AN ANALYSIS OF SUITABLE LANDFILL SITE FOR AKURE SOUTH LOCAL GOVERNMENT AREA USING GIS

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ABSTRACT

This study was carried out to determine places that are suitable to site new landfills within Akure South local government since the current ones are no longer suitable where they were located. This objective was achieved by employing the TOPSIS multi-criteria decision model. Ten decision criteria were used in a GIS environment in order to generate the overall suitability map. These criteria include: land use/land cover, elevation, slope, soil, geology, well points, water ways, built-ups, existing dumpsites and road network. The suitability map showed that the existing dumpsites were sited in an unsuitable location. It also showed that 61% of the study area is not suitable which covers about 191km^2, while 5% is moderately suitable and about 33% is found suitable which covers 101km^2. The result indicated that suitable sites were majorly in areas outside the city such as Ita Oniyan, Ita Oniga, Oke Agbe, Alademehin and Adun with south of Akure city such as Kajola and Egbeda. Therefore, it was recommended that necessary action should be taken by the planning management to ensure that the existing dumpsites were evacuated from within the city and for new landfills to create in order to reduce the resulting effects from landfill hazards.

Keywords: Landfill, Dumpsite, Suitability, TOPSIS and MCDA

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1 | Introduction

Garbage disposal remains a major environmental challenge worldwide. Landfilling, the burial of trash in abandoned quarries or dug pits, is the predominant waste management strategy globally. About 71% of municipal solid waste is landfilled (Shahabuddin *et al.* 2024). Well-designed, maintained landfills can provide a clean, safe disposal option. However, poor practices create pollution risks.

Waste refers to any discarded, unwanted material from daily human activities. It encompasses municipal refuse, industrial byproducts, demolition debris and more. Anything no longer useful is considered waste, also called trash, garbage, junk or litter (Prajapati, *et al.* 2021). Solid waste generation has grown with population expansion, economic growth, urbanization and industrialization. Developed and developing nations alike face waste management challenges (Bilgilioglu, *et al.* 2022). Inadequate waste evacuation from dumps creates unsanitary conditions and health hazards. Indiscriminate dumping provides breeding grounds for disease-carrying pests like flies, rodents and mosquitoes. These transmit deadly illnesses including

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typhoid, malaria, cholera and leishmaniasis, which plague Nigeria and Africa. Unhygienic environments particularly endanger outdoor workers, those handling infectious materials, and vulnerable children.

Landfill siting was once complex and time-consuming. However, geographic information systems (GIS) have enabled systematic, technical site selection (Eliawa, 2022). GIS powerfully retrieves, stores, analyzes, and displays spatial data. It integrates diverse datasets to support environmental management and infrastructure planning decisions. As a tool for pollution control and conservation, GIS's role in analyzing suitability is critical.

The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is a numerical multi-criteria decision making (MCDM) method developed by Hwang and Yoon (1981) (Hwang and Yoon, 1981). It selects alternatives based on their Euclidean distances from ideal and anti-ideal solutions. TOPSIS is a simple, clear technique that effectively solves MCDM problems by ranking alternatives by their relative closeness to an ideal solution. It is one of the most popular classical MCDM methods (Papathanasiou and Ploskas, 2018).

TOPSIS has wide applications in areas like energy, water resources, environment, human resources, business, and marketing. It can analyze trade-offs, incorporate subjective judgments, provide transparency, and enable data-driven analysis. This makes it a useful framework for decision-makers facing complex problems with multiple criteria. Integrating TOPSIS MCDM with GIS has been applied in several studies for spatial decision analysis (Mitra, 2023). By leveraging TOPSIS' systematic weighting and ranking abilities within a GIS environment, decision-makers can identify and prioritize locations for prevention and mitigation actions.

In addition, the TOPSIS MCDM method provides an effective, organized framework to support complex spatial decisions. Combined with GIS, it equips decision-makers with a powerful data-driven tool for evidence-based policymaking.

Current estimates reveal that 36 million tons of solid waste are generated annually in Nigeria. The rising rate of globalization has led to a sharp increase in the daily volume of solid waste generated in our cities, making solid waste management a major environmental and public health issue for developing country governments. Valuable urban development land has been converted into dumping sites or landfills. High population density in human settlements has the capacity to produce large volumes of waste. How refuse dump sites and waste disposal planning have impacted the aesthetics and development of cities, and the local impacts of dump site locations warrants examination. The rate at which municipal solid waste is generated in dumpsites in Ondo State, Nigeria, which is rapidly urbanizing, has been escalating tremendously in recent years. Babayemi & Dauda, (2009) pointed out that shortages of innovative technologies and equipment for segregation and collection, flaws and gaps in solid waste management strategies and implementation, low environmental awareness and low-income levels among the populace, are reasons behind the dire waste crisis. The lack of a detailed land use plan has obstructed effective waste disposal, damaged aesthetics, and posed serious health challenges for residents (Olukanni *et al*., 2014).

