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Locational of Zahak municipal landfill, using Geographic Information System (GIS)

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Abstract

Zakhak city with a total area of 945 square kilometers is located north of Sistan and Balouchestan province and is located in the geographical position 8944. 30 degrees north and 7067. 61 degrees east. The city's population, according to the 2006 census, is 71,462, it generates 25 tons of waste per day. These wastes accumulate behind the hospital in Zahak, where environmental pollution for residents of nearby villages is one of the most important problems due to the misplaced location of the site. The study area is located in the Sistan block in terms of Structural-sedimentary divisions in Iran. NQ stratigraphic unit is the largest stratigraphic zone in Sistan Plain, consisting of alluvial fine-grained sediments in a river whose sedimentation time from the end of the Miocene to the early days of the Holocene continued. These sediments are often the result of erosion lake plain and drainage, shapes today to have gained in the context of all the villages, settlements and activity centers formed and large parts of the East area The study encompasses the study. In this research, it has been attempted to investigate the geomorphology of the area with the overlap of gradient layers, elevation digital, geology, roads, distance from the city, distance from the well, distance from the river and priority drainage system with the help of GIS. Then the banned areas were identified, so that the eastern parts of the city of Zahak are more preferable.

Keywords: Location, Landfill location, urban waste, Zahak.

1. Introduction

The increasing growth of the urban population of Iran, along with the creation of new population centers, the lack, or policy making and evaluation of various urban activities and activities based on a comprehensive national plan (land use planning) and the continuation of evacuation of all types of wastewater and sewage into the environment, including crisis factors Behavior that has caused the natural environment and the quality of human health, especially urban populations, to be at risk and disadvantage (Poorehmad et al. 2007). Several criteria are involved in the selection of landfill sites, each of which is of particular importance and constitutes a constraint on selection. The ultimate goal of these criteria is to find a site that has the lowest environmental impacts on the natural environment around the landfill and the mooring area. Pollution of groundwater resources and soil of the region is one of these works (Pourahmad et al. 2007). The city of Zahak was no exception to this, as reports indicate the unprocessed production and burial of urban waste in the city, which threatens the health of the people, especially residents of the village of Jalal-Abad Zahak and Shahid Namjoo. Also, the unpurchased burial of garbage will endanger the health of the water resources of the area (half well) located near the landfill site. Therefore, paying attention to the location of the landfill for this urban waste is very important. In this research, location based on engineering geology indexes, using AHP analysis method in GIS software is carried out. Engineering geology factors that affect this subject include morphology, slope, rock, faults, seismicity, lubricity, soil (including erodibility and permeability), land use, hydrology and hydrogeology.

2. Geographical location of the study area

Zahak is located in northern Sistan and Baluchestan province. The geographical location of this city is in the map 8944. 30 degrees north and 7067. 61 degrees east. The city of Zahak with a total area of 945 square kilometers has two central parts and Jiznak, and 4 villages of Zahak, Khajeh Ahmad Jazink and Kumak and also has 203 villages. The distance from the city center to the provincial capital is 213 km, the distance from the city to Tehran is 1518 km and its height from the sea level is 483 m. The shape (1) shows the geographical location of the area in question.

3. Geology of Sistan Plain

Zabul plain is a small part of the Trough of Afghanistan, which is a central part with the Herirud fault of the Felishi Basin of the East of Iran (Fig. 2). Geophysical surveys show that the overall trend is from the north to the south plain and a significant volume of Neogene to Quaternary deposits is accumulated, with only Quaternary rows of 2500 meters (Aghanabati 2004). Due to the resistance of the hard

