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ORIGINAL ARTICLE

Alternative suitable landfill site selection using analytic hierarchy process and geographic information systems: a case study in Istanbul

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Abstract Solid waste management is an important environmental event for developed and developing countries. One of the most sensitive issues in waste management is the selection of a suitable location for the landfill site. This paper presents geographic information systems and analytic hierarchy process approach for selecting the alternative for landfill site selection in Istanbul, Turkey. Totally, eleven factors were used, and two main classification groups were set up in the study which is environmental and economic. Environmental factors are land use, geology, settlement areas, surface waters, population density, airports, and protected areas. Economic factors are slope, solid waste transfer stations, land values, and highways. The identified factors are separated by sub-criteria according to the appropriateness of solid waste landfill. One of the studies that has been made is the discussion of the creation of a dynamic model for the location selection of the solid waste dumping site. In light of legal restrictions, 80% of the study area is classified as unauthorized area. As a result of the study, 1% of the region is unsuitable, 4% is less suitable, 13% is suitable and 2% is very suitable and the digital map bases leading the decision makers were created.

Keywords Geographic information systems · Multi-criteria decision making · Analytic hierarchy process · Landfill siting

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Introduction

Geographical information system (GIS) is an essential tool used in the solution of environmental issues. GIS plays an active role in data-driven processes involving spatial information (Yomralıoğlu 2000). In work carried out, GIS is used together with different decision-making methods to produce meaningful outputs. In the literature review, it is seen that analytical hierarchy process (AHP) is used predominantly as one of the multi-criteria decision-making methods (Huang et al. 2011). Studies using GIS and AHP are commonly carried out in literature (Akıncı et al. 2013; Aydi et al. 2015; Beiler and Treat 2015; Bozdağ 2015; Bozdağ et al. 2016; Erden and Karaman 2012; Eroğlu and Aydin 2015; Houshyar et al. 2014; Palchaudhuri and Biswas 2016; Tudes and Yigiter 2010; Widiatmaka 2016; Xu et al. 2012; Ying et al. 2007). In developing countries, the increase of human population and related human activities accelerated urbanization (Sumathi et al. 2008b). As a result of growing population, change of consumption patterns, economic growth, change of income, urbanization, and industrialization, solid waste production and diversification have increased (Ngoc and Schnitzer 2009). Urban solid waste management from environmental issues is a serious problem in all countries of the world. Waste management and waste disposal alternatives are a complex process involving decision makers and related parties. Selection of the most suitable landfill site depends on regulatory constraints and regulations, as well as physical process conditions and environmental, economic, health, and sociocultural impacts (Sadek et al. 2006). One of the most sensitive issues in waste management is the selection of a suitable location for the dumping site; some factors are taken into consideration, and there is no universal formulation for selection (Vasiljevic et al. 2012). Landfill site selection studies using GIS and MCDM methods are frequently encountered in the literature (Baban and Flannagan 1998; Basağaoğlu et al. 1997; Khan and Samadder 2015; Torabi-Kaveh et al. 2016).

A study was conducted using the GIS and analytical hierarchy process (AHP) in the Cleveland County settlement in Oklahoma, the USA, by Siddiqui et al. (1996). It is stated that the regulations for the new urban solid waste dumping sites to be built and the challenges raised by local residents will reveal some difficulties. The constraints for the AHP method in the study were created with the help of experts and users of the region's properties and land assessments. Gupta et al. (2003) have pointed out that technological and industrial project activities in the study are harmful to the natural ecosystem and lead to consequences, either directly or indirectly. They have argued that it is necessary to reduce the environmental impact in the most suitable landfill site and to report Environmental Impact Assessment (EIA). In this direction, potential new landfill sites are proposed by taking advantage of criteria weights determined by the fuzzy logic method. In the study carried out by Kontos et al. (2005), multi-criteria decision-making methods (MCDM), GIS, spatial analysis, and spatial statistics were used. The appropriate landfill site has been made use of the Greek and European Union regulations and universal and practical applications for site selection. As a result of the application, it has been determined that 9.3% of the Lemnos Island is suitable for landfill. Sener et al. (2006) talked about the importance of solid waste management in urban areas in their study, and they realized the appropriate landfill site for Ankara province by using GIS and MCDM. Simple Critical Weighting and AHP methods are used from MCDM. In the study, 16 different map layers such as topography, residential areas, roads, and airport were included as input. At the end of the study, the produced maps were compared using two different MCDM. Sumathi et al. (2008a) have pointed out that the rapidly increasing urban population in the study they are doing is increasing the importance of environmental sustainability and effective solid waste management in urban areas in developing countries. Many factors such as geology, land use, and air quality have been used as inputs in the study. Using GIS and MCDM, field results were obtained which include India's Pondicherry, Karaikal, Mahe, and Yanam regions. In the study conducted by Guiqin et al. (2009), it is stated that the site selection is important and necessary for waste management in rapidly developing regions. Due to the complexity of waste management systems, the selection of the appropriate landfill site requires several alternative outcomes and evaluation criteria. For the study conducted in Beijing of China, GIS and AHP methods were used. Very suitable, appropriate, and inappropriate areas have been identified as a result of the work. It is emphasized that the general disposal method used in the management of urban solid waste in Turkey be the waste landfill operation in work done by Şener et al. (2011). It has been mentioned that the social, environmental, and technical parameters should be taken into account when choosing the landfill location. The study was carried out for the Beyşehir Lake basin located within the borders of Konya province. Geology, land use, slopes, and roads were employed in the study. In the study conducted by Yesilnacar et al. (2012), attention was drawn to the need for solid waste disposal sites in urban waste management. Restrictions and environmental regulations cover areas that are mechanically unsuitable. This compelling situation can be solved effectively with GIS and AHP. As a result of the work, it was seen that all the constraints of the expert-based solutions were evaluated at the same time, and the solution could not be reached quickly. In the study conducted by Uyan (2014), landfill site selection for Konya province in Turkey was carried out using MCDM and GIS, and 15.52% of the study area was in a very suitable class. Yal and Akgün (2014) have determined alternative solid waste landfills using GIS and MCDM in their study of Ankara, which includes the Gölbaşı municipality. Inputs such as geology, slope, settlement, agriculture, and erosion were used in the study. In the work done by Abd-El Monsef (2015), an alternative solid waste dumping site for the Red Sea, which is a rapidly growing tourist area in recent years, has been identified using GIS and AHP methods. Different factors such as transportation routes, airports, surface waters, and residential areas were used in the study. As a result of the study, three alternative dumping sites were identified. In the study conducted by Yıldırım and Güler (2016), AHP and GIS techniques were jointly used to identify suitable municipal solid waste disposal site for the Metropolitan Mersin, Turkey, utilizing some decision criteria (i.e., lithology, aquifer type, and distance from lineaments). The classified suitability map indicates that 0.73% of the study area is most suitable, 2.75% is suitable, 3.39% is moderately suitable, 4.77% is poorly suitable, 3.47% is least suitable, and 84.89% is completely unsuitable for siting. The aim of the study carried out by Djokanovic et al. (2016) is to evaluate the point of view of geological engineers from finding a landfill area which is a complicated process. Alternative landfill sites for the Pancevo region of Serbia were identified using the GIS and AHP methods in the study. As a result of the study, it is determined that 62.31% of the region is not suitable and 12.12% is very suitable. Maguiri et al. (2016) have identified alternative landfill sites for Mohammedia city of Morocco using GIS, remote sensing, and MCDM. In the study, distance from houses, surface waters, land use, and slope were used. At the end of the study, three different dumping sites were identified. Bahrani et al. (2016)