This study aims to verify the suitability of refuse dump site locations in Akure South Local Government Area and provide solution for where the new locations of the dump sites should be located using the TOPSIS multi-criteria decision

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model. The objectives of this study are to:

i. determine the proximity between the existing dumpsites, residential areas and well points within the study area,
ii. identify hazards associated with the existing dumpsites
iii. Analyze the suitability of existing dumpsite locations
iv. Generate suitability map which will indicate highly suitable areas, moderately suitable and less suitable to a new dumpsite / landfill.

2.0 | Study Area Description

Ondo State lies in southwestern Nigeria between latitudes 7°10′N and 5°05′E and longitudes 06°48'00"E and 06°80'00"E. It covers approximately 15,500 km^2 (6,000 square miles) with a population around 3.5 million. The state has 18 local government areas and borders several other Nigerian states and the Atlantic Ocean to the south.

The capital is Akure, formerly the capital of the historic Akure Kingdom and located in Akure South Local Government (Figure 1). The climate is tropical wet and dry. Average annual temperature is 28.4°C, slightly below Nigeria's mean. Ondo receives around 183 mm (7 inches) of rain annually, with precipitation likely on 273 days yearly.

Ondo holds deposits of various mineral resources including bitumen, coal, dimension stone, feldspar, gemstones, glass sand, granite, gypsum, kaolin, limestone and petroleum. Extraction of these resources contributes to the state's economy.

3 | Methodology

3.1 | Description of Data and Sources

The study adopted the field survey method and

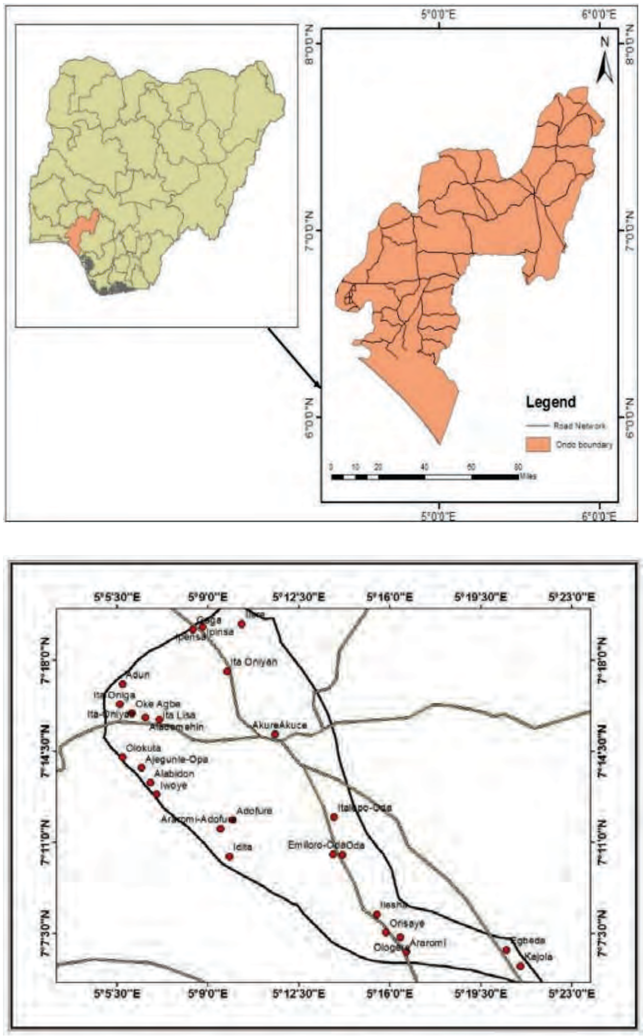

Figure 1: Study area map

other sources of data, which include existing soil data, road network data, hydrology data, land use data and study area shapefile. All the above datasets were collected, manipulated and analyzed in a GIS environment, which was used for further analysis. The field survey involves visiting the existing dumpsite in order to take the coordinates and some land-use references for image classification, as shown in Table 1.

3.2 | Data Processing and Analysis

3.2.1 | Data processing of various criteria

Multi-temporal Sentinel image; 2022 was processed with ArcMap 10.7, and the image was enhanced for visualization purposes; the boundary of the study area was also extracted from the full

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Table 1 | Data Source and Attributes

Data	Source	Year	Resolution	Relevance
LANDSAT ETM+	USGS	2016	30m	To generate the land use factor
DEM	Shuttle Radar Topographic	-	30m	To generate slope factor
Soil map	FAO	2015	Resampled to 30m	To generate soil factor
Geology map	USGS		Resampled to 30m	To generate the geology factor
Road map	Ancilliary data			To generate road factor
Administrative map	Ancilliary data			Extract the boundary of the study area
Questionnaires		2023		Environmental hazard

scene. Maximum Likelihood Classifier was used to produce different land use/land cover (LULC) maps, after which the built-ups were extracted. The soil data collected was entered into Excel and used to create a database of soil types. A digital elevation model (DEM) of 30m resolution was also imported into ArcGIS software to derive different raster layers, which include slope, flow direction, and flow accumulation.