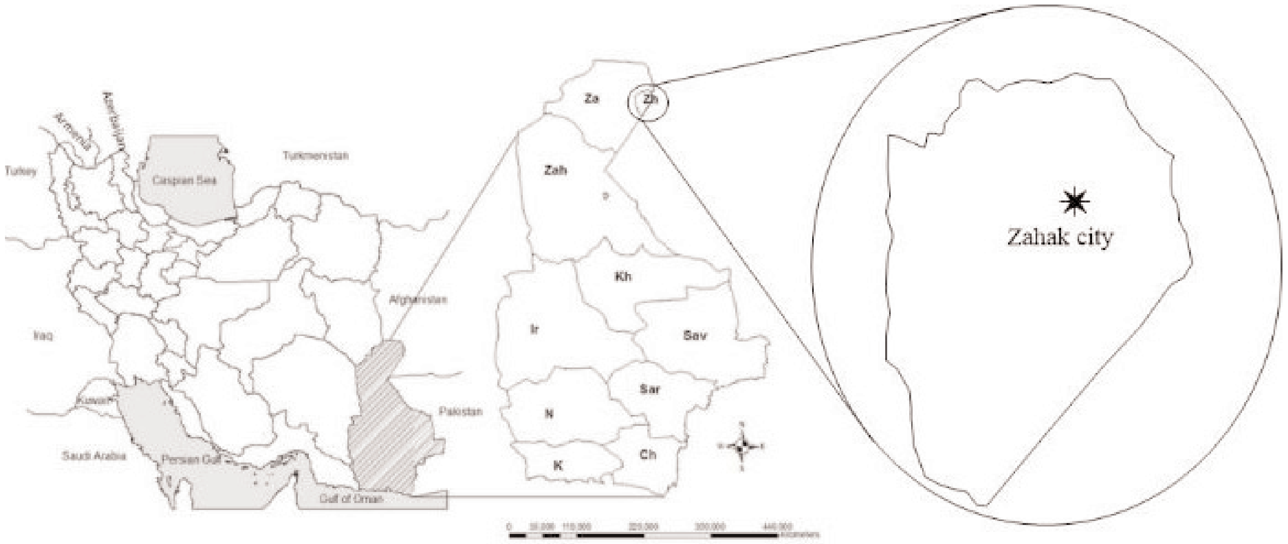

Figure 1. Geographical location of the study area

block, the Pasadenian movements did not produce any significant changes in the Neogene sediments and the flatness of the plain was consistent with the horizontal structure of these deposits (AlaeTaleghani 2005). A complex ophiolitemelange is distributed spatially in the southern parts of the region (Zahedan to Kholeh Stone) with facies such as serpentin, peridotite and deep-sea sediments. In this zone there are no older sediments than Cretaceous. Upper Cretaceous facies are also flush deposits with volcanic rocks, with a thickness of up to 3,000 m (Disserated 1995). This zone is severely crushed and tectonized and undergoes a modest transformation. According to Thirrol et al. (1983), the lobe between the Afghan bloc of Lut zone during the Cretaceous has been consistent with the absolute age data obtained from the ophiolites of southern Nosrat Abad (60-100 million years) (Darwish Zadeh 1991).

3.1. Sources of surface water

Surface water sources in Sistan are based on the Hirmand River, and this river is a vital shrine of Hamoon Lake and semi-well.

4. Results and Discussion

In this section, by using appropriate methods that are able to provide the necessary results and information, an appropriate field for studying the findings and providing scientific and logical explanations for answering the research questions is provided. In this research, in order to locate suitable areas for landfill, slope parameters, lithology, distance from access routes, distance from the airport, distance from fractures, distance from the city, distance from surface waters, distance from groundwater resources, and Underground water depths have been used.

4.1. Satellite Image

This image is provided by the ETM Landsat sensor (Fig. 4), the specification of which is in accordance with Table (1).

4.2. Stone units of the region

The map of the unit's stone units is part of the map 1: 250,000 of the zahak. After digitization, faults and channels are identified in the study area to identify the formations and rocky units.