performed the most appropriate landfill site identification by obtaining the necessary maps for the Shabestar province of Iran in their study. They selected the most suitable area by analyzing the suitability of the alternative areas in 6.25% of the study area. In the study conducted by Rahmat et al. (2017), the landfill site for Behbahan province of Iran was determined by using GIS, AHP, and SAW methods. Layers such as land use, distance to surface water, distance to city, and distance to roads are used. It has been found that 38% of the study area is highly suitable for the dumping site. Nascimento et al. (2017) used the MCDM and GIS methods to model the landfill sites in the state of California in the USA. It has been determined that 61 landfill sites in 25% of the study area are located in suitable and very suitable classes. Barakat et al. (2017) have used MCDM and GIS methods to detect a new suitable landfill site for Morocco. The aim of the work is that the landfill sites used can have a negative effect. Ten criteria were used in the study. It has been determined that 10% of the study area is in the most appropriate class. Chabuk et al. (2017) performed a landfill site detection study for Al-Musayiab Qadhaa using 15 variables using AHP, GIS, and SAW methods. It is predicted that the areas identified in the study may function until 2030.

In this study, it is aimed to determine the location of alternate landfill site for the province of Istanbul by using the weight of the criteria that can be obtained by GIS's locational analysis and AHP of MCDM in which the actions were carried out with this objective.

Materials and method

Study area

The city of Istanbul is located in the northwest Marmara region of Turkey, in the coordinates of 28°10′ and 29°40′ East longitude and 40°50′ and 41°30′ North latitude (Fig. 1). According to the Turkish Statistical Institute (TUIK) data for 2016, the population of Turkey is 79,814,871. Of this population, 14,804,116 live in the province of Istanbul. This figure is approximately 19% of the total population of the country.

Methodology

The steps can be listed as:

- Identification of study area,
- Setting criteria for AHP operation,
- Obtaining existing data and maps,
- Calculation of weights of criteria by AHP method,
- Determination of sub-criteria depending on main criteria,
- Transfer of criteria to GIS environment in a common coordinate system,
- Reclassification of layers by sub-criteria values,
- Reclassify layers with distance values with Euclidean distance,
- Weighing the layers and analyzing them in the GIS environment to determine the most suitable areas, and
- Creating a dynamic model with a modular structure within the GIS software for location selection.

After these steps, the economic scenario was also considered in addition to the environmental scenario in order to demonstrate that the results may differ according to different priorities. Moreover, the model was re-performed by selecting different pixel size since it has an importance in the stage of obtaining the required data.

Calculating criteria weights by AHP

In the study conducted, the most intensively used factors were evaluated by conducting a literature search (Baba et al. 2015; Bah and Tsiko 2011; Changa et al. 2008; Demesouka et al. 2016; Donevska et al. 2012; Gemitzi et al. 2007; Ghobadi et al. 2013; Gorsevski et al. 2012; Mahini and Gholamalifard 2006; Moeinaddini et al. 2010; Monsef 2015; Nas et al. 2010; Şener et al. 2010; Yal and Akgün 2013; Yıldırım 2012). The research was carried out together with the restrictions stated in the regulation of our country. Moreover, the factors to be used are determined by considering the characteristics of the study area. Eleven sub-criteria were used in the study under the environmental and economic main criteria.

Environmental factors are land use, geology, settlement areas, surface waters, population density, airports, and protected areas. Economic factors are slope, solid waste transfer stations, land values, and roads. The identified factors are separated by sub-criteria according to the appropriateness of solid waste landfill, and values are assigned. Scores are assigned between 0 and 5 for all factors (Guiqin et al. 2009). Also, the scores can be seen in Table 1. Figure 2 shows the hierarchy model of landfill suitability used in the study.

AHP is a general measurement theorem. The theorem uses discrete and continuous binary comparisons in multiple hierarchical structures. The AHP provides qualitative and quantitative measures as one of the MCDM. A comparison between 1 and 9 is made in which 1 indicates that it is equally important, while 9 suggests that it is definitely more important. With AHP, measurement of physical and social events from people's concerns for a long time can be

