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Report

Selecting an Appropriate Location for Solid Waste Disposal in Tepi Town Using GIS and MCE Assessments, Tepi, Yeki, Southern Nation, Ethiopia

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Abstract: Disposing Solid waste material is a difficult task in which the selection of the site is regulated with different factors as well as regulations. If it is not properly selected by considering the factors critically it may cause different environmental and social problems. Now, tepi town is using a site which is not selected by using scientific. A site which is not selected by using scientific study is not well accepted by social and regulations. Therefore the main objective of this study was to select the suitable site for waste disposals by using GIS and Multi criteria evaluations. During the selection of this site the factors such as Boundary map, land use land cover, river, existing solid waste disposals, river; road network, slope map and others are taken as considerations. All maps of these factors are reclassified and evaluated by using geographic information system by preparation of their suitability map. The relative weight of factors was determined by using Analytical hierarchy methods and factors were developed by using geographic information system software. Finally the prepared solid waste disposal site selection was grouped into highly suitable, moderate suitable, low suitable and unsuitable. Generally the distance greater than 1500m from the main road is classified as unsuitable since it would not be economically feasible to transport solid waste and less than 1000m affects the odor of the waste. Based on these factor two suitable sites are located in east & south of the town. The reclassified factor cover 24.9ha or 20% not suitable, 62.6 ha or 51.9% covers low suitable, 28.6 ha or 23.7% covers suitable, 2.8 ha or 2.3% covers moderate suitable and 1.7 ha or 1.4% covers highly suitable.

Keywords: Waste Site, Factors, Multi Criteria Evaluation, Weight Over Lay Analysis, Analytical

1. Introduction

In the present day, the developing world is undergoing significant population growth and a substantial migration towards urban areas, necessitating the construction of infrastructure to ensure sustainability [1]. However, in contrast to this trend, many developing countries, such as Ethiopia, face challenges related to inadequate infrastructure and the absence of designated sites for proper solid waste disposal [2]. Key issues include the inability to employ modern techniques for selecting appropriate solid waste disposal locations and the improper disposal of various waste types within urban areas, which are among the most critical problems globally [3].

The establishment of a solid waste disposal site is a critical infrastructure in urban areas. The management of solid waste is a matter of global concern, impacting both developed and developing nations [4]. It is crucial to prioritize the development of efficient, technically advanced, and cost-effective solutions for solid waste management in the near future, in order to benefit the increasing urban population and the natural environments that support them. [5].

In most urban areas, solid waste disposal sites are chosen based on their proximity to collection areas rather than their technical and environmental suitability [6]. However, such practices clearly raise the potential for environmental issues. [7].

Similarly, in Tepi town, the collection and disposal of municipal and industrial dry waste lead to a variety of environmental issues. A significant portion of solid waste ends up in open dumps or drainage systems. Open-air burning of waste leads to spontaneous combustion at solid waste disposal sites. The detrimental impact of inadequate solid waste services on the town's productivity and economic development is severe [8].

This study is centered on the selection of a solid waste disposal site in Tepi town and how the current practice of open disposal can be transformed into a sustainable solid waste dumping site. The data used for identifying a suitable solid waste disposal site include the town's road network, land use, slope map, existing solid waste disposal sites, river locations, and soil type maps.

2. Statement of the Problem

Solid waste management is a significant challenge faced by urban planners worldwide, particularly in developing countries where factors such as rapid urbanization, inadequate planning, and limited resources contribute to the poor state of municipal solid waste managemen [8]. In Africa, the rapid growth of urban areas since the 1960s has strained the land resources surrounding cities and led to an increase in waste generation. The prevalent practice of open dumping of solid waste, especially in densely populated areas of African cities, has resulted in serious environmental and social issues [9]. In Ethiopia, the disposal of solid waste is a major concern for communities and municipalities, with waste being indiscriminately disposed of in open spaces, including major roadsides, drainage areas, riversides, and forests [10]. Selecting suitable solid waste disposal sites and implementing proper disposal methods are crucial in minimizing environmental contamination and enhancing the aesthetics of urban areas [11]. Therefore, this study aims to identify a suitable solid waste disposal site and address the disparity between the current and future volumes of solid waste generated in the study area.

3. Objective of the Study

3.1. General Objective

The general objective of this study is selection of the most suitable solid waste disposal site using multi criteria evaluation (MCE) and geographic information system technique for tepi town.

3.2. Specific Objectives

1. identify problems related to existing waste disposal site
2. set identify criteria for solid waste disposal site selection,
3. develop factors for site selection suitable analysis,
4. select suitable site for solid waste disposal sites in tepi town,
5. What is responsiveness rate of the existing and current study