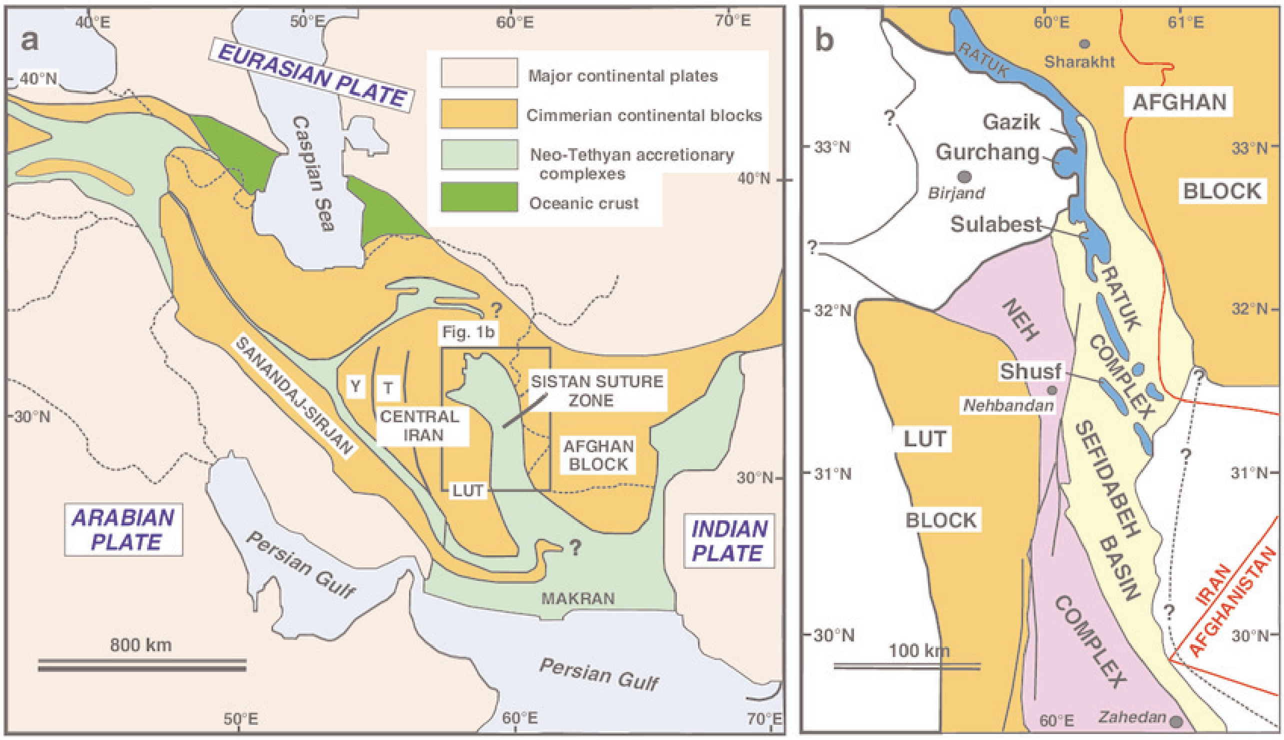

Figure 2. A: The main geological classification of welded zone Sistan
B: Simple geology map of the welded zone of Sistan (Walker & Jackson 2004)

4.3 Digital Elevation Map (DEM)

This map is prepared using Landsat satellite imagery to provide a topographic slope of information.

4.4 Slope area

For this information layer, the DEM images of the area were used and after processing and analyzes, a slope was constructed on that slab layer (Fig. 7).

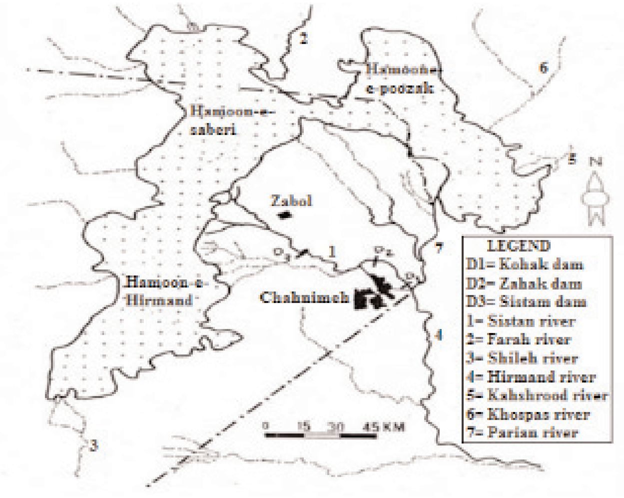

Figure 3. Hydrological system of Sistan Plain (BeykMohammadi et al. 2005).

Table 1. Landsat satellite imagery

MAP ROJEC-TION	REFERENCE DATUM	Output format
UTM- Zone no. 41	WGS84	GEOTIFF

Table 2. Score for Lithology factor

Layer	Classifieds	score
Lithology	Radialarite shale, shale and mudstone, shale and sandstone	5
	Andesite, Basalt, Split, Serpentinite, Ultrabazic rocks, gabro, granodiorite, quartz diorite	4
	Conglomerate, sandstone, Eocene base gland, Siltestone	3
	Massive lime, limestone, limestone and coral lime, Pelagic limestone	2
	Debris, playa, sandal	1

Table 3. Score range for distance factor of access routes

Layer	Classifieds	score
Distance from access roads (M)	0-200	1
	200-400	2
	400-700	3
	700-1000	4
	> 1000	5

4.5 Information Access Layer

This layer is provided using Google Earth Satellite imagery (Fig. 8). Due to the role of this parameter in landfill location, distances are classified in five classes. Table (3) shows the scoring range for the access paths factor.