To determine a potential location suitable and sustainable for the dumpsite, the multi-criteria evaluation (MCE) and overlay operations were adopted, which include the creation of factors maps, Euclidean distance analysis, reclassification, and weighted overlay. Ten criteria were used, which include: Land use, Elevation, Geology, Existing dumpsites, Slope, built-up area, Soil, Roads, Well points and Waterway. The distances were measured based on the adopted standard in this study. Each parameter considered has a different Euclidean distance (EPA, 2016), and these were used to determine the buffer zones and varying degrees of suitability within each layer as shown in Tables, and these were used to determine the buffer zones and varying degrees of suitability within the layer, as shown in Table 2. Reclassification was carried out so as to create a single ranked map of potential dumpsites. The values of classes between layers were compared by assigning numeric values to classes within each map layer. Measuring all values on the same numeric scale gives it equal importance in determining the most suitable locations; in this study, the numeric weight from 1-4 was selected for all the parameters based on the criteria. The coordinates of the existing dumpsites collected from fieldwork were imported into ArcGIS 10.7 as a text file and then converted to a shape file to show the suitability of the locations of the existing dumpsites.

3.2.2 | TOPSIS

The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is a discrete multi-criteria decision-making (MCDM) technique that requires integration with Geographic Information

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Table 2 | Constraint Criteria (Derived from EPA Landfill Manual, 2006)

Criteria	Unsuitable	Least Suitable	Moderately Suitable	Highly Suitable
Distance from Built-up	Less than 300m	300m - 500m	500m - 800m	> 800m
Geology	Sand stone	Metamorphic		Igneous rock
Distance from Road	Less than 100m	> 2000m	1000m - 2000m	100m - 1000m
Distance from water body	Less than 160m	160m - 480m	480m - 960m	> 960
Distance to groundwater	0 – 3000m	3000 – 7000m	7000 – 11000m	>11000
Distance to existing dumpsite	0 – 3000m	3000 – 7000m	7000 – 11000m	>11000
Land use	Built-ups & Water bodies	Vegetation and wet lands	Outcrop	Bare land
Elevation	0-5.5m	5.5 – 9.9m	9.9 – 17.3m	>17.3m
Slope	Area > 15^o	10^0 - 15^0	5^0 - 10^0	0^0 - 5^0
Soil	Area with alluvial soil		Alisols	Alisols

Systems (GIS) for spatial modeling. In this study, TOPSIS was coupled with ArcGIS to develop a landfill suitability map. As global waste management challenges intensify, the combination of optimization techniques with GIS has become increasingly critical for making informed, evidence-based decisions.

To begin, thematic layers were constructed for each suitability criterion. Spatial databases were developed for ten key factors, represented as vector and raster themes, and all layers were resampled to ensure uniform resolution. The integration of these layers facilitated the extraction of values necessary for TOPSIS computations.

Stratified random point generation was employed to enhance spatial coverage and statistical rigor while maintaining computational efficiency. Specifically, 1,000 random points were evenly distributed across the study area using ArcGIS Data Management Tools. The "Extract Multi Values to Points" function in ArcGIS Spatial Analyst was utilized to retrieve values from the ten thematic layers for each point. By mapping these extracted points, spatial variability, redundancy, and potential biases were assessed, improving the reliability of the dataset. The extracted values were subsequently transferred to an Excel database for further calculations within the TOPSIS framework.

One of the critical components of the TOPSIS methodology is assigning weights to each criterion. In this study, weights were determined based on expert opinions, ensuring that the most influential factors in landfill siting were

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appropriately prioritized. The assigned weights were as follows: geology (4%), soil (6%), existing dumpsites (6%), well points (5%), built-up areas (15%), road networks (10%), stream networks (8%), land use (18%), slope (14%), and elevation (14%).

The TOPSIS analysis proceeded with the construction of a decision matrix, where the collected data were organized for computation. The decision matrix was then normalized using vector normalization, following Equation (1):

$$\bar{X}_{ij} = \frac{Xij}{\sqrt{\sum_{i=1}^{n} X_{ij}^2}} \quad (1)$$

Each raw value in the matrix was squared, summed, and square-rooted to produce a denominator for normalization. This process transformed the dataset into a comparable scale, ensuring consistency across criteria.
Once normalized, the data were weighted using Equation (2):

$$V_{ij} = \bar{X}_{ij} \times W_j \quad (2)$$

where $\bar{X}_{ij}$ represents the normalized value and W_j is the assigned weight for each criterion. The multiplication of these values produced the weighted normalized matrix, which was subsequently used to identify the ideal best and worst values.