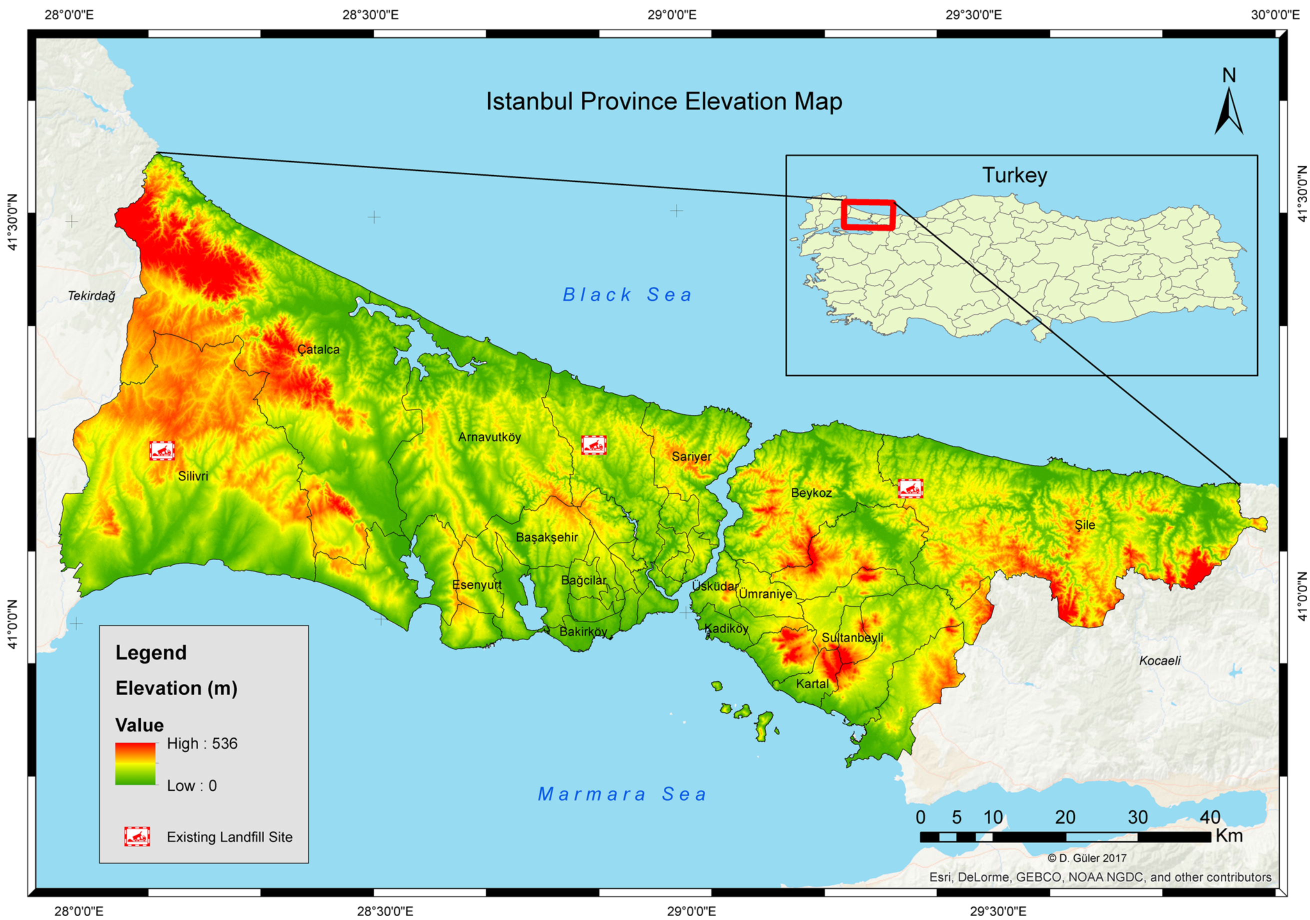

Fig. 1 Istanbul province elevation map

done together (Saaty and Vargas 2001). To explain the AHP methodology:

- Identification of the problem and determination of the target,
- Starting from the top level of the hierarchy, creating different levels of target, criteria, sub-criteria, and alternatives,
- The creation of the comparison matrix in the relevant sections,
- To find the highest eigenvector, consistency indicator, consistency ratio, and normalize values of each criterion, and
- If the values found are satisfactory, normalize the weighing process; if not, repeat the steps to reach the target range (Saaty and Kearns 1985; Vaidya and Kumar 2006).

In AHP, the λ_{max} value is used as a reference index by calculating the consistency ratio (CR) of the estimated vector (Saaty 1980). In order to calculate the (CR), the consistency index (CI) for each matrix of order n can be computed by the following equation; $CI = \lambda_{max} - n/(n-1)$. Calculation of the consistency ratio is $CR = CI/RI$. It is obtained by dividing the value of consistency index (CI) by the Random index value (RI). The values of (RI) from matrices of order 1–10 can be found from Saaty (1980). It is important to note that if the value of consistency ratio is smaller or equal to 0.1, then the inconsistency is acceptable according to (Saaty 1980).

The pairwise comparisons matrices used in the study can be seen in Tables 2, 3, 4, and 5.

Land use

Forest areas are not suitable for landfill. Vineyards, scrublands, and pasture lands were selected and scored more appropriately for site selection. The areas used for irrigated and non-irrigated agriculture have high values because they are suitable for landfill facilities. The sub-criteria determined from the CORINE data were extracted as a new layer.

Geology

Volcanic zones are considered to be suitable areas for dumping site selection since they have restricted water

Table 1 Criteria scores

Criteria	Sub-criteria	Score
Land use	Non-irrigated	5
	Irrigated	4
	Pasture land	3
	Scrubland	2
	Vineyard	1
	Forest	0
Geology	Sedimentary	5
	Metamorphic	4
	Volcanic	3
Settlement areas (km)	4 <	5
	3–4	4
	2–3	3
	1–2	2
	0–1	0
Surface water (m)	2000 <	5
	1500–2000	4
	1000–1500	3
	500–1000	2
	0–500	0
Population density	0–30	5
	30–330	4
	330–640	3
	640–1600	2
	1600 <	1
Airports (km)	7 <	5
	5–7	4
	3–5	3
	1–3	2
	0–1	0
Protected areas (km)	1 <	5
	0–1	0
Slope (°)	0–5	5
	5–10	4
	10–15	3
	15–20	2
	20–25	1
	25 <	0
Solid waste transfer stations (m)	0–250	5
	250–500	4
	500–750	3
	750–1000	2
	1000 <	1
Land values (TL)	0–400	5
	400–1600	4
	1600–2800	3
	2800–4000	2
	4000 <	1
Roads (m)	0–500	5
	500–1000	4
	1000–1500	3
	1500–2000	2
	2000 <	1