4.6 Distance from Water Resources

Considering that only water resources in the study area are semi-well and its use in drinking, sanitary and agricultural uses, it is vital to consider the dis-

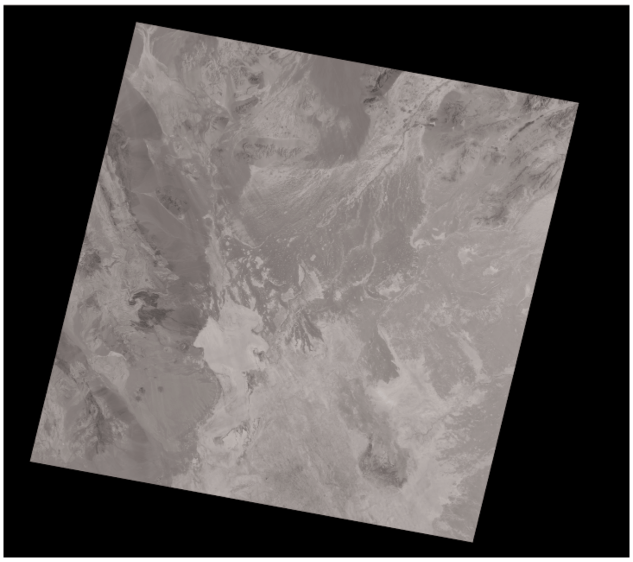

Figure 4. Satellite image of the area (ETM Landsat sensor) in 2001

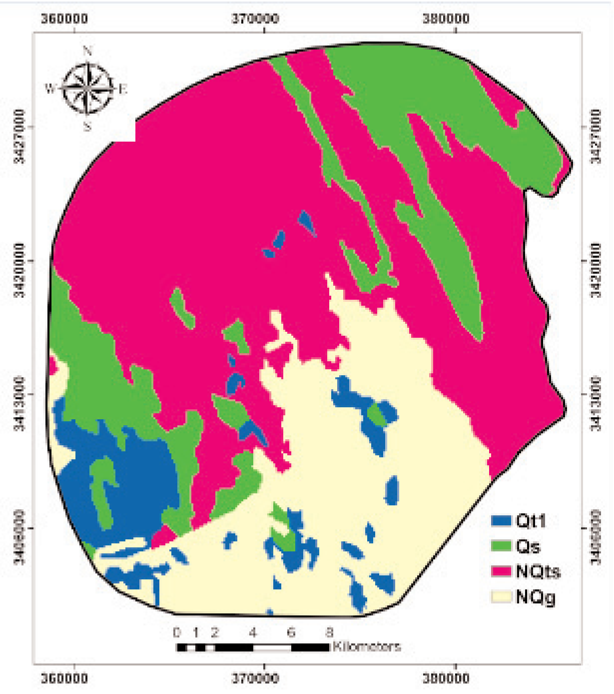

Figure 5. Geological map of the study area

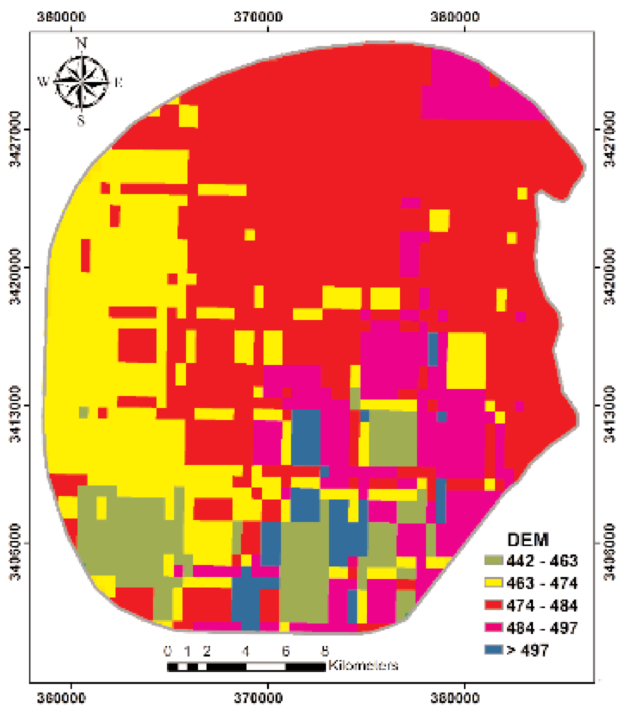

Figure 6. Digital elevation map (DEM)