The ideal best (A+) and ideal worst (A−) values were determined for each criterion following Equations (3) and (4):

$$A^+ = \{V_1^+, V_2^+, \ldots, V_j^+, \ldots, V_n^+\} \quad (3)$$

$$A^+ = \{(\text{MAX } V_{ij} \mid j \in) . (MIN\ V_{ij} \mid j \in J_2) \mid\} \quad (4)$$

$$A^- = \{V_1^-, V_2^-, \ldots, V_j^-, \ldots, V_n^-\} \quad (5)$$

$$A^- = \{(\text{MIN } V_{ij} \mid j \in J_1) . (MAX\ V_{ij} \mid j \in J_2) \mid\} \quad (6)$$

In this study, there were 14 beneficial criteria, where higher values indicated more suitability, and 4 non-beneficial criteria, where lower values were preferred. For beneficial criteria, the highest weighted normalized value among the 1,000 sample points was selected as A+, while the lowest was chosen as A−. The reverse applied to non-beneficial criteria, where A+ was the lowest value and A− the highest.

Subsequently, the Euclidean distances from the ideal best and worst values were computed using Equations (7) and (8):

$$S_j^+ = \sqrt{\sum_{i=1}^{n} \left(V_{ij} - V_j^+\right)^2} \quad (7)$$

$$S_j^- = \sqrt{\sum_{i=1}^{n} \left(V_{ij} - V_j^-\right)^2} \quad (8)$$

Where: V_{ij} is the value from the weighted normalized matrix V_{+j} is the ideal best value V-j is the ideal worst value
These calculations, executed in Excel, provided essential metrics for evaluating landfill suitability. The final step involved calculating the performance score (P*i* values), which measures the relative closeness of each location to the ideal solution. The performance score was determined using Equation (9):

$$Pi = \frac{S_i^-}{S_i^+ + S_i^-} \quad (9)$$

Where S_i^- represents the Euclidean distance from the ideal worst value and S_i^+ represents the Euclidean distance from the ideal best value. Locations with the highest *Pi* values were ranked as the most suitable for landfill siting.
The spatial distribution of suitability scores was then visualized using GIS. The computed S_i^+, S_i^-, and *Pi* values were exported from Excel and imported into ArcGIS. The "Add XY Data" function was used to map these values, ensuring

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proper georeferencing within the projected coordinate system (WGS_1984_UTM_Zone_32N). To produce the final landfill suitability map, the Inverse Distance Weighting (IDW) interpolation technique was employed, generating continuous spatial representations of suitability across the study area.

By integrating GIS with the TOPSIS MCDM approach, this study provides a systematic and objective framework for landfill siting, ensuring environmentally and socially sustainable waste management solutions.

4.0 | Results and Discussion

4.1 | Hazards Associated with Dumpsites

It was revealed from field investigation that all forms of waste are being brought to the dumpsite without prior sorting. Questionnaires were administered in order to find out some major hazards the existing dumpsite has caused to the people living in the environment. The majority of the respondents are male, and the hazard identified include air pollution, odor, well water pollution, pest breeding such as flies, mosquitos and frequent malaria. From the data obtained from the respondents, the major hazards experienced by the people due to the dumpsite include air pollution, odor and pest breeding (Table 3).

Table 3 | Types of hazards discovered in the study (Author's Analysis, 2023)

Hazard Type	Female	Male
Air pollution	10	42
Odor	8	40
Well water Pollution	5	28
Pest breeding (flies, mosquitos, etc)	12	43
Frequent fever / malaria	4	21

4.2 | Criteria / Factor Used

4.2.1 | Geology

The geology of the study area was extracted from the geology Africa which was gotten from USGS. The predominant geology was that of the Precambrian age which is known as the igneous rock. This type of rock covered the whole study area. Since igneous rocks are majorly known for their low permeability, therefore it is highly suitable for siting of Africa, which was gotten from USGS. The predominant geology was that of the Precambrian age, which is known as igneous rock. This type of rock covered the whole study area. Since igneous rocks are majorly known for their low permeability, they are highly suitable for sitting a landfill.

4.2.2 | Soil Type

Figure 3 the soil varieties that is contained in the study area. Clay textured soil (Dystric Nitosols/Eutric Nitosols) was most preferred for dumpsite because it is impermeable to leachate, i. e, it causes reduvtion in the amount of liquid contaminant which will enter the soil / ground in the study area. Clay-textured soil (Dystric Nitosols/Eutric Nitosols) was most preferred for dumpsites (Table 4) because it is impermeable to leachate, i.e., it reduces the amount of liquid

Table 4 | Soil type present in the study area (Source: Author's Analysis, 2023)

Type	Value	Percentage
Ferric Luvisols	High	95.8986
Eutric Nitosols	Very High	4.101395

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contaminant that will enter the soil/ground.