4. Materials and Methods

4.1. Location and Description of the Study Area

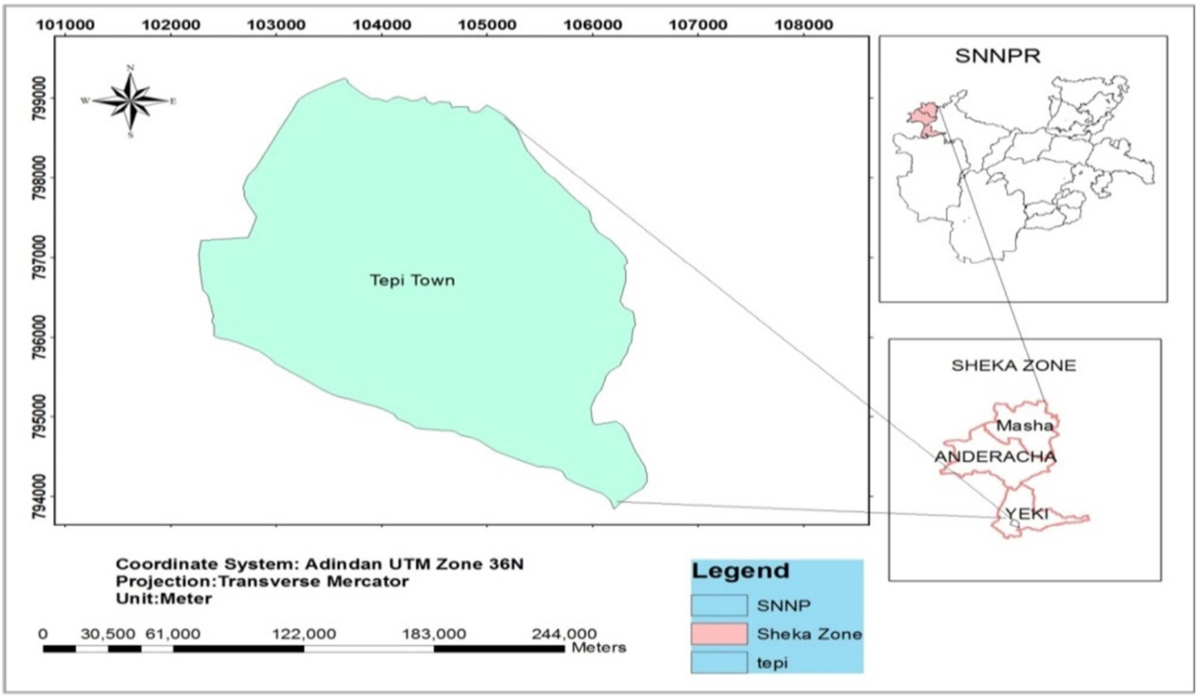

Figure 1. *Location map of the study area.*

Tepi town is located in the Southern Nations, Nationalities, and Peoples Region of Ethiopia, specifically within the Yeki Wereda, part of the Sheka Zone. Yeki is bordered by the Bench Maji Zone to the south, the Gambela region to the west, Anderacha to the north, and the Kafa Zone to the east. Tepi is a significant town within the Yeki Wereda, situated approximately 611km from Addis Ababa, the capital city of Ethiopia, and 850km from Hawasa, the capital city of the SNNP's regional state. The town's coordinates fall between 7°12'N - 7°43'N latitude and 35°3'E - 35°7' longitude, with an average.

4.2. Materials and Methods

4.2.1. Materials

ArcGIS Desktop is globally recognized as one of the most extensively utilized GIS software [4]. This study employs various components of ArcGIS Desktop, such as Arc Map, Arc Catalog, and Arc Toolbox. These components are utilized for tasks including creating the geo database, editing, data management, storage, geo-referencing data from diverse sources, performing spatial multi-criteria analysis, generating criteria maps, assigning weights for each criterion, overlaying, analysis, visualization of output data, and more. The study predominantly relies on ArcGIS software and its extensions, occasionally incorporating other tools like DNR Garmin for uploading spatial information and conversion purposes, Google Earth, and Notepad (MS Excel) for viewing, editing, and rearranging spatial data from GPS and secondary sources as needed.

The study employs both primary and secondary data. Primary data is gathered through field surveys and observations, focusing on naturally existing and manmade features, the local community, and aerial photographs of Tepi Town. Secondary data is acquired from various sources, including the internet, reports, books, journals, governmental institutions, and other documents. The data sources are categorized into Primary (e.g., features within Tepi Town) and Secondary (e.g., literature from the web, unpublished documents, and data from different organizations).

Data gathering involves formal and informal techniques, with two primary methods: Instrumental Survey and Contact with Relevant Organizations. The instrumental survey is conducted by researchers and experts using instruments and labor forces to collect primary data throughout the town. Additionally, a simple unstructured questionnaire is prepared to engage in conversations with relevant workers in organizations, identifying and collecting valuable secondary data and materials.

Table 1. *Data type, source and description.*

No.	Item	Specification	Source	Description/purpose
1	Boundary map	Shape file format	Digitization	To determine the location of the study area
2	Land use land cover	1:50,000	Tepi municipality	Classification of land use &determine the sites and assign the most suitable land use for the solid waste site
3	Existing SWD site	Coordinate (x, y, z)	Field survey	To locate the existing solid waste disposal site
4	Road network	Shape file format	Digitization	Locate the accessibility of solid waste disposal site
5	Slope map	DEM raster data format	Field survey	Evaluate the terrain type (analyses the slope)
6	River	Shape file format	Digitization	To identify the pollution location and to identify the distance from the river

Table 2. *Materials types & purposes.*

NO.	SOFT WARES	SPECIFICATION	PURPOSES
1	Arc GIS(Arc Map)	Version 10.2	Displaying and processing the data for analysis
2.	Idrisi	Version 32	For weight overlay analysis
3.	Microsoft office word	Version 2007	Report writing
4.	Computer	Pc and dell	For containing soft ware’s we used
5.	GPS	Rover, receiver, control GPS	For data collection

4.2.2. Methods

The location of solid waste disposal sites is a critical consideration, necessitating a specific distance from various features such as lakes, ponds, rivers, wetlands, floodplains, highways, critical habitat areas, water supplies, wells, and airports [23]. In the case of Tepi town, the selection of the solid waste disposal site was conducted through Multi-Criteria Decision Evaluation, involving the creation of layers to generate a comprehensive output map.

The process involved assigning weights to different criteria, achieved through a series of pairwise comparisons of relative importance. Drawing on experience and assessing likely impacts on the surrounding environment, distinct weights were assigned to each parameter. The Analytical Hierarchy Process was employed to derive these weights. Figure 2 illustrates the methods employed in this process, drawing insights from various sources found in different literature references.