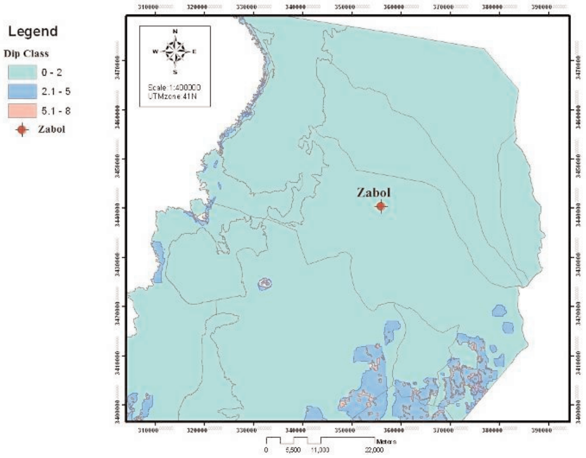

Figure 7. Classification of the slope of the studied area (Bazzi and Sargolzaei, 2015)

tance from these resources in locating. For this purpose, we plotted the distance from the water resources and the distances from these sources were arranged in five classes (Fig. 9).

4.7 Distance from the river

Google Earth satellite imagery is used to prepare the map. Therefore, the distances from the river were classified into five classes (Fig. 10).

4.8 Distance from the city

In order to prevent the risk to human health and the environment, the landfill must always be located outside the city and away from the population centers.

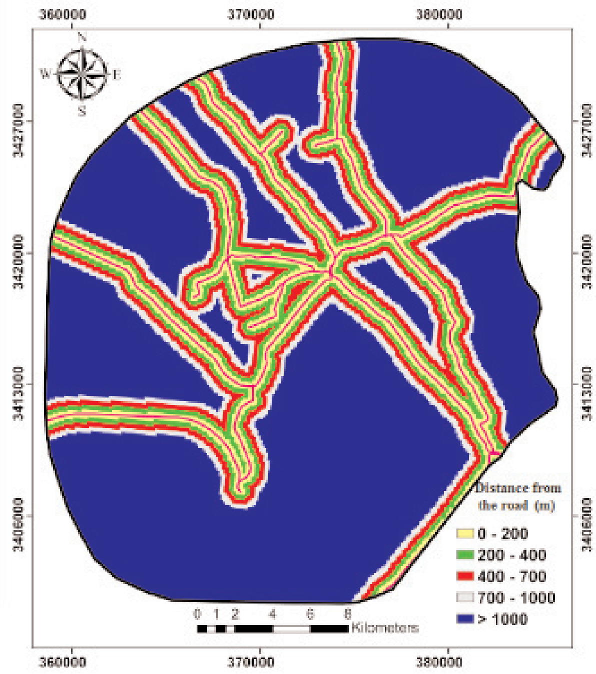

Figure 8. Information Access Layers

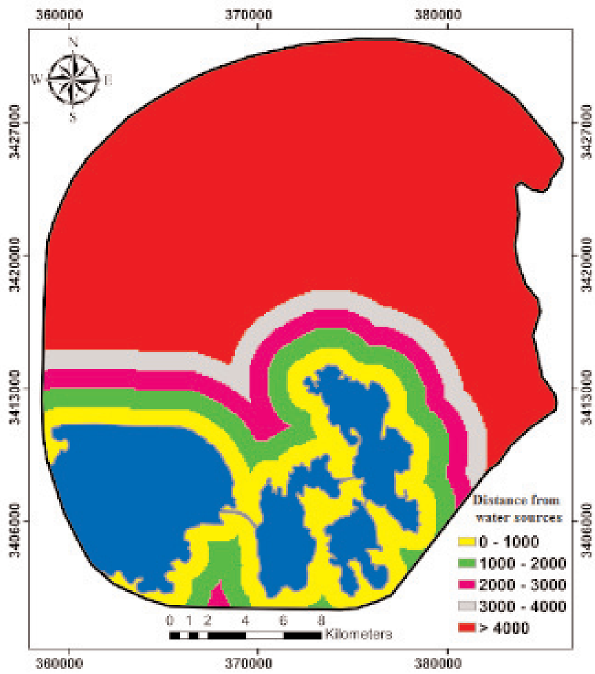

Figure 9. Information Layer Distance from Groundwater Resources

Table 4. Score range for the distance factor of water resources

Layer	Classifieds	score
Distance from water resources (m)	0-1000	1
	1000-2000	3
	< 2000	5