Table 5 | Percentage of land use in the study area (Source: Author's Analysis, 2023)

Value	Percentage
Very low (Built ups, wetland, waterbody)	45.55316
Low (vegetation)	37.23493
Moderate (outcrops)	7.644882
Very High (bare gorund)	9.567029

4.2.3 | Land use

Five major classes were classified which include; vegetation, built-up area, bare ground, outcrops, wetland and water body (Figure 2). These were classified according to their suitability in Table 5. Table 5: Percentage of land use in the study area (Source: Author's Analysis, 2023)

4.2.4 | Distance to existing wells

The proximity of a solid waste dump site to a groundwater well point is an important environmental criterion in the dump site selection so that well points may be protected from the runoff and discharge. Also, in order to prevent contamination from pollutant, solid waste disposal sites should be away from wells. As shown in the Figure 4, most of the existing wells were located within the city, especially within the built up areas indicating its prominence as an important utility within the area.

4.2.5 | Distance to streams

This shows the position of the river and other water bodies in the study area (Figure 5). As shown in the map, the local government is home to different stream channels which increases the probability for contamination, especially those closer to existing dumpsites. Waste disposed close to streams or any water body will cause water pollution or contamination because there would be seepage of leachate from the wastes into the water body. Therefore, a dumpsite must not be located close to stream and rivers in order to avert vulnerability to ground and surface water pollution from contamination.

4.2.6 | Distance to existing Dumpsite

A landfill is expected to be located far from an existing one so as to create a significant amount of gap between them so as to avoid creating a kind of menace to the people in that environment. Also, not creating a significantly sufficient distance between the existing dumpsite and a new one could increase the chances of the two merging together, this will cause an increase in environmental pollution and health hazards. In this study buffer zones of 0 – 3000m, 3000 – 7000m, 7000 – 11000m, 11000 – 19000m and >19000m were created and used for the analysis (Figure 6). The resulting map was classified into five classes which are very low, low, moderate, high and very high respectively (Figure 6).

4.2.7 | Distance to Road Network

A dumpsite must be located close to the road network for easy accessibility in order to reduce relative costs such as transportation costs. It is also worthy of note that dumpsite is not expected to be too close to residential areas because if it is close, it could cause an increase in the environmental impact on those residing in that location. Therefore, it is expected that a landfill is sited not too far from the road and not too close to residential areas or built-ups. The minimum and maximum distance from the road network for this study was set to be between 1000 – 3000m is suitable, while

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less than 1000m and greater than 3000m is considered unsuitable (Figure 7).

Table 6 | Percentage of distance to building (Source: Author's Analysis, 2023)

Value	Percentage
Very low	22.67852
Low	24.71085
Moderate	14.64248
High	14.51162
Very High	23.45653

4.2.8 | Distance to Building

Environmental issues such as offensive odor, air pollution, noise, and pest breeding, which could affect the overall health of people living in the area could occur. Therefore, landfills should be located at a significant distance away from built-ups. Since dumpsites that are far from built-ups usually have low effects related to environmental pollution and health problems compared to ones that are closer to built-ups, the various distances used for buffer in meters include the following: 0 – 300, 300 – 600, 600 – 900, 900 – 1200, >1200 which was then reclassified into very low, low, moderate, high and very high respectively in Table 6 and shown in Figure 8.

4.2.9 | Slope

Lower-slope areas are more suitable than high-slope areas. A steep slope area is not suitable for constructing a waste dump site. In the study area, a slope of less than 6% is considered to be the most suitable (Figure 9).

4.2.10 | Elevation

Places with lower elevation are preferred to places with higher elevation when carrying out suitability analysis for landfills because places with a higher elevation tends to allow flow of contaminated liquid down compared with places with lower elevation. Areas with high elevation will also involve high cost of construction, transportation, higher risk of pollution compared to low elevation areas. Therefore, areas with low elevation are best for siting a landfill. It can then be said that as elevation increases, the chance of that location being used for landfill site decreases because elevation and landfill suitability is inversely related. The elevation map as shown in Figure 10 was divided into five classes which are very low (0-2.8m), low (2.8-5.5m), moderate (5.5 – 9.9m), high (9.9 – 17.3m) and very high (>17.3m).