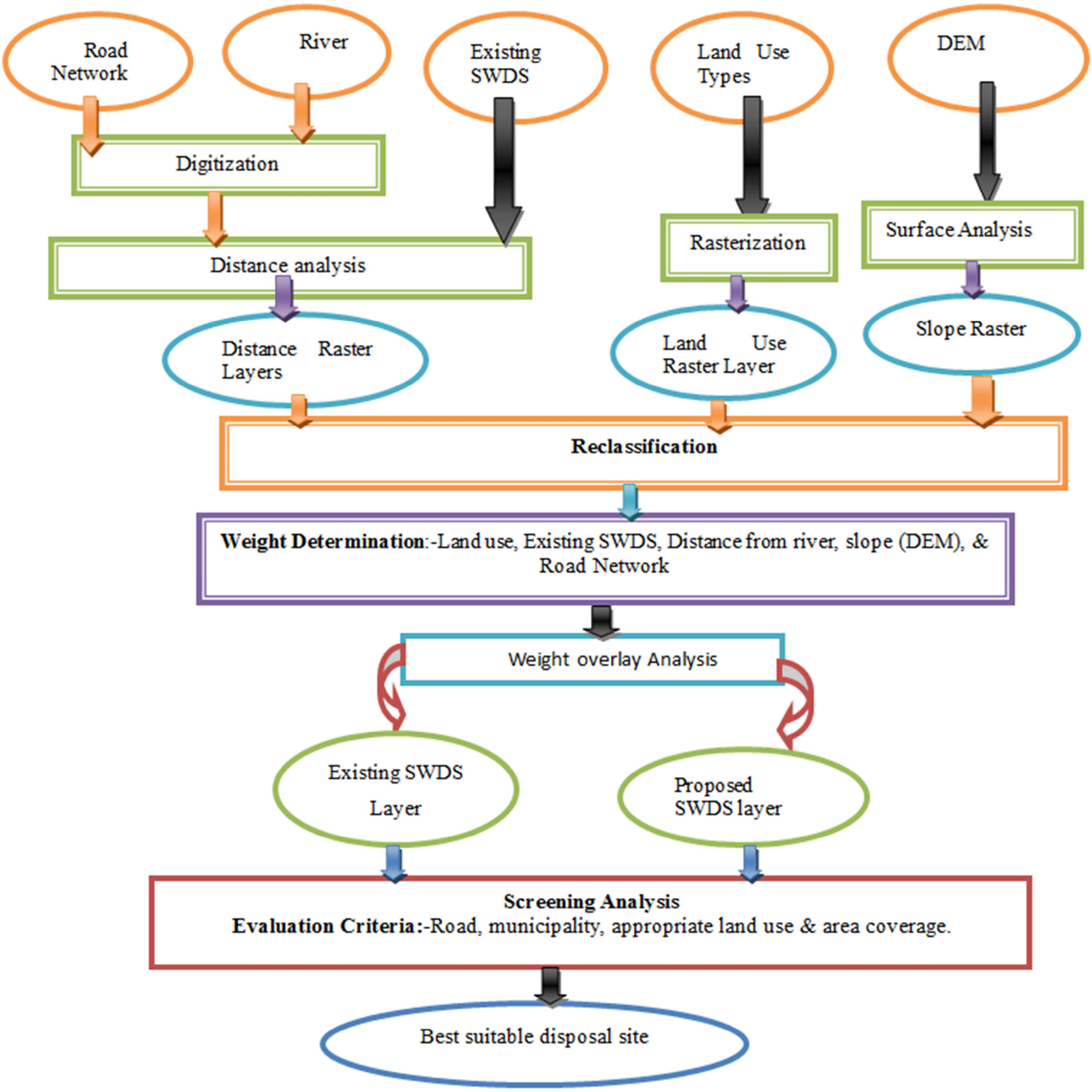

Figure 2. *Technological Scheme of suitable solid waste disposal site selection.*

5. Data Analysis and Discussion

5.1. Analysis Specification

The study utilized various factors, including Digital Elevation Model, slope, road network, land use, existing solid waste disposal sites, and distance from the river, to determine suitable sites for municipal solid waste disposal. These data layers were converted into raster layers, and a suitability rescaling option was applied, indicating ratings from 1 to 5 (1 being not suitable, 2 low suitable, 3 suitable, 4 moderately suitable, and 5 highly suitable) to assess the suitability of each site. This approach allowed for a comprehensive analysis of multiple factors to identify the most appropriate locations for solid waste disposal.

5.2. Factor Development

5.2.1. Road Factor

The road network plays a crucial role in transporting solid waste from its source to the disposal site. Therefore, it is important to consider the proximity of the disposal site to the road network to minimize transportation costs. However, it is also essential to avoid locating the disposal site too close to the road network to mitigate the impact of solid waste odors.

To determine the suitable distance from the road network for locating the solid waste disposal site, a buffer distance can be established. This buffer distance will help in determining the optimal proximity to the road network while considering factors such as transportation cost reduction and odor control, as shown in Figure 3. By establishing this buffer distance, the study can effectively identify the most suitable location for the solid waste disposal site in relation to the road network.

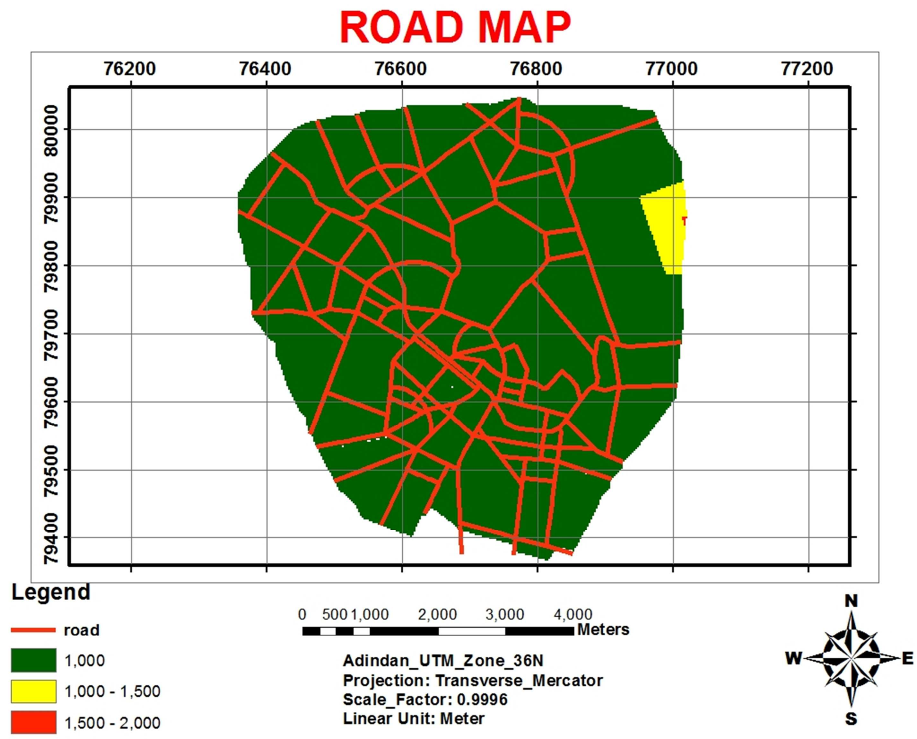

Figure 3. *Raster road map.*

The factor was re-classified to make sure that which sites are more suitable according to section.5.1.1. Figure 4 is constructed in order to create the re-classified map of Tepi town road network

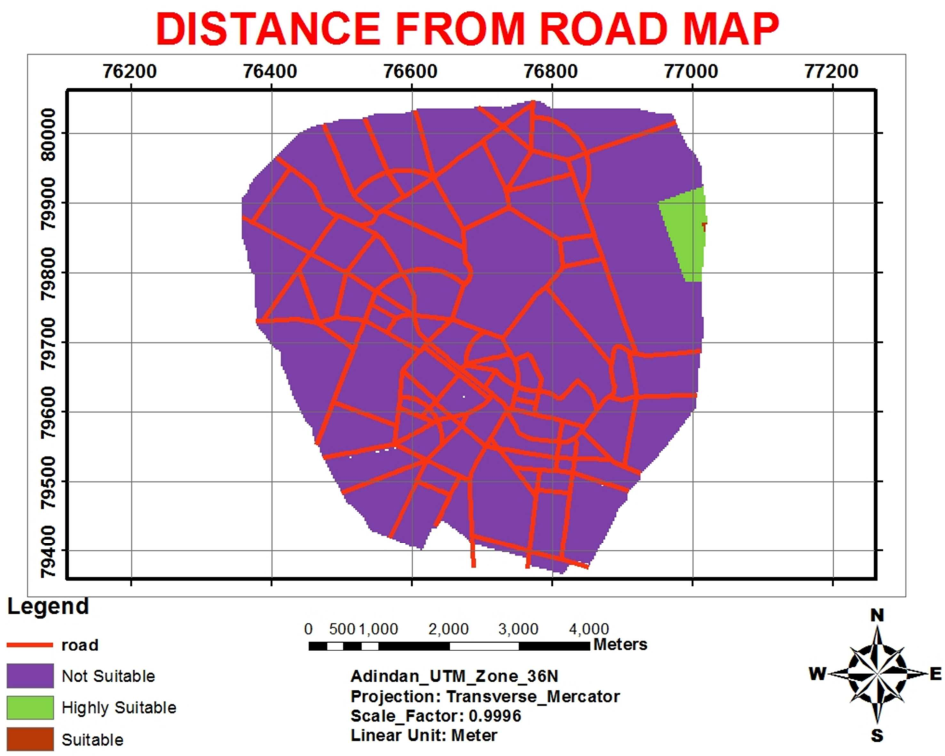

Figure 4. *Reclassified distance from road map.*

The figure illustrates the reclassification of factors into three classes for determining the suitability of the solid waste disposal site in relation to the road network. The first class, ranging from 0 to 1000 meters, is deemed not suitable, while the second class, covering 1000 to 1500 meters, is classified as highly suitable. The third class spans 1500 to 2000 meters and is considered suitable for the study's purposes.

