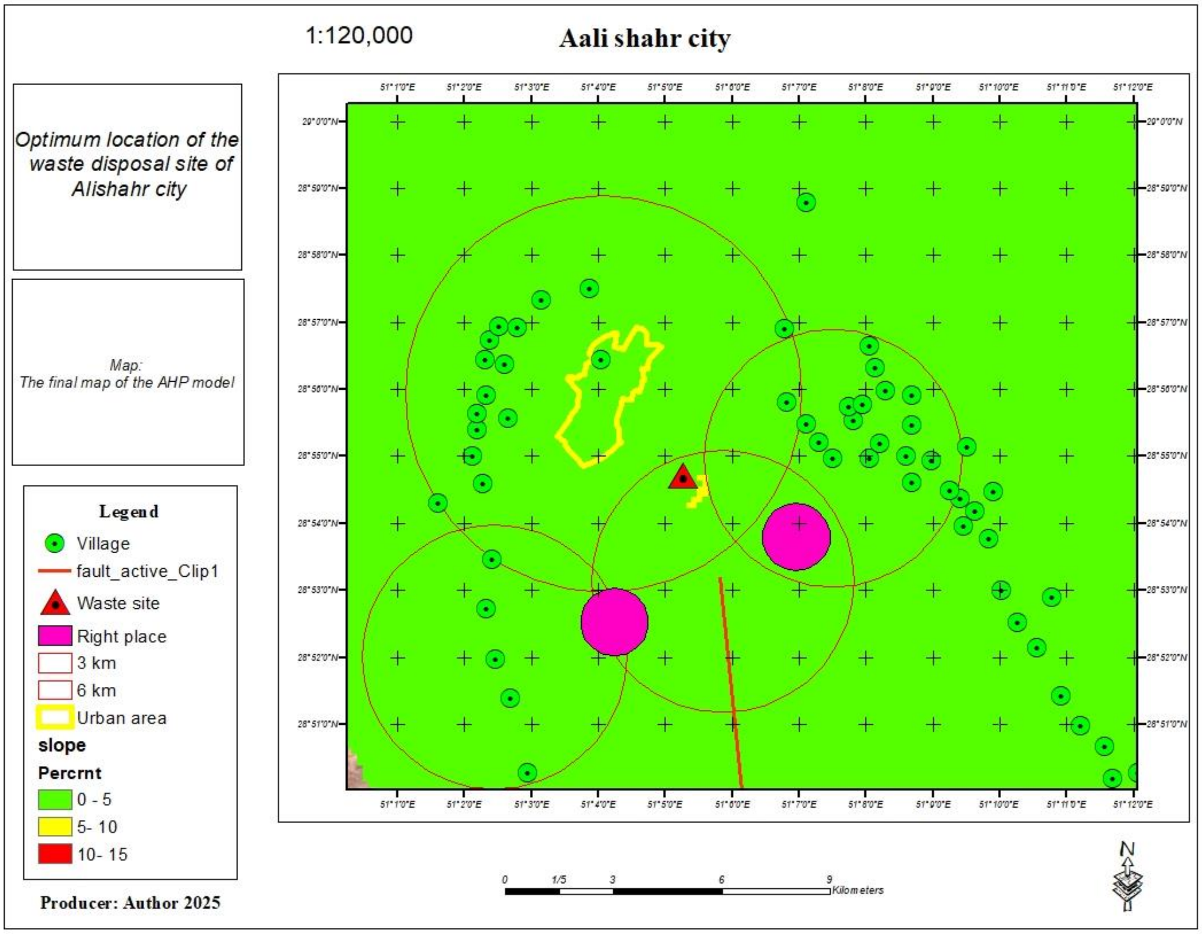

Figure 13- Map of suggested points resulting from the AHP technique

4. Conclusion

In this study, in addition to identifying suitable locations for municipal waste disposal in Alishahr, an evaluation of the current landfill site was also conducted. The location analysis was carried out using Geographic Information Systems (GIS) and the Analytic Hierarchy Process (AHP) model based on seven key indicators. The findings from the AHP analysis revealed that the eastern, northern, and western regions of Alishahr are among the most unsuitable areas for waste landfill development. This unsuitability is primarily due to several critical factors:

- **Proximity to rural settlements:**

These areas are densely populated by rural communities. Establishing a landfill near residential or agricultural zones poses risks of odor nuisance, groundwater contamination, land devaluation, and public dissatisfaction, all of which contribute to social and environmental unsuitability.

- **Proximity to the city center and asphalt roads:**

Although nearness to road networks can reduce transportation costs (an economic consideration), excessive proximity to urban and peri-urban areas leads to visual pollution, unpleasant odors, and decreased land value, thus creating economic and social conflict. Proper landfill siting requires balancing transport efficiency with acceptable buffering distance from populated and high-traffic areas.

- **Presence of active faults:**

The Tangestan Heights fault is located southeast of Alishahr. Although the current site is between 2000 to 3000 meters from the fault, the general proximity to fault lines increases the risk of leachate infiltration into fractured strata, threatening groundwater quality. From a geo-environmental perspective, areas with known tectonic activity must be excluded or assigned lower suitability.