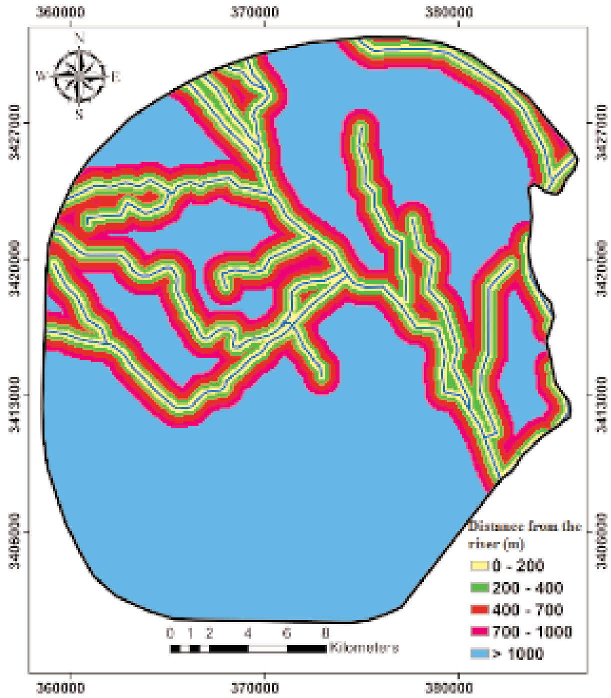

Figure 10. Information layer distance from the river

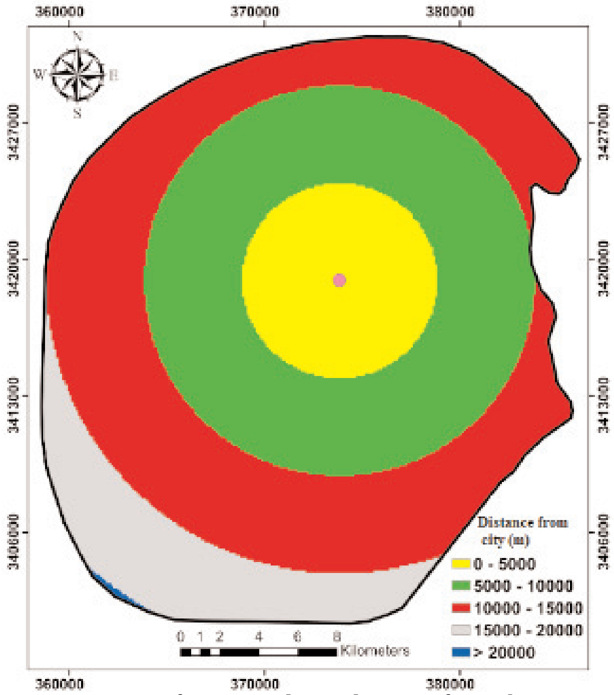

Figure 11. Information layer distance from the city

Table 5. Score range for the distance factor from the river

Layer	Classifieds	score
Distance from access roads (M)	0-200	1
	200-400	2
	400-700	3
	700-1000	4
	> 1000	5

Table 6. Score range for distance factor from city

Layer	Classifieds	score
Distance from city (Km)	0-5	1
	5-10	2
	10-20	3
	20-30	4
	> 30	5

Depending on the life of the landfill, which is estimated at least 20 to 15 years, the landfill should not be the city's future development path. On the other hand, in order to reduce the costs and the time of transportation, it should even be placed in a more intimate position than the place of production.