The study finds that a distance of 1000 to 1500 meters from the road network is economically viable and highly suitable for the site location, helping to avoid transportation conflicts and addressing visual concerns. Distances greater than 2000 meters are deemed unsuitable due to economic feasibility issues, while distances less than 1000 meters can impact the odor of the waste.

Based on these considerations, two suitable sites are identified to the east and south of the town. The reclassified factor indicates that 1234 hectares or 30% of the area is not suitable, 308 hectares or 51.9% is highly suitable, and 1819 hectares or 18.1% is suitable for the solid waste disposal site

Table 3. *Suitability score of reclassified road network.*

No.	Road distance in meter	Suitability score	Suitability class	Area (ha) or percentage (%)
1	0-1000	1	Not suitable	144.9 or 30%
2	1000-1500	5	Highly suitable	250 or 46.9%
3	1500-2000	3	Suitable	148.6 or 23.1%
3	1500-2000	3	Suitable	148.6 or 23.1%

5.2.2. River Factor

The river layer is an essential component for creating a surface water constraint in the process of locating a solid waste disposal site [12]. It is important to avoid placing the disposal site in close proximity to the river due to the potential risk of contaminants from the waste leaching into the groundwater and eventually reaching the rivers and streams. This is a significant environmental concern, and therefore, a location farther away from surface water sources is preferable.

To establish this constraint, a buffer distance function is utilized to generate a buffer around the river, with buffer distances ranging from 1000 to 2500 meters. This buffer map is created to visually represent the distance location from the center of the river, allowing for the identification of suitable areas for the solid waste disposal site while maintaining a safe distance from the river to minimize environmental risks.

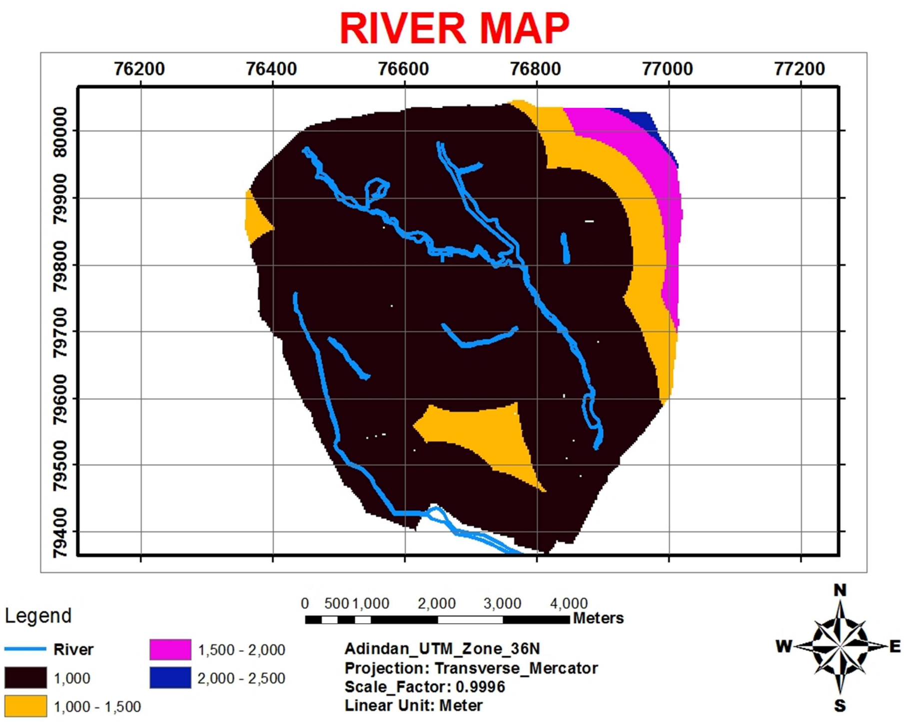

Figure 5. *Raster distance from River map of Tepi Town.*

The river factor map is further reclassified into more suitable classes, as shown in Figure 5. The first reclassified factor class ranges from 0 to 1000 meters, which is considered low suitable due to the potential for pollution. This class covers 1187.06 hectares or 36.15% of the total area. The second class spans from 1000 to 1500 meters, which is suitable, covering an area of 787.98 hectares or 32.64%. The third class ranges from 1500 to 2000 meters, which is highly suitable, covering 596.89 hectares or 31.21%. The fourth class ranges from 2000 to 2500 meters, which is deemed not suitable for the solid waste disposal site.

Based on this criterion, the highly suitable area for the solid waste disposal site is 596.89 hectares or 31.21% of the total area. This reclassification helps to identify the areas that are more suitable for the solid waste disposal site while minimizing the risk of pollution to the river and surrounding environment.