4.3 | Suitable Site for Dumpsites

The TOPSIS MCDM method provides an effective, organized framework to support complex spatial decisions. Combined with GIS, it equips decision makers with a powerful data-driven tool for evidence-based policymaking. The map (Figure 12) shows the place which is suitable in siting a new landfill since the existing ones are sited in a wrong location. Most of the existing dumpsites were located majorly in Akure, the capital city, which makes the site to be majorly unsuitable. According to Figure 12, 61% of the area fall within the less suitable category and this include built up areas, wetlands and waterbodies. As indicated by Jakhar *et al.* (2023) & Ozoh *et al.* (2021), landfills within built up areas and streams increases the chance for pollution and opens up the region for impending dangers. Areas of moderate suitability constitute 5% while suitable area comprise 32% of the study area. These suitable sites are seen to be located in the outskirts of the city of Akure, in locations such as Egbdea and Kajola in the south and Iwoye, Ita Lisa, Adun and Ita Oniyan. The advantage if using TOPSIS is that

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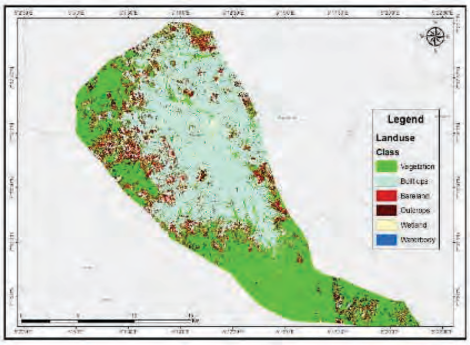
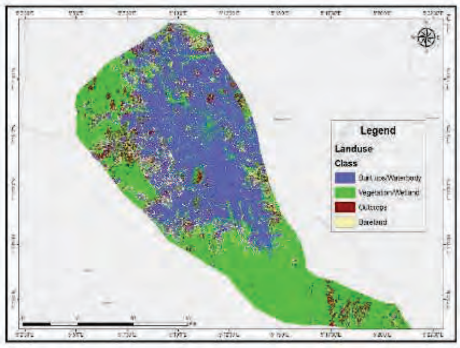
<tr><td>Figure 2: Land use</td><td>
</td><td>
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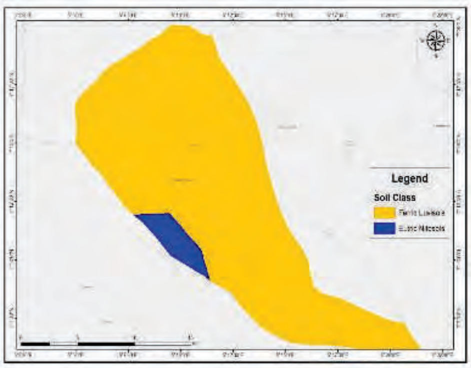
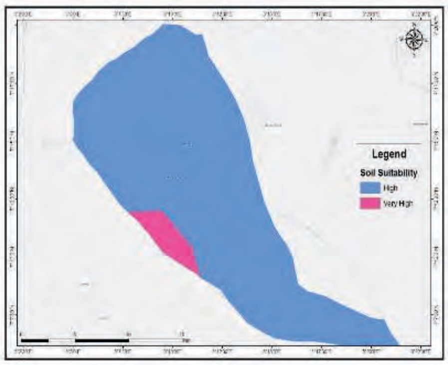
<tr><td>Figure 3: Soil classes</td><td>
</td><td>
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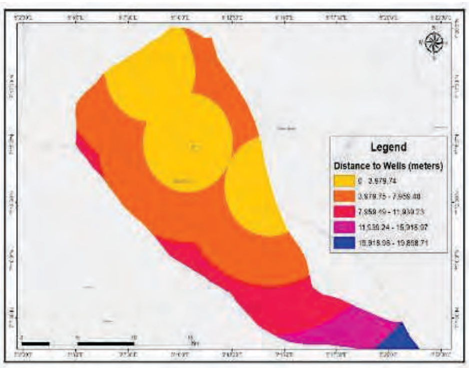
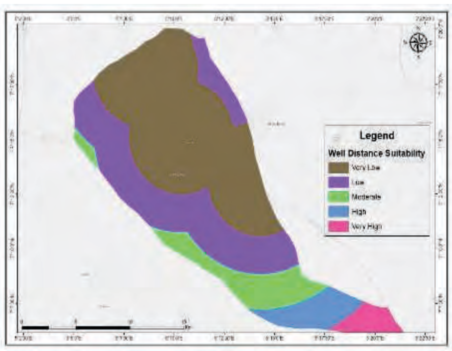
<tr><td>Figure 4: Distance to Existing Wells</td><td>
</td><td>
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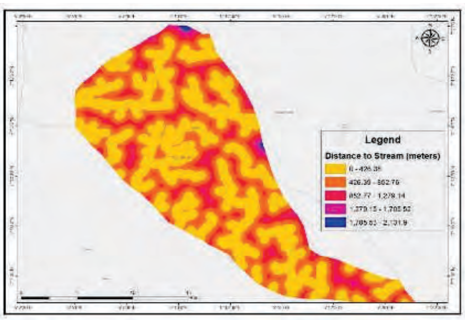
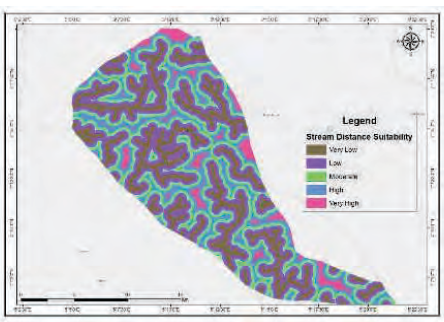
<tr><td>Figure 5: Distance to Streams</td><td>
</td><td>
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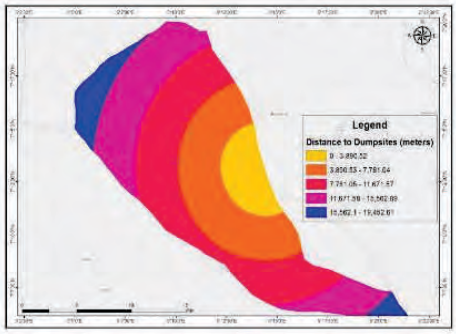
Figure 6: Distance to Existing Dumpsite