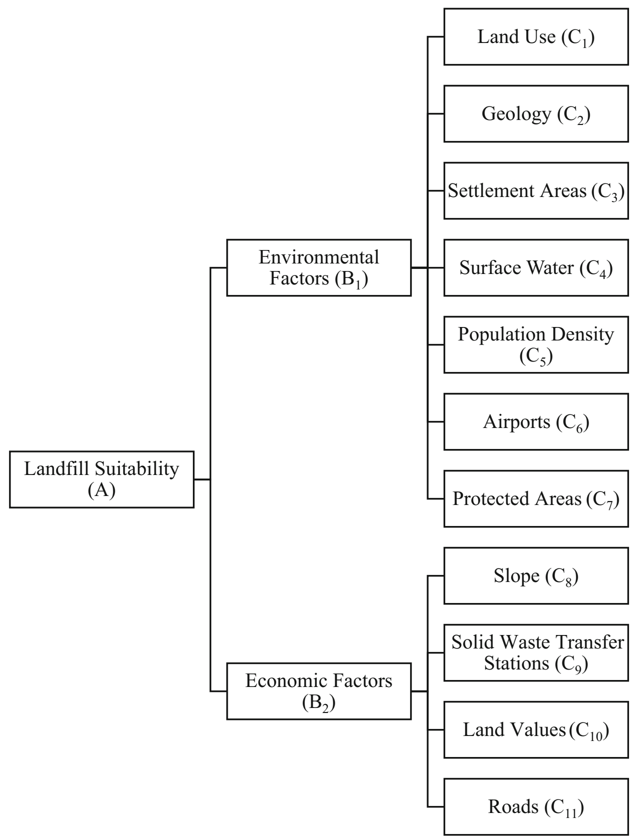

Fig. 2 Hierarchy model of landfill suitability

Table 2 Pairwise comparisons matrix A-B1, B2

A	B_1	B_2	W
B_1	1	3	0.75
B_2	1/3	1	0.25

CR = 0.0000; A, landfill suitability; B_1, environmental factors; B_2, economic factors; W, weight

permeability. Because of their volcanic structures, the metamorphic and sedimentary rock features have less water permeability. Therefore, as the criteria rate, they assigned with higher scores.

Table 3 Pairwise comparisons matrix B1-C1–7

B_1	C_1	C_2	C_3	C_4	C_5	C_6	C_7	*W*
C_1	1	2	2	1/2	1	1/3	1	0.139695
C_2	1/2	1	1	1/2	3	1	1/3	0.108967
C_3	1/2	1	1	1	3	2	2	0.176534
C_4	2	2	1	1	3	2	1	0.196820
C_5	1	1/3	1/3	1/3	1	1/3	1/3	0.060198
C_6	3	1	1/2	1/2	3	1	1	0.156509
C_7	1	3	1/2	1	3	1	1	0.161277

CR = 0.093436; B1, environmental factors; C1, land use; C2, geology; C3, settlement areas; C4, surface water; C5, population density; C6, airports; C7, protected areas; *W*, weight

Table 4 Pairwise comparisons matrix B2-C8–11

B_2	C_8	C_9	C_{10}	C_{11}	*W*
C_8	1	3	5	4	0.540631
C_9	1/3	1	3	3	0.253508
C_{10}	0.2	1/3	1	2	0.117414
C_{11}	¼	1/3	1/2	1	0.088447

CR = 0.053904; B2, economic factors; C8, slope; C9, solid waste transfer stations; C10, land values; C11, roads; *W*, weight

Table 5 Criteria weights of all factors

Goal A	Hierarchy B	Hierarchy C	*W*
A	B_1	C_1	0.10477125
		C_2	0.08172525
		C_3	0.13240050
		C_4	0.14761500
		C_5	0.04514850
		C_6	0.11738175
		C_7	0.12095775
	B_2	C_8	0.13515775
		C_9	0.06337700
		C_{10}	0.02935350
		C_{11}	0.02211175

Settlement areas

Solid waste landfill sites must be located at least one kilometer (km) away from the settlement areas as specified in the regulation (RRSW 2010). Considering the adverse effects that may be created environmentally, higher values are given to the lower criteria as the distance to settlement areas increases (Fig. 3).

Surface water

Due to adverse environmental effects, solid waste disposal sites close to surface waters cannot be established as stated in the regulation (WPCR 2004). The data layer of surface water is produced from CORINE data.

Population density

The population and area information of Istanbul's municipalities are obtained from Istanbul Metropolitan Municipality. Population densities of the districts were calculated by comparing the population information to the information of the square km area. Places, where population density is high, have assigned low scores while areas with low density have high scores.

Airports

There are three airports currently in use in Istanbul. The main airports are Sabiha Gökçen Airport on the Anatolian side and Atatürk Airport on the European side. On the European side, there is also the Istanbul Hazarfen Airport. After the coordinate information was obtained at Istanbul New Airport, which is in the construction phase, it was added to the airport data and used for the study.

Protected areas

The protected area data in the study area was obtained from the Web site of the General Directorate of Nature Conservation and National Parks in Google Earth format and used by converting data in ArcGIS software.

Slope

Economic factors are considered as the cost of construction will increase in areas where the slope is excessive. The areas where the slope is more than 25° are not regarded as suitable for solid waste landfill in the literature. The digital elevation model (DEM) of the study area was obtained from ASTER GDEM.

Solid waste transfer stations

From an economic point of view, landfill sites close to solid waste transfer stations are more advantageous (Guiqin et al. 2009). Coordinate information for a total of eight solid waste transfer stations in use in Istanbul has been converted into a data layer in ArcGIS software. Four of the stations are located on the European side, and the other four are located on the Anatolian side. Areas close to solid waste transfer stations are assigned high scores.