From an economic standpoint, landfill development in regions with steep slopes, complex access routes, or high potential for conflict with nearby land uses results in increased infrastructure and mitigation costs. Conversely, the southern and southeastern regions of the city demonstrate a favorable balance of all factors: they are sufficiently distanced from settlements and faults, lie at acceptable elevations and slopes, and maintain accessibility without infringing on populated zones.

According to the results of the AHP model, two locations in the southern and southeastern parts of Alishahr were identified as optimal sites for landfill development (Figure 13). These sites were not only selected based on current conditions but also considering the future urban expansion trajectory, which is oriented toward the south and east. This forward-looking approach ensures that the landfill site remains functional, accessible, and non-intrusive in the medium- to long-term planning horizon (up to 2045).

5. Future Recommendations

5.1. Integrate Machine Learning with AHP and GIS for Enhanced Precision

To improve the accuracy and robustness of landfill site suitability models, future research should explore the fusion of machine learning (ML) techniques—such as Random Forest, Support Vector Machine, and Gradient Boosting—with AHP and GIS frameworks. These supervised models can learn from existing spatial and environmental datasets to predict suitability scores across the landscape, allowing identification of nonlinear patterns and interactions that traditional AHP may not capture. Training such models on validated site data (e.g, known suitable and unsuitable zones) can yield superior classification accuracy, while the interpretability of AHP ensures stakeholder trust in decision criteria.

5.2. Incorporate Urban Growth and Scenario Forecasting

Given ongoing urban expansion toward the south and east of Aalishahr, future studies should integrate dynamic scenario modeling, such as Land Use–Land Cover (LULC) change simulations, paired with population growth projections up to 2045. By combining spatial-temporal modeling with real estate and urban planning datasets, researchers can evaluate how changing land uses, infrastructure corridors, and socio-economic development may influence long-term landfill site suitability. This approach supports adaptive planning by verifying that proposed landfill sites remain optimal under different future growth scenarios.

5.3. Utilize Multi-Temporal Environmental Monitoring and Risk Assessment

To ensure environmental compliance and operational sustainability, it is recommended that future studies incorporate multi-temporal environmental monitoring, such as groundwater sampling, soil analysis, and surface water quality measurements at proposed and existing sites. Coupling this empirical evidence with risk assessment techniques—for instance, probabilistic modeling of contaminant transport or failure analysis—can refine suitability criteria and threshold intervals. Additionally, the use of remote sensing tools (e.g. multispectral imagery for vegetation stress, thermal anomalies) can help detect signs of early environmental disturbance, enabling proactive management of landfill-related risks.

These recommendations aim to expand the methodological depth of landfill site selection studies, enhance predictive reliability, and align environmental planning with evolving urban conditions.

Author Contributions

- **Conceptualization:** Khadije Ranjbar, Ali Almodaresi
- **Methodology:** Khadije Ranjbar
- **Software (GIS, AHP modeling):** Khadije Ranjbar
- **Validation:** Ali Almodaresi
- **Formal analysis:** Khadije Ranjbar
- **Investigation:** Khadije Ranjbar
- **Data curation:** Khadije Ranjbar
- **Visualization (maps, figures):** Khadije Ranjbar
- **Writing – Original Draft:** Khadije Ranjbar
- **Writing – Review & Editing:** Ali Almodaresi
- **Supervision:** Ali Almodaresi

Data Availability Statement

The spatial datasets used in this study were obtained from publicly accessible sources, including the United States Geological Survey (USGS), OpenStreetMap, and Google Earth. Municipal waste data were provided by Aalishahr Municipality upon request. Derived GIS layers and AHP model outputs generated during the current study are available from the corresponding author upon reasonable request.

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Ethical considerations

This study did not involve any human participants, animal subjects, or experiments requiring ethical approval. All data used were obtained from publicly available sources or provided by authorized institutions. The research was conducted in accordance with ethical standards for academic integrity and responsible data use.

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Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Appendix A: Method of Satellite Image Analysis

To support spatial analysis and land use classification, satellite imagery was employed using the following procedure:

1. **Image Source and Type:**
   Landsat 8 OLI/TIRS satellite imagery with a spatial resolution of 30 meters was obtained from the USGS Earth Explorer platform. For higher-resolution visual interpretation and digitization of urban features, Google Earth images (2023–2024) were also used.

2. **Preprocessing Steps:**

- **Georeferencing:** All images were projected to the WGS 1984 UTM Zone 39N coordinate system.
- **Radiometric and Atmospheric Correction:** Landsat imagery underwent radiometric calibration and atmospheric correction using the FLAASH module in ENVI software.
- **Clipping:** The images were clipped to the administrative boundary of Bushehr City using the shapefile provided by the municipal planning department.

3. **Land Use Classification:**
   A hybrid classification approach was used:
   - **Supervised classification** was conducted using the Maximum Likelihood Algorithm in ArcGIS 10.8, based on training samples collected through field visits and Google Earth digitization.
   - **Visual interpretation** was applied to refine ambiguous areas and adjust boundary lines between classes.