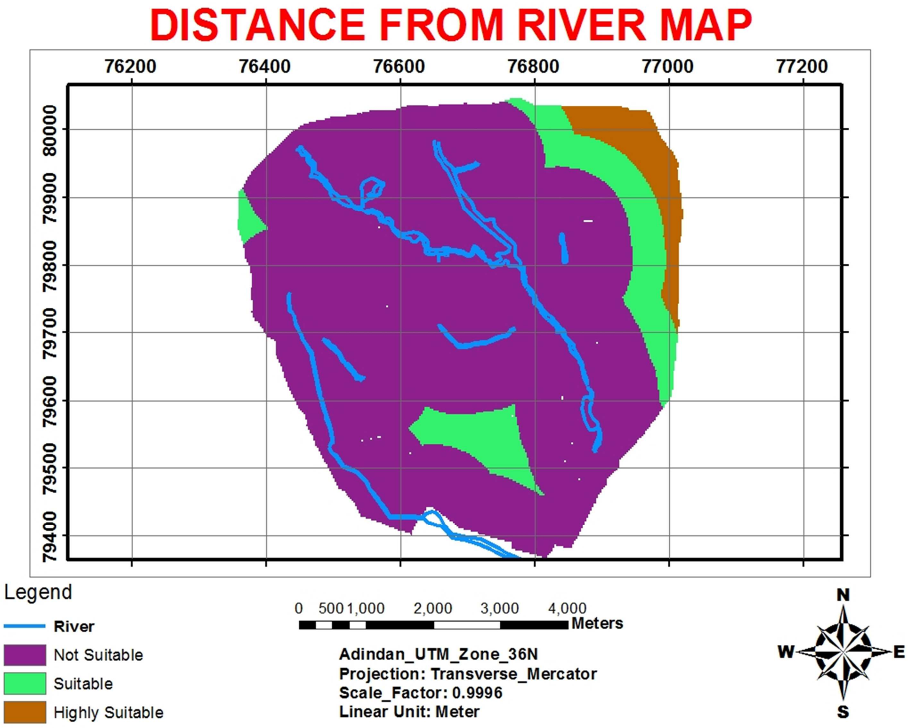

Figure 6. *Reclassified distance from River map of Tepi.*

Table 4. *Suitability score of reclassified River.*

No.	River distance(m)	Suitability score	Suitability class	Area (ha) or Percentage of Total (%)
1	0-1000	2	Low suitable	1187.06ha or 36.15%
2	1000-1500	3	Suitable	787.98 ha or 32.64%
3	1500-2000	5	Highly suitable	596.89ha or 31.21%
4	2000-2500	2	Low suitable	1187.06ha or 36.15%

5.2.3. Land use Factor

The land use factor is a crucial consideration in determining the suitability of areas for a solid waste disposal site [13]. Different land use types, such as residential areas, institutional areas, bare land, commercial areas, recreational areas, and agricultural areas, are evaluated and assigned an appropriate index of land use suitability. These land use types are converted into a raster layer to assess their suitability for a solid waste disposal site. The raster is then reclassified to identify the most suitable sites.

The reclassified land uses play a significant role in the selection of a suitable site for waste disposal. Based on the provided values, bare land and agricultural areas are deemed more suitable, while institutional areas, residential areas, commercial areas, and recreational areas are less suitable for the selection of a disposal site. Among them, bare land is identified as the most suitable site, while the other land uses are restricted for solid waste disposal.

Figure 7 illustrates the different land use and land cover types in Tepi town. The data shows the extent of each land use type, with residential areas covering 233.600 hectares (15.2%), agricultural areas covering 45.475 hectares (11.76%), commercial areas covering 37.175 hectares (12.09%), recreational areas covering 7.700 hectares (10.9%), bare land areas covering 626.950 hectares (33.05%), and institutional areas covering 284.200 hectares (17%). These percentages indicate the suitability of each land use type for the selection of a solid waste disposal site, with highly suitable, moderately suitable, low suitable and not suitable classifications.

Table 5. *Suitable score of land use land cover.*

No.	Land use types	Suitability Score	Suitability class	Area (ha) or Percentage (%)
1	Residential	2	Low suitable	233.600 ha, 15.2%
2	Commercial	1	Very low suitable	37.175ha, 12.09%

No.	Land use types	Suitability Score	Suitability class	Area (ha) or Percentage (%)
3	Recreational	3	Suitable	7.700ha, 10.9%
4	Agriculture	4	Moderate suitable	45.475 ha, 11.76%
5	Bare land	5	Highly suitable	626.950 ha, 33.05%
6	Institution	0	Not suitable	284.200ha, 17%

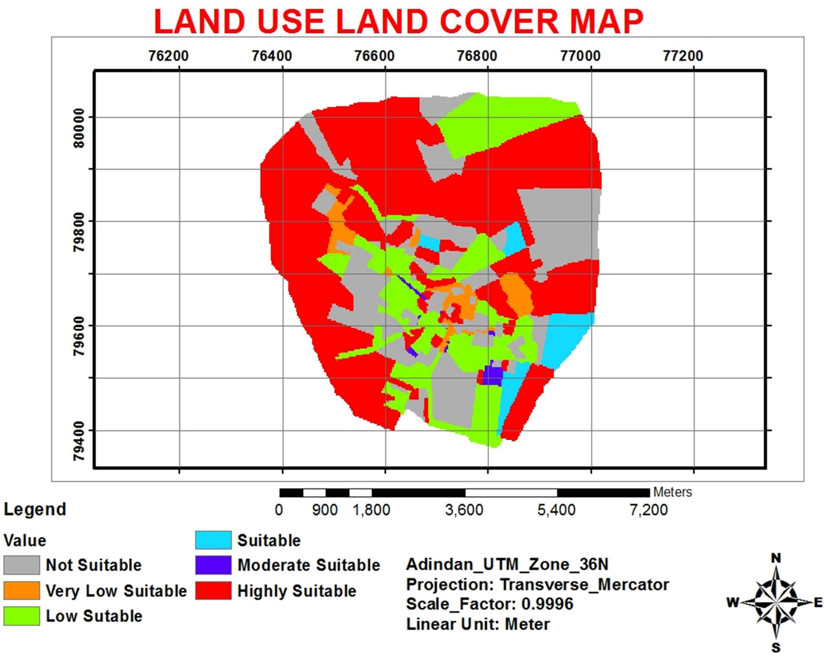

Figure 7. *Reclassified the land use land cover map of Tepi Town.*

5.2.4. Digital Elevation Model (DEM) and Triangulation Irregular Network

The slope of the land is an important factor in determining the suitability of an area for a solid waste disposal site [14]. Slopes indicate the maximum rate of change in surface value over a specific gradient and are typically expressed in degrees or percentage. To obtain the slope map for the final analysis, a Digital Elevation Model (DEM) was utilized. The slope map calculation was performed using the spatial analysis tool in ArcMap 10.2.

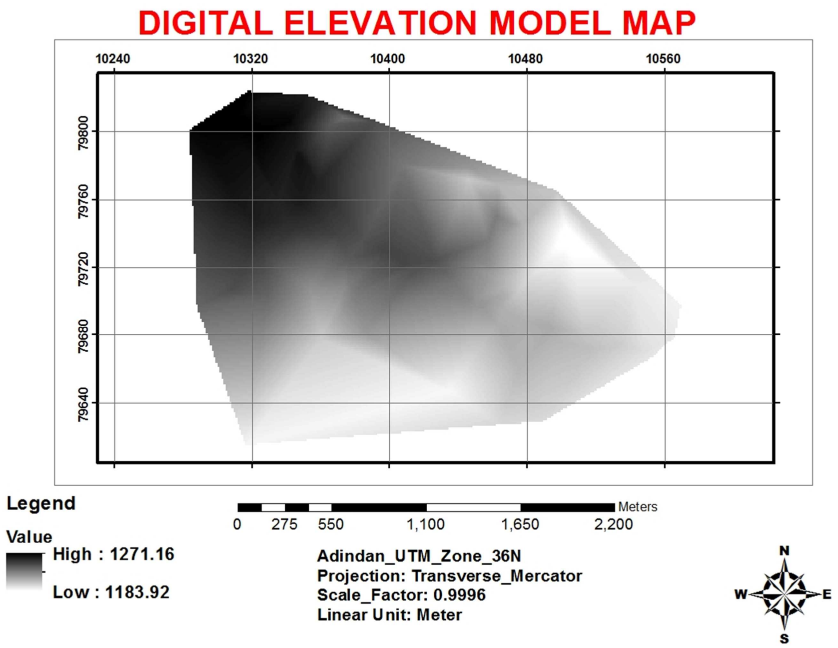

Figure 8. *Digital Elevation Model Map.*

The slope calculation is a function within the spatial analyst tool, which was used to derive the slope map from the DEM and Triangulated Irregular Network (TIN). TIN is a vector data structure that divides geographic space into contiguous, non-overlapping triangles. These triangles are formed by connecting the vertices of sample data points, each with x-, y-, and z-values, using lines to create Delaunay triangles. TINs are commonly used to store and display surface models, providing valuable information about the terrain's slope and shape.