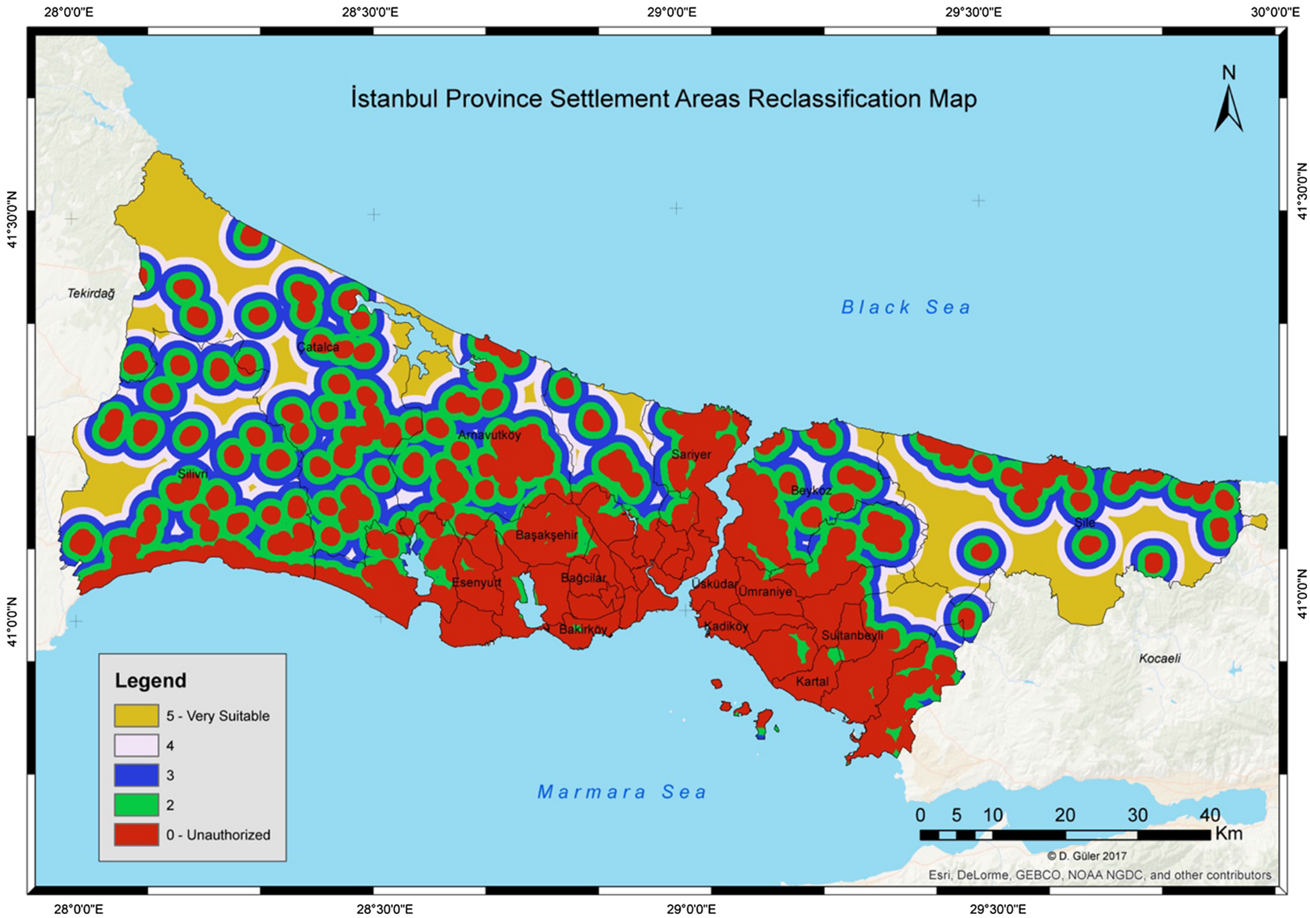

Fig. 3 Istanbul province settlement areas reclassification map

Land values

Among the factors used for solid waste landfill in the literature, a small number of land values are given (Guiqin et al. 2009). The land value factor was chosen considering that Istanbul, which is a study area, has very variable land prices. Land unit prices for the year 2014 in the street scale of Istanbul were obtained from the Turkish Lira (TL) unit on the Web page of the Revenue Administration Department. Land values of the counties are calculated by taking the average of the land values of the streets. Areas with high land values are assigned low scores.

Roads

One of the economic factors was the distance from the roads. From solid waste transfer stations, landfills can create long-haul costs in the process of transporting wastes (Guiqin et al. 2009). For this reason, high values have been assigned to areas close to roads (Fig. 4).

Model development for landfill site selection

Factors and weights used for site selection of solid waste dumping site may vary depending on the study area and the preferred scenario of importance. Scenarios with economic, environmental, or social content can be produced. It will be easier to implement these operations with a dynamic model that can be modified, and it will be able to minimize the errors that may occur during the operation. One of the objectives of the work done is to prepare a model for site selection with solid waste dumping site. In the case of differentiation of limitations brought about by any regulation change that will take place, it will be reached in a very short time by arranging in the model. When the criteria are calculated differently from the weights, the model will be able to reduce the number of steps. The “model builder” module included in the ArcGIS software used in the study created a model for the dumping site (Fig. 5). In the model, the blue trailing layers represent the criteria used in the study. Input data in vector format is converted to raster data by Euclidean distance method. The