4. **Accuracy Assessment:**
   Ground truth data (collected during field surveys in early 2024) and high-resolution Google Earth images were used for validation. An error matrix was constructed, and the overall classification accuracy was found to be approximately 89%, with a Kappa coefficient of 0.85.

5. **Extraction of Spatial Indicators:**
   From the classified image, land use layers were extracted and used as constraints in the landfill site selection model. Additionally, slope and elevation layers were generated from a 30m DEM (USGS SRTM) using the Spatial Analyst tools in ArcGIS.

References

Adinehvand, A., Karimi, H., & Azadkhani, P. (2016). Analysis of the landfill site of Khorramabad city, Master's thesis. Bakhtar Ilam Higher Education Institute.

Aghdasi Zad, R., Dashti, S., & Morshedi, J. (1398). Identification of suitable areas for urban waste disposal using spatial analysis (case study: Hamidieh County) Health and Development, Volume 8, Issue 4, 305-321.

Ajtamai, A., Rabiei, L., Rokrok, K., & Babaki, M. (2018). Site selection for urban solid waste disposal using GIS (Case study: Ghaemshahr) Human Geography Research Quarterly, 50(4), 751–778.

Al-Karadaghi, K., Ali, S. S., Al-Ansari, N., Laue, J., & Chabuk, A. (2019). Landfill site selection Sulaimaniyah governorate, the in GIS and MCDM methods using Iraq. Sustainability, 11(17), 4530.

Alokhande, T., Kote, A., & Mali, S. (2020). Integration of GIS and AHP-ANP Modeling for Landfill Site Selection for Nagpur City, India. In Recent Developments in Waste Management (pp. 499-510. Springer, Singapore.

Asefi, H., Zhang, Y., Lim, S., & Maghrebi, M. (2020). An integrated approach to suitability assessment of municipal solid waste landfills in New South Wales, Australia. Australasian Journal of Environmental Management, 27(1), 63-83.

Askarian, M., Vakili, M., & Kabir, G. (2004). Hospital waste management status in university hospitals of the Fars province, Iran. International Journal of Environmental Health Research, 14(4), 295-305.

Barredo, J. I., & Demicheli, L. (2003). Urban sustainability in developing countries' megacities: modelling and predicting future urban growth in Lagos. Cities, 20(5), 297-310.

Chauhan, A., & Singh, A. (2016). A hybrid multi-criteria decision making method approach for selecting a sustainable location of healthcare waste disposal facility. Journal of Cleaner Production, 139, 1001-1010.

Farhoudi, R., Habibi, K., & Zandi-Bakhtiari, P. (2005). Site selection for municipal solid waste landfills using fuzzy logic and GIS: A case study of Sanandaj City. Honar-e-Ziba Journal, (23), 15–24.

Firouzi, M., & Amanpour, S. (2011). Locating the landfill site of urban waste using a geographic information system (GIS) (case study of Lamerd city) Journal of Advanced Applied Geology, No. 1, Vol. 1, 112 – 104.

Hadili, B., Pourmohammadi, M., & Kord, Q. (2012). Management and location of solid waste in urban areas using GIS (Noshahr city study area) Master's thesis, University of Tabriz.

Hejazi, S. A. (2015). Locating the landfill site of urban waste using spatial information techniques and hierarchical analysis, a case study of Maragheh city. Scientific and Research Journal of Geography and Planning, 2019, No. 54, 105 – 125.

Jalilian, S., Ardakani, S., Cheraghi, M., Munavari, S. M., & Lorestani, B. (2021). Locating urban solid waste landfills using SWARA, COPRAS and Geographic Information System (GIS) methods, case study: Kermanshah city. Environmental Health Engineering, Volume 9, Issue 1, 41-58.

Kabir, Z., & Khan, I. (2020). Environmental impact assessment of waste to energy projects in developing countries: General guidelines in the context of Bangladesh. Sustainable Energy Technologies and Assessments, 37, 100619.

Keshavarzi Shirazi, M., Taleb, J. B., & Bidakhti, N. (2012). Locating construction waste landfills (case study of cities in Fars province), Master's thesis, Shiraz University.

Majumdar, S., & Sivaramakrishnan, L. (2020). Mapping of Urban Growth Dynamics in Kolkata Metropolitan Area: A Geospatial Approach. In Urbanization and Regional Sustainability in South Asia (pp. 9-24. Springer, Cham.

Naibi, M., & Moeen al-Dini, M. (2023). Locating the waste transfer station in Karaj city, Alborz province, Journal of Natural Environment, Volume 76, Issue 1, 29-41.

Nations U. (2014). World urbanization prospects: The 2014 revision, highlights. Department of Economic and Social Affairs.

Pasalari, H., Nodehi, R. N., Mahvi, A. H., Yaghmaeian, K., & Charrahi, Z. (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.

Sharholy, M., Ahmad, K., Vaishya, R. C., & Gupta, R. D. (2007). Municipal solid waste characteristics and management in Allahabad, India. Waste management, 27(4), 490-496.