By using these spatial analysis tools and techniques, the slope map can be generated and integrated into the overall assessment of suitable areas for a solid waste disposal site. This information is vital in identifying areas with appropriate slopes for the establishment of such facilities while considering environmental and engineering factors

5.2.5. Slope Factor

The slope of the land is indeed a crucial factor to consider when selecting a solid waste disposal site. Higher slopes can lead to increased runoff of pollutants from the disposal site, potentially contaminating surrounding areas [15]. It is preferable to have a topographic surface that sheds water effectively to reduce standing water and infiltration. Steep slopes can also make construction of the disposal site difficult and costly.

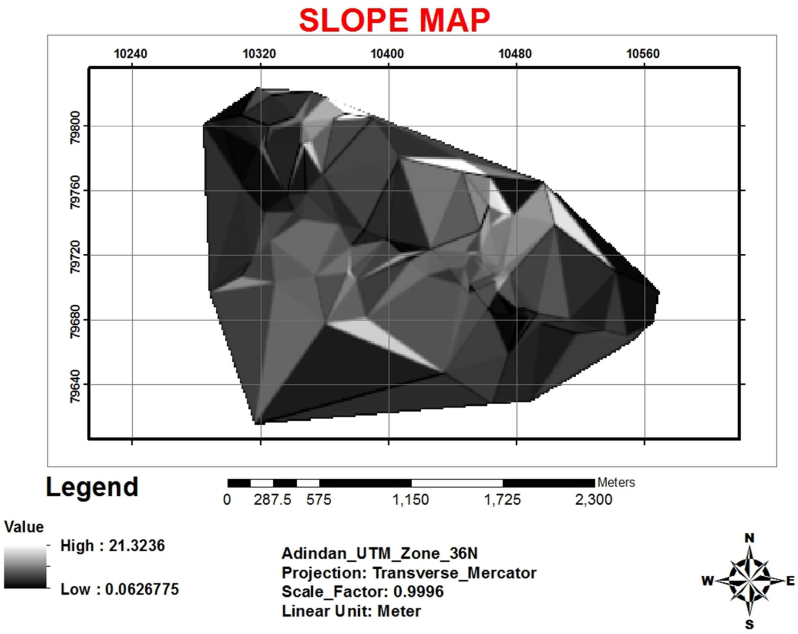

Figure 9. *Raster slope map of Tepi Town.*

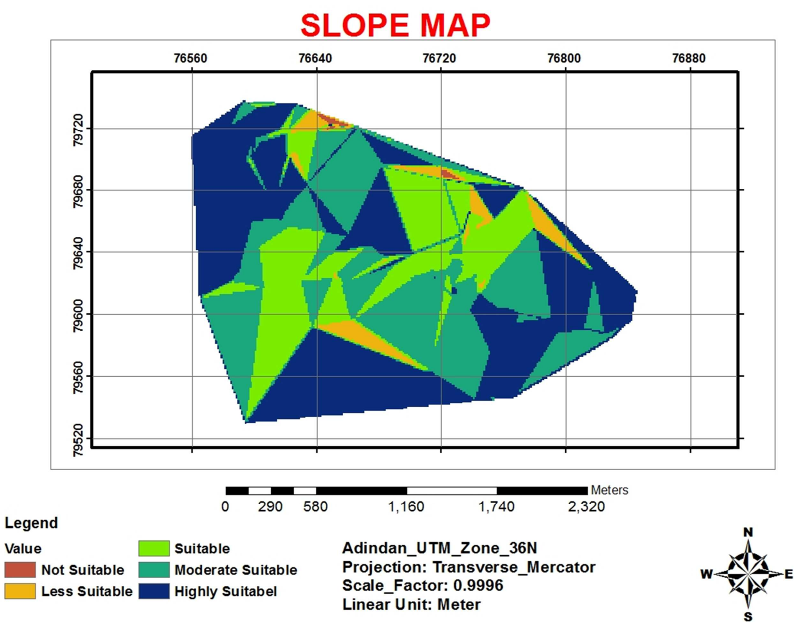

Figure 10. *Reclassified slope map of Tepi Town.*

***Table 6**. Suitability scores for slope.*

No.	Slope in percent	Suitability score	Suitability
1	0-2.45	5	Highly suitable
2	2.45-4.21	4	Moderate Suitable
3	4.21-6.7	3	Suitable
4	6.7-12.05	2	Low Suitable
5	12.05-21.82	1	Not suitable

In the context of solid waste disposal, a slope of less than 20% is generally considered suitable for preventing contaminant runoff. Therefore, preference is given to landforms located in flat or undulating areas. The study area in question comprises different landforms, including flat and mountainous terrain, with slopes ranging from 0% to 41%.

Based on the data, it is determined that land with slopes between 4% and 20% is highly suitable for solid waste disposal site selection. This information is derived from the analysis of the land structures in the study area, which was evaluated by developing the slope from the Digital Elevation Model (DEM).

This assessment of slope suitability is essential in identifying appropriate areas for the establishment of a solid waste disposal site, taking into account the potential impact on water runoff and the feasibility of construction.

The final procedure is reclassification of slope in to five classes 0-2.45% highly suitable, 2.45-4.21% is moderate suitable, 4.21-6.7% is suitable, 6.7-12.05% low suitable and greater than 12.05% is not suitable. The area covered 10.59ha, 11.32ha, 75.15ha, 21.06ha and 1.44ha highly suitable, moderate suitable, suitable, low suitable and not suitable sites respectively.

5.2.6. Existing Solid Waste Disposal Site Factor

It's important to consider the existing solid waste disposal site as a crucial factor in the selection of a new disposal site. The proximity of the new site to the existing one can have significant implications for logistical and environmental reasons. The distance allocation from the existing solid waste disposal site, as depicted in the figure, provides valuable information for the new site selection process. This information can help in understanding the spatial relationship between the existing and potential new sites, allowing for informed decision-making regarding the placement of the new disposal site. By taking into account the existing solid waste disposal site and its spatial relationship with the study area, it becomes possible to identify suitable locations for the new disposal site while considering factors such as transportation, environmental impact, and community concerns. This holistic approach to site selection ensures that the new disposal site is not only well-suited for waste management but also takes into account the broader context of the surrounding area.