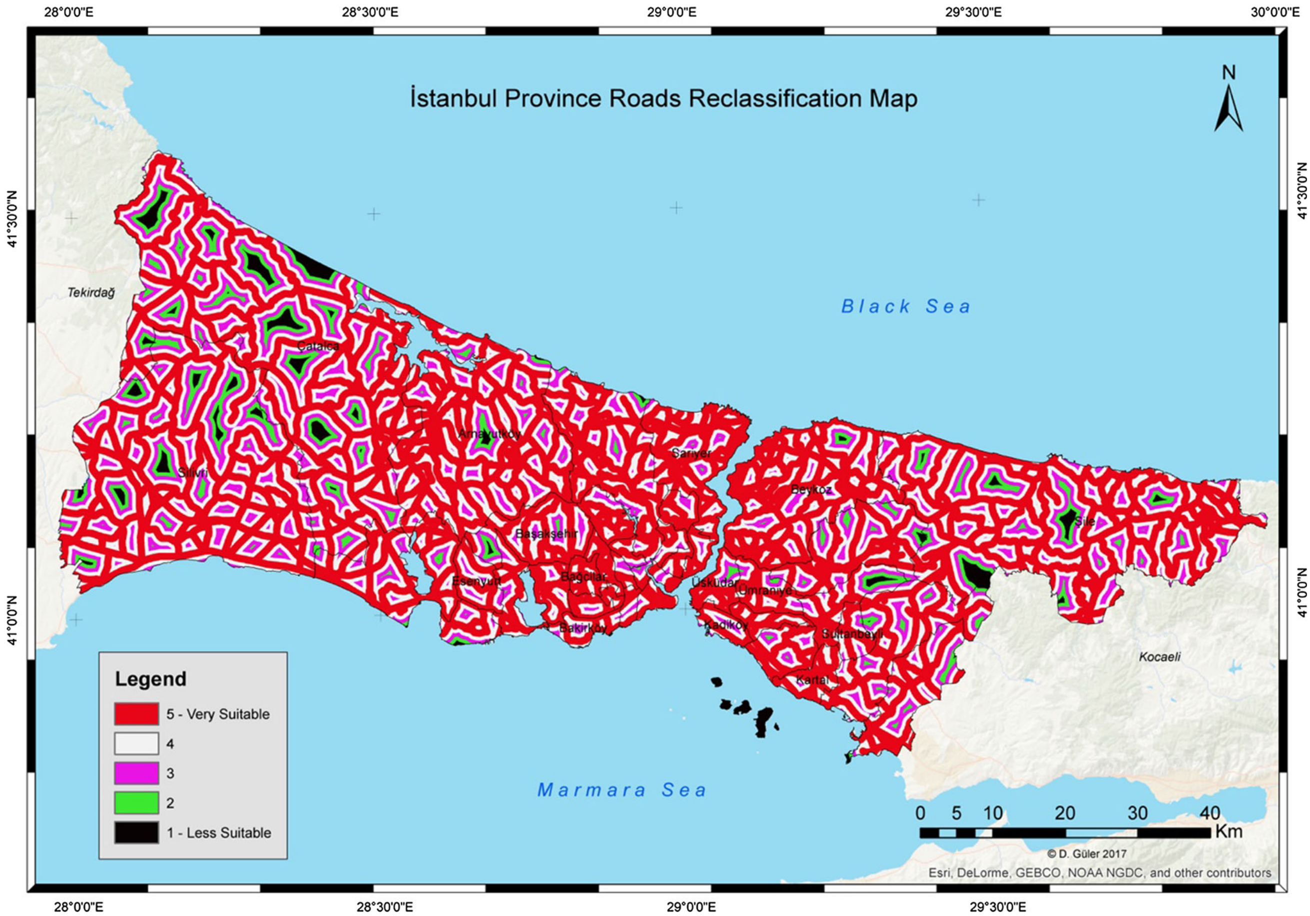

Fig. 4 Istanbul province roads reclassification map

layers converted to raster format are subject to reclassification according to the scores of the sub-criteria. The weighted registration is performed using weights of the criteria obtained from the AHP using the weighted sum spatial analysis tool. Finally, the results are obtained by subtracting the fields that cannot be used as a landfill site.

Results and discussion

As a consequence of the work done, alternative areas for solid waste landfill have been determined. Fields obtained as a result of the analysis are classified as follows: unsuitable, less suitable, suitable, and very suitable. In light of legal restrictions, 80% of the study area is classified as unauthorized area. 1% of the study area was unsuitable, 4% was less suitable, 13% was suitable, and 2% was found to be very suitable (Fig. 6). The alternative regions identified are shown in Fig. 7. As shown in the figure, “Area 1” is located close to the highway and Çerkezköy districts within the Silivri county of Istanbul. There is a forest area just behind the “Area 1”. Another alternative selection is the “Area 2” which is located near the village of Çeltik connected to Silivri county. But this area is now mostly in use for agricultural purposes, therefore, the selection is not seen suitable for this moment.

Area 3 is located in the area between Fenerköy and Gazitepe on the Silivri county. Agriculture and unused land and farms are dominant in the region. Area 4 is located in Alipaşa district of Silivri county. Agricultural areas are dominant in the region. Area 5 is located on the Anatolian side. It is located in the vicinity of Degirmençayı district, which is connected to Şile county. As a result of the evaluations, the best region regarding land use and environmental conditions was decided as area 1. The presence of a highway near the area will reduce costs for solid waste transported from stations. It is in a remote location to settlements. There is an existing Silivri Yemen landfill site opened in 2016 near area 1. As it is aimed to find alternative areas for the future, area 1 has a high degree of suitability when the other existing sites lose their function. After area 1, area 4 can be considered as an alternative. The cost of the solid waste vehicles to be transported from transfer stations will also decrease because of the proximity