4.9 Weighing the information layers

After identifying the criteria for locating and classifying maps into different classes based on how the parameters are affected, the importance of each parameter in giving a certain weight to each parameter is based on its impact and the purpose of the final mapping. Weighing in this research has been done by Analytical Hierarchy Process (AHP). This method is based on expert knowledge. In this method, it is possible to formulate the problem and consider different criteria. The basis of work in the hierarchical analysis method is based on pairwise comparisons, so that the parameters are compared to each other and the work of judgment is easy and the accuracy of the calculation is high. (Table 7) shows the paired comparison table between the effective parameters in the zoning. In the next step, the matrix of the comparison of the pair in which its values express the relative importance of the parameters were calculated according to (Table 8), and finally, based on the paired comparison matrix, the weight calculations of each parameter were made (Table 9). Another benefit of this is calculating the Consistency Rate, which makes it possible to review judgments. This value should be less than 0.1 to allow for acceptable adaptation, but if it is more than 0.1, judgments should be reviewed.

Table 7. Comparison of the nine effective parameters in locating

Landfill Site Selection
Node: 0
Compare the relative LIKELIHOOD with respect to: GOAL
1=EQUAL 3=MODERATE 5=STRONG 7=VERY STRONG 9=EXTREME

1	W	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C
2	W	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	G
3	W	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	H
4	W	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	R
5	W	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	S
6	C	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	G
7	C	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	H
8	C	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	R
9	C	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	S
10	G	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	H
11	G	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	R
12	G	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	S
13	H	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	R
14	H	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	S
15	R	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	S

Abbreviation	DEFINITION
Goal	Landfill site selection
W	water source
C	city
Goal	litology
H	hight
R	road
S	river

Inconsistency Ratio= 0.1

Distance from road= R, lithology= L, groundwater depth= H, distance from fracture= F, distance from waterway= D, distance from groundwater resources= W, distance from city= C, distance from airport= A, slope= S
AB=Absolutely more important; VS= Very Strongly more important
ST= Strongly more important; WK=Weakly more important

4.10 Integration of information layers and landfill site mapping

Combination of maps with overlapping weighted maps is obtained. To construct a landfill location map, according to equation (1), the spatial value of the Potential Map Locality Values (or PMLV) in GIS

Table 8. Coupled matrix matrix for 9 effective parameters in locating

	H	W	S	A	C	L	D	R	F
H	**1**	**2**	**3**	4	4	4	5	5	6
W	0-5	1	2	3	4	4	5	6	7
S	0-333333	0.5	1	2	3	4	5	6	6
A	0.25	0.333333	0.5	1	1	2	3	3	4
C	0.25	0.25	0.333333	1	1	2	3	4	5
L	0.25	0.25	0.25	0.5	0.5	1	2	3	4
D	0.2	0.2	0.2	0.333333	0.333333	0.5	1	2	3
R	0.2	0.166667	0.16667	0.333333	0.25	0.333333	0.5	1	2
F	0.166667	0.142857	0.166667	0.25	0.2	0.25	0.333333	0.5	1

Table 9. Assigned weights to 8 effective layers in locating

Evaluation	Weights
H	0.280791
W	0.221499
S	0.1665
A	0.0875664
C	0.088284
L	0.0611686
D	0.0413861
R	0.0304104
F	0.0223949

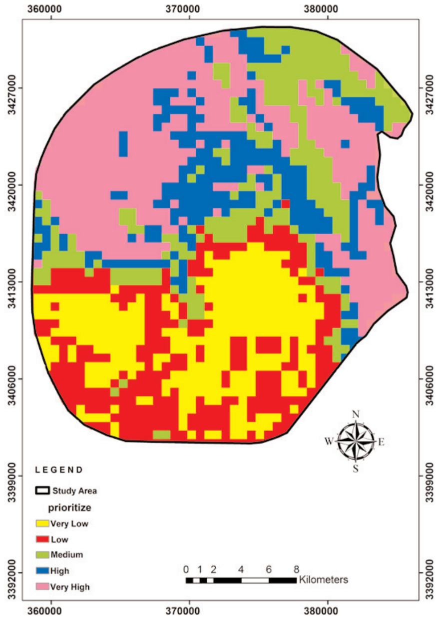

Figure 12. The map of the integration of 9 layers of 1.