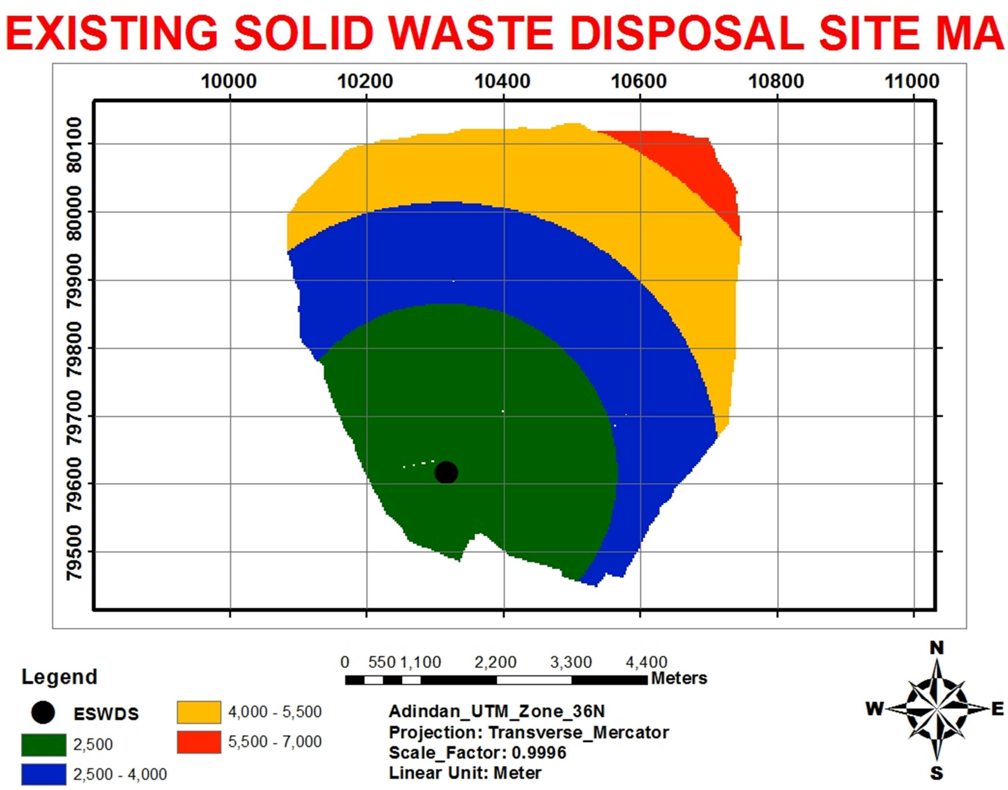

***Figure 11.** Raster existing solid waste disposal map of Tepi Town.*

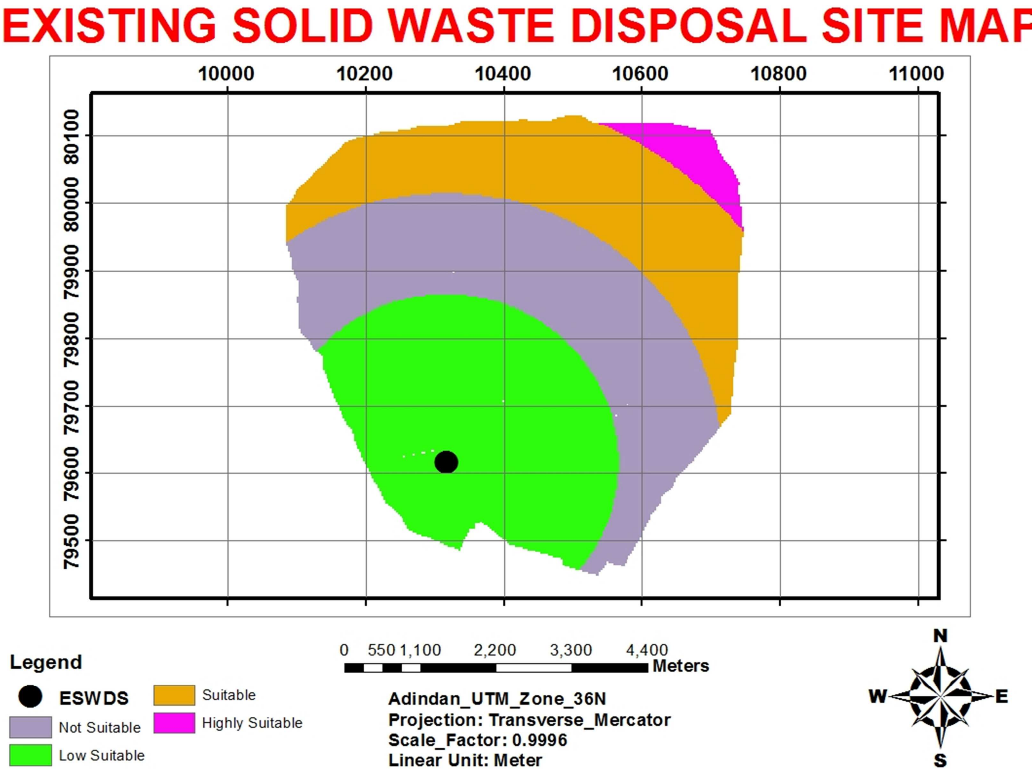

Figure 12. *Reclassification of existing solid waste disposal site map of Tepi Town.*

The developed factor was reclassified to determine the suitable new disposal sites.

The factor layer classification into five classes provides a clear understanding of the suitability of different distances from the existing solid waste disposal site. The classification ranges from not suitable to highly suitable based on distance from the site.

In this classification, the distance range from 0m to 2500m is considered not suitable, while the range from 2500m to 4000m is classified as low suitable. Moving further, the range from 4000m to 5500m is considered suitable, and the range from 5500m to 7000m is classified as highly suitable.

The table (Table 7) provides scores and area coverage for these different distance ranges. It indicates that the distance range from 5500m to 7000m, which is classified as highly suitable, covers 9.76 units or 48.43% of the total area.

This information is valuable for the selection of a new solid waste disposal site, as it helps in identifying the most suitable areas based on their distance from the existing site and the coverage of these areas within the study area.

***Table** 7. Suitability score for existing solid waste disposal site.*

No.	Distance Classification in meter	Suitability Score	Suitability class	Area (ha) or Percentage (%)
1	0-2500	1	not suitable	2.56 or 9.54%
2	2500-4000	2	Low suitable	6.33 or 18.60%
3	4000-5500	3	Suitable	8.15 or 23.43%
4	5500-7000	5	Highly suitable	9.76 or 48.43%

5.3. Suitablity Analysis

The Analytical Hierarchy Process (AHP) indeed offers a robust methodology for decision-making, particularly in complex scenarios such as solid waste disposal site selection. Pairwise comparisons provide a structured approach to evaluating the relative importance of different factors, allowing decision makers to derive ratio scale priorities. This method offers a more nuanced and informed way of assigning weights compared to traditional methods.