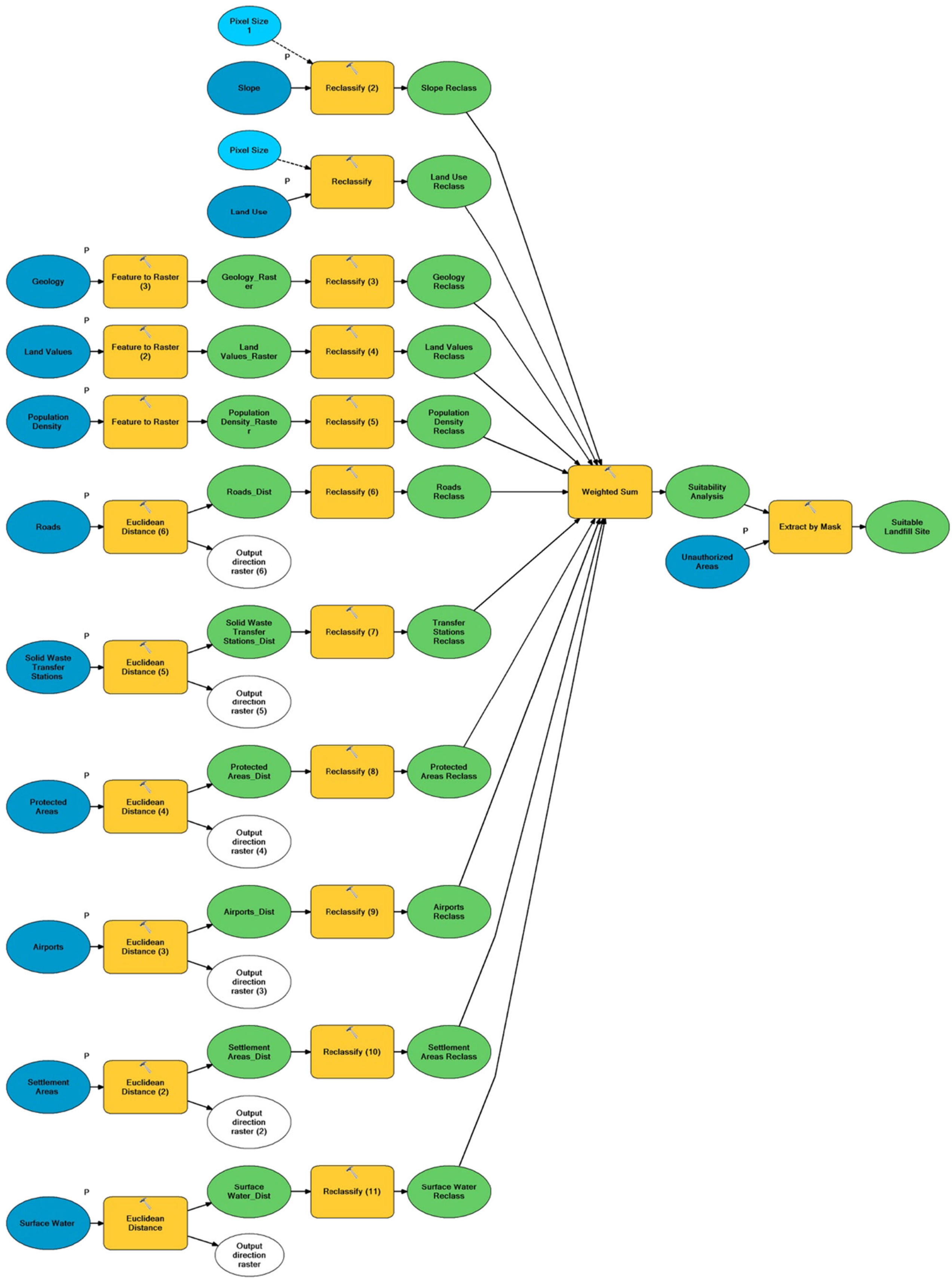

Fig. 5 Landfill site selection model

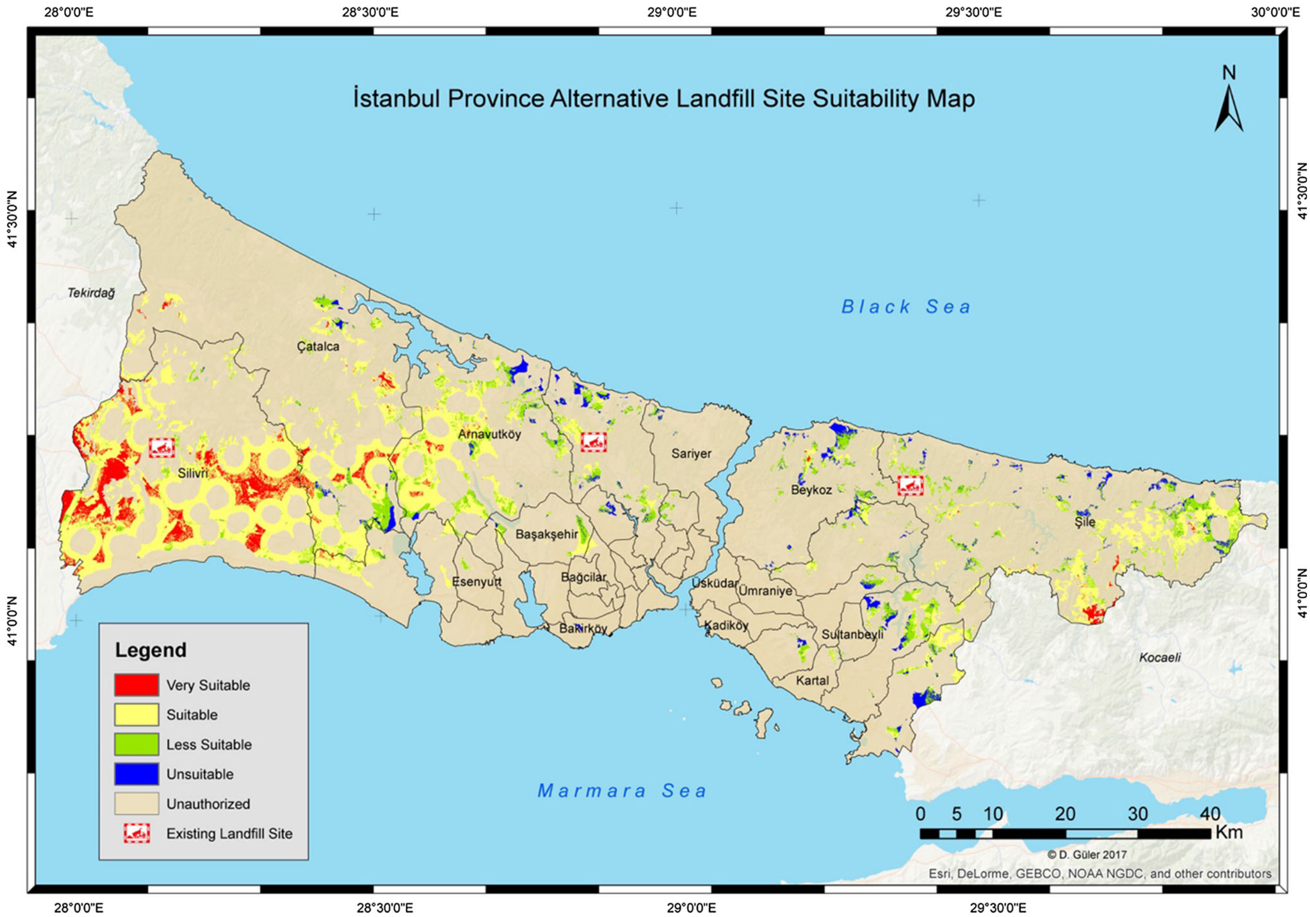

Fig. 6 Istanbul province alternative landfill site suitability map

of the region road, which is usually made up of agricultural land.

Existing dumping site facilities

There is a total of three regular dumping sites in Istanbul. There are Kömürcüoda on the Anatolian side and Odayeri and Silivri Seymen on the European side. The facilities in use have been opened to service according to the environmental and legal specifications in the construction years. It has been examined whether the existing dumping sites are in the appropriate areas obtained as a result of the study. Odayeri regular dumping site is located within the suitable areas obtained as a result of work. Silivri Seymen regular dumping site corresponds to the forest area from the characteristics of land use in operation. Therefore, there are areas classified as unauthorized areas in the study. The current area is located at a very short distance to the suitable areas obtained in operation. Kömürcüoda regular dumping site is located in the forested area like Silivri Seymen and is not allowed in the area. The area where the dumping site is located in Kömürcüoda is very close to the less suitable classification obtained in the study.