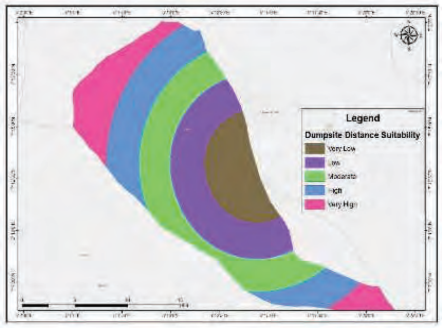
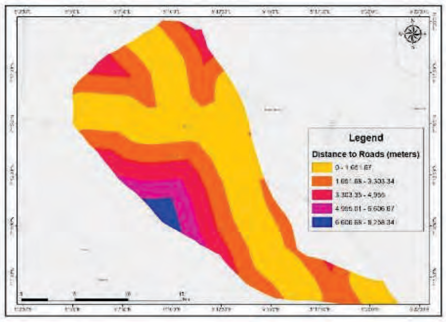


Figure 7: Road network



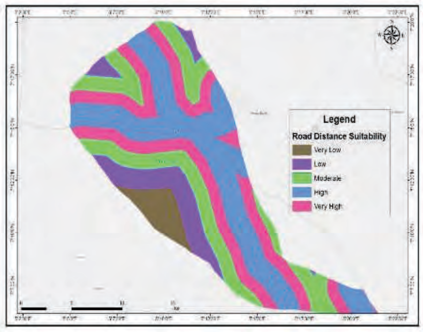
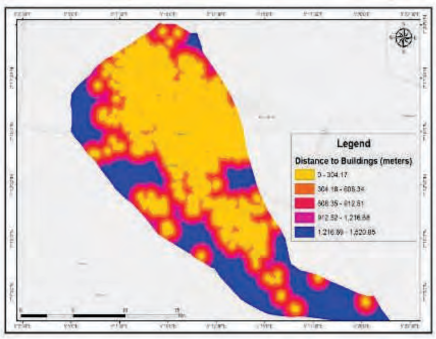


Figure 8: Distance to Built ups



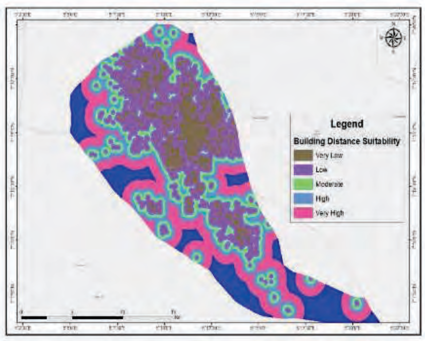
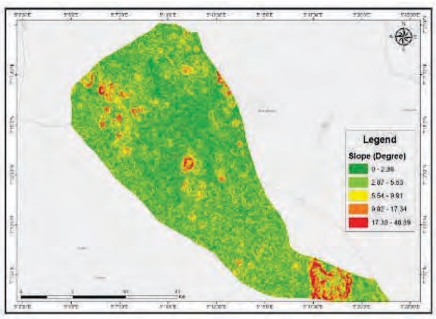