The process of pairwise comparison enables decision makers to systematically assess the contribution of each factor to the overall objective, simplifying the decision-making process by breaking it down into manageable comparisons.

In the context of solid waste disposal site selection, the reclassified factors are assigned weights based on their importance. This weight assignment is carried out using IDRISI 32 software, taking into account factors such as Digital Elevation Model, Land Use, Slope, Road, River, and Existing Solid Waste Disposal Site.

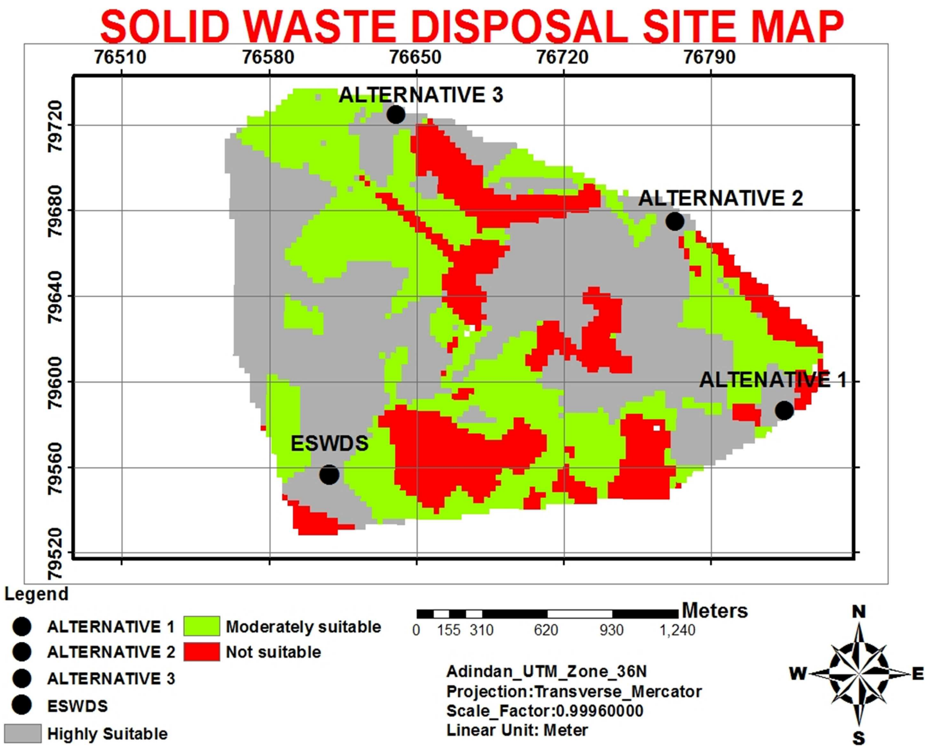

Figure 13. *Solid waste disposal site of Tepi Town.*

The principal eigenvector weight for these factors is then determined, providing a clear understanding of the relative importance of each factor in the decision-making process. This information is crucial for ensuring that the selection of a solid waste disposal site is based on a comprehensive and well-informed assessment of the various contributing factors.

Table 8. *Principal Eigenvector (Weights) of the pair wise comparison matrix.*

No.	Criteria	Weight	Weight in percent
1	Land use	0.4087	41%
2	Slope	0.2491	25%
3	Road	0.1562	16%
4	River	0.0920	9%
5	Existing waste disposal	0.0899	9%
	Total	1	100%
	Consistency Ratio (CR)	0.07	Acceptable

Principal Eigenvector (Weights) of the pair wise comparison matrix *is* multiplied by its factor and sum up, by using spatial analysis tools in GIS environment. After this calculation, the following result is appears.

$$\text{Raster calculation} = \text{Land use*0.41"+Slope*0.25"} + \text{Road*0.16"+River* 0.09"} + \text{"Existing solid Waste Disposal site*0.09"}$$

6. Conclusion and Recommendation

6.1. Conclusion

The process of solid waste disposal site selection involves evaluating various factors such as road network, distance from rivers, slope, digital elevation model, land use, and existing solid waste disposal sites. GIS technology is a cost-effective and practical approach for this purpose, as it can efficiently generate high-quality maps for waste disposal site selection within a short timeframe. Additionally, Multi-criteria decision analysis (MCDA) is a valuable tool for making waste disposal site decisions by providing consistent ranking and weightings to potential areas.

Understanding the influential factors and conducting multi-criteria analysis are crucial for selecting a suitable waste disposal site without disturbing the local population with waste-related odors. GIS software can be utilized to select a suitable site and produce quality maps in a short period, addressing this concern.

In this study, six factors were defined and used as output map layers to select a suitable waste disposal site. The integration of GIS and MCDA was employed for the analysis, with two methods of MCDA—Weighting and Analytic Hierarchy Process—used to compare results and ensure accuracy. The output maps were classified into five classes, ranging from "not suitable" to "highly suitable" areas.

Following the production of output maps, three select sites became available, and after evaluation, select site one was determined as the most suitable site in the study area due to its easy accessibility.

This study demonstrates the power of GIS in handling large amounts of data and narrowing down areas of interest for potential waste disposal sites. It underscores the importance of using advanced technology and analytical methods to make informed decisions in waste management and site selection.

6.2. Recommendation

The proper selection of solid waste disposal sites is crucial for the development, health, and beautification of Tepi town. This knowledge is essential for creating an unpolluted environment that is suitable for the local population. To achieve this, the municipality needs to have a comprehensive understanding of the sources, effects, and risks of solid waste on the town's growth and the well-being of its residents. Recommendations for the municipality and society are outlined to address this issue.

For the municipality, effective waste management, proper area allocation for waste disposal, and public awareness campaigns are essential. It is important to ensure that waste is disposed of in designated areas only. The society also has a responsibility to maintain the town's cleanliness and health by disposing of waste properly, rather than simply discarding it on the streets or in open areas.

Considering the rate of solid waste generation and the town's population growth is also crucial. Understanding the resources needed for the town's future growth, as well as the amount of solid waste generated and the selection of suitable disposal sites, are important factors to consider.

GIS technology can play a significant role in waste management by facilitating data manipulation, simulating alternatives, and supporting effective decision-making. It can be used for waste collection route planning, site selection for transfer stations and landfills, and waste collection point analysis. The use of GIS and multi-criteria evaluation methods can help in the selection of suitable waste disposal sites, providing visual guides for urban planners and aiding in the planning of urban infrastructures.

In conclusion, the recommendation for the future is to establish landfills as the suitable solid waste disposal sites. Landfills are created through land disposal methods, typically involving the mass disposal of waste into designated areas. This approach can contribute to the development and beautification of Tepi town while ensuring proper waste management and environmental sustainability.

Conflicts of Interest

The authors declare no conflicts of interest.

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