Examination of approach scenarios and pixel values

The pixel values of the data used in the study and the pixel size according to the studies in the literature were chosen as 30 m. The results of the analysis were obtained by transforming the given values of the factors of highways, airports, solid waste transfer stations, and protected areas in the vector data format into 30 m pixel size raster data. The model was rerun by selecting 100 m pixel size. When the result data produced by the model is examined, it is seen that the classification values generated with the size of 30 m pixels are very close to the results of 100 m pixel size in the working region. The regions obtained as a consequence of the analysis are evaluated according to their spatial properties, and the final alternative area is decided. Since the data used in work done has a pixel size of 30 m or less, the selected pixel size could be utilized. It has been observed that in cases where there is not enough data available in different studies that can be performed, the

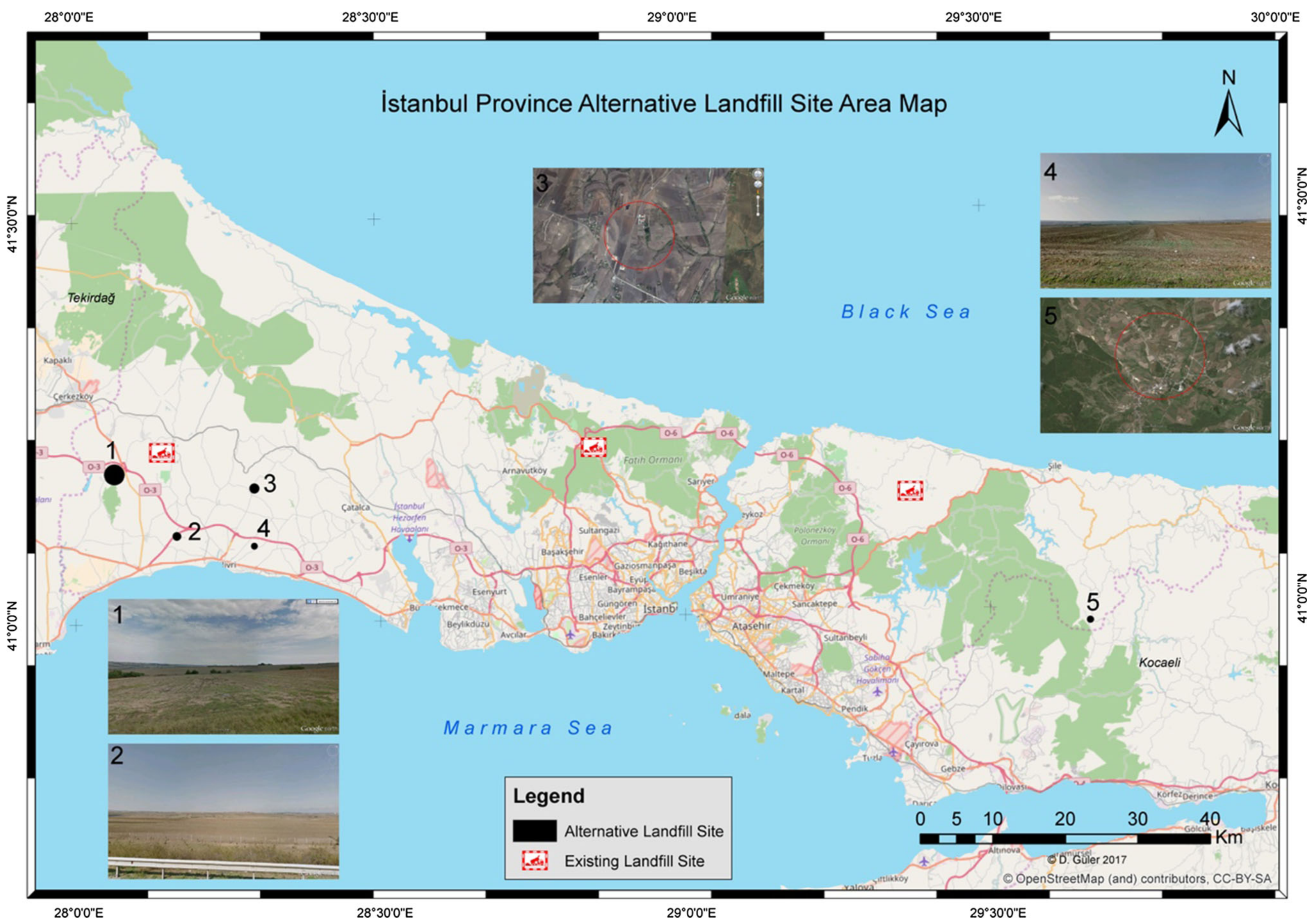

Fig. 7 Istanbul province alternative landfill site area map

results can be achieved using high pixel sizes of 100 m. However, if the study area is small, even the small areas covered by the areas to be decided will be critical. Therefore, increasing the pixel size may cause low accuracy in the results to be achieved in operation.

In the AHP hierarchy, environmental factors were calculated as 0.75 and economic factors as 0.25. The studies in the literature were examined, and these weights were changed to examine the model, and the results were evaluated. In the AHP hierarchy, an environmentally friendly scenario was created. By considering an economic scenario, the environmental factors were calculated as 0.25, and the economic factors as 0.75, and the weights of the sub-criteria were recalculated. The model was reworked by processing recalculated weights, and results were obtained for the economic scenario. When the result is examined, it has been seen that the areas of the "suitable" class have decreased and those of the "unsuitable" class have increased. It has been observed that different results are achieved in choosing the location with the weights determined between the two environmental and economic scenarios. It is also seen that the model used can be utilized in different studies with different criteria weights.

Conclusions

It is regarded that population increases rapidly with urbanization, and as a result, the amount of solid waste generated by the increase in consumption in communities increases. It is a regular landfill process, one of the solid waste disposal methods, to remove the environmental problem. An alternative site selection analysis for the regular landfill facility in the study was carried out in the province of Istanbul. To make more use of the effective analysis capacity of the GIS, a dynamic model in the study has been provided for faster and more accurate analysis. Result data is obtained by using data layers used as model input. The resulting data was classified according to their suitability for the dumping site, and the resulting map was created. Regions were selected as candidates, and an alternative solid waste landfill was proposed as a consequence of the evaluation. The results obtained from the model are used to examine the suitability of existing dumping site. It has been shown that when the work to be done is complete, the created model can benefit by arranging it according to the working region and the characteristics of the data to be used. It has been proved that GIS is an important tool in solutions to environmental problems with the ability to work with large volumes of spatial data. In the case of studying the model used in the study, the model was rerun with 100 m pixel size selected. When the result data produced by the model is examined, it is seen that the classification values generated with the size of 30 m pixels are very close to the results of 100 m pixel size in the working region. An economic scenario has been set up in the discussions. It has been observed that different results are achieved in choosing the location with the weights determined between the two environmental and economic scenarios. It is also seen that the model used can be utilized in different studies with different criteria weights. The main conclusions reached as a result of research and deliberations in the field of study: AHP is an effective decision-support method for the determination of solid waste landfills; GIS is an effective information system in terms of alternative decision-support tools; the conditions of the study area are critical for the selection of landfill sites; a pixel size selection is a component that must be evaluated against the working region; and the use of the model is beneficial in terms of explanations in studies.

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