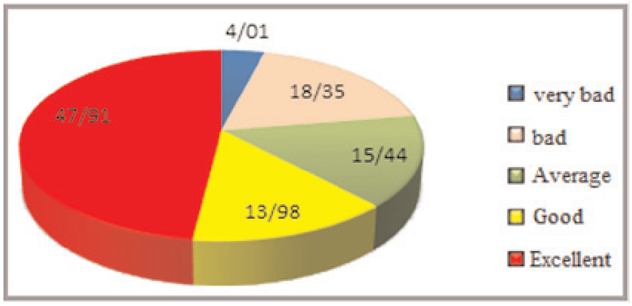

Figure 13. The percentage of different areas for landfill location

Table 10. Areas intended for different parameters (Bazzi and Sargolzaei, 2015)

layer	Layer privacy	Reference
slope(%)	> 30	Criteria, 2005; Koo, 1996
Access roads (m)	200	Allen and Dillon, 1997
Fault and Fracture (m)	100	Khorshiddoost, 2009
Distance from the waterway (m)	200	Environmental Protection Agency
Distance from airport (m)	8000	Farhoudi et al, 2008
Urban areas (m)	5000	Cantwall, 1999
Distance from ground-water resources (m)	1000	Sener et al. 2006

software, by combining the value values of each of the layers of information, including The weight assigned to each layer (Table 8) was calculated, and the resulting map was created (Fig. 12) and the percentage of zones for each class was obtained (Fig. 13).

Relationship (1)

PMLV = ([H] * 0.280791) + ([W] * 0.221499) + ([S] * 0.1665) + ([A] * 0.08756) + ([C]* 0.088284) + ([L] * 0.061168) + ([D] * 0.041386) + ([R]*0.030410) + ([F] * 0.02239)

4.11 Remove prohibited areas from the main map

In order to maintain the health of the water, soil and prevent damage to the burial ground, some places should be avoided such as residential centers, natural and ancient protected areas, roads and roads, ground-

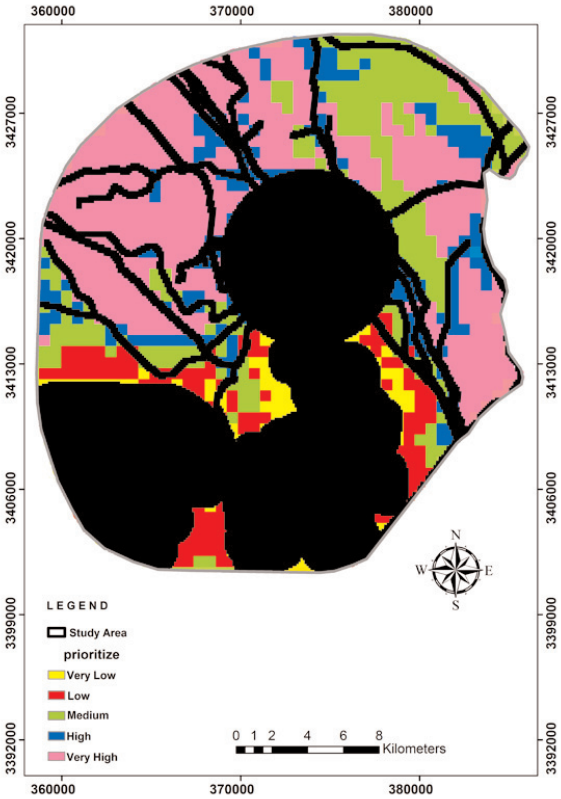

Figure 14. Final design of landfill location after combining prohibited areas

water and surface water and faults, and prohibited areas Suitable for them. Observance of these restrictions is subject to the conditions of the region (Bagher Kazemi 2009). Prohibited areas in this study were identified according to the nine layers of information used for location (Table 10). Ultimately, with the overlapping of prohibited areas with the map from the previous stage, a final landfill landfill plan has been prepared (Fig. 14).

5. Conclusion

In order to locate 9 factors (in order of prioritization: distance from groundwater resources, topographic slope, lithology, distance from the city, distance from the river, distance from access routes and distance from fracture) has been used. The layers are integrated according to the fuzzy logic, and the landfill landfill map is obtained in five classes (very good, good, average, bad and very bad). According to this map, 47% of the area of the study area is located in a very good class, which mainly includes the eastern and northwest of the city of Zahak. Also, 13.9% were in good class, 15.4% in moderate class, 18.3% in bad class, and 4% in badly classified class.

An officer of the area is also recognized as a prohibited area. By integrating these areas into the location map, the final landfill map is obtained.

Eventually, Landfill needed the area to bury 20 years waste from the city of Zahak, which is 647 hectares.

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