Figure 9: Slope



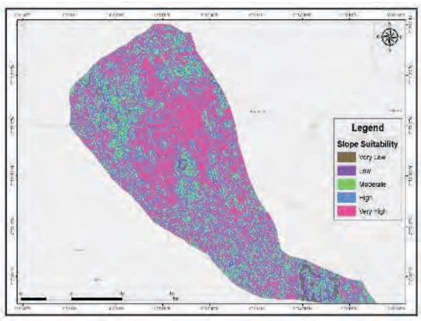


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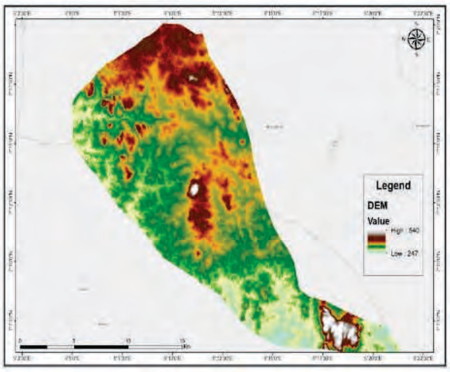
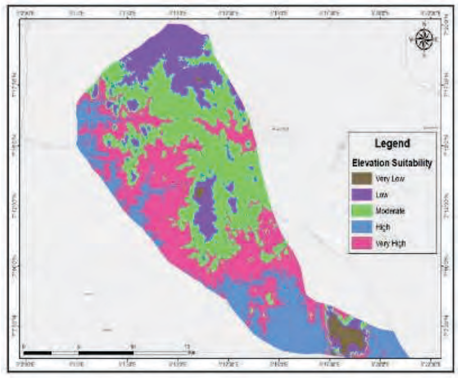
Figure 10: Elevation		

it has the ability to systematically rank alternatives based on multiple criteria, ensuring an optimal and scientifically justified site selection process. This approach minimizes environmental risks and enhances sustainable waste management planning.

Table 13 | Percentage of areas suitable to site a new landfill in Akure south

Suitability	Area (km^2)	Percentage
Less suitable	190.918	61.7547
Moderately suitable	17.3295	5.60543
Highly suitable	100.908	32.6399

(Source: Author Analysis, 2023)

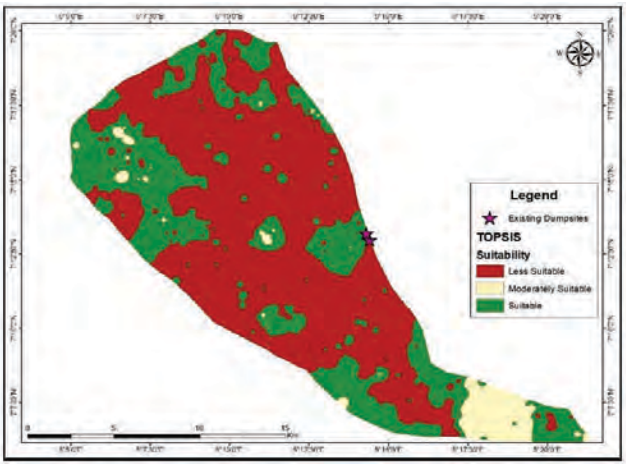


Figure 12: Map showing suitable locations for new landfill in Akure South LGA
(Source: Author Analysis, 2023)

5 | Conclusion

The TOPSIS model is an effective decision-making tool for landfill site selection, as demonstrated in this study. The analysis reveals that 32.6% of the study area, approximately 101 km², is suitable for landfill siting, while 61.7% is considered less suitable, including the location of the existing dumpsite. The integration of the TOPSIS MCDM method with GIS has proven to be an effective approach for landfill site selection, ensuring that decision-making is data-driven and scientifically justified. The study revealed that a significant portion of the current landfill sites in Akure are poorly located, increasing environmental and public health risks. Through spatial analysis, the study identified that 61% of the study area falls within the less suitable category, while only 32% is deemed suitable for landfill development. These suitable sites are mainly located on the outskirts of Akure, in areas such as Egbdea, Kajola, Iwoye, Ita Lisa, Adun, and Ita Oniyan.

The suitability classification was determined by evaluating multiple spatial factors, including the proximity of existing dumpsites to residential areas and well-points. The spatial analysis was conducted using GIS-based proximity analysis, which measured the distance between dumpsites,

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populated regions, and critical water sources. Specifically, Euclidean distance analysis was applied to assess how closely the existing dumpsites are situated to residential zones and well-points, ensuring that site selection adhered to environmental and public health guidelines. The hazards associated with the current dumpsites were identified through a combination of field surveys, geospatial analysis, and respondent feedback. While questionnaire responses provided insights into perceived risks, the study validated these claims using land use maps, topographic data, and other factors. This ensured that findings were evidence-based rather than purely subjective. The analysis revealed that the existing landfill sites pose potential threats such as groundwater contamination, air pollution, and disease outbreaks due to their proximity to human settlements and water sources.

Given these findings, immediate action is recommended for landfill relocation. Planning authorities should prioritize evacuating the current dumpsites and establishing a new, properly sited landfill in the identified suitable zones to mitigate environmental and public health risks. Implementing strict environmental regulations, continuous monitoring, and stakeholder engagement will be essential in ensuring sustainable waste management in the region. There is also need to implement the evidence-based solution such as TOPSIS for future landfill site selection to prevent improper waste disposal that could lead to pollution and other health hazards. Also, further studies should explore integrating additional criteria, such as socio-economic factors and climate impact, into the TOPSIS model to improve landfill site selection accuracy.

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