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Strategic Planning, Based on Environmental Spatial Assessment, Using SWOT and GIS to Locate Sustainable Industrial Areas (Case Study: Tehran Province)

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ABSTRACT: Unbalanced distribution of population in a country like Iran as well as accelerating urbanization and environmental degradation, both arising from incorrect location of industrial areas, are two problems that require appropriate industrial development policies to get resolved. Considering the expansion of industrial areas along with their role in contamination of the environment, it is necessary to develop strategies to improve environmental performance. The purpose of this study is to provide strategies for establishment of industrial areas, based on environmental spatial assessment, using SWOT technique and GIS. In this method, once the spatial data are mapped and analyzed with GIS software, leading to determination of effective factors for location of industrial areas and their, the maps of such effective factors can be prepared. After weighing effective layers on location, based on the AHP model, the GIS software capabilities have been used to merge and overlap the maps and the industrial areas location map are prepared. The map has been classified in five classes (very poor, poor, moderate, good, and very good) and finally, based on the final map and SWOT analysis, optimal strategies have been developed to reduce environmental degradations. The location analysis with integrated GIS and SWOT method is effective for providing optimal strategies. More accurate results of this study show that the study area is located in "defensive" position and the authorized areas to locate the industrial areas in the "very good" class are over 240,191.9 hectares large, being mostly in the south and southwest of Tehran.

Keywords: Site selection, Industrial area, Fuzzy, Strategic planning, MCDM.

INTRODUCTION

Urban growth and expansion have occurred hand in hand with development of industrial activities, a combination that has created employment opportunities and economic powers for the citizens, on one hand, while exposing these very citizens to various kinds of pollution, e.g. water, air, soil, noise, and visual pollution as well as chemical contamination, on the other. Therefore, it is quite important to find the optimal limit in which, along with job creation and production growth, the environment and human health will not be damaged, or damage and destruction will be reduced to conventional level (Naseri, 2012).

Due to the concentration of environmental problems in small industrial companies, they pose environmental hazards (Fernández & Ruiz, 2009). For industrial development, one should move towards an efficient, clean, and eco-friendly development (Li et al., 2016).

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Therefore, the industrial sites must be properly planned and land and environmental planning tools have to merge together in the early stages of development of industrial zones in order to reduce the effects (Korhonen & Snäkin, 2005; Ruiz et al., 2012). The main purpose of geo-environmental assessment is to select the industrial sites and assist policy makers, planners, and developers to plan optimal development of industrial area, while preserving the environment (Hadipour & Kishani, 2014).

Although location of industrial areas, due to various impacts on each region, is considered one of the major factors of regional planning, since industrial areas have concentrated on a large number of economic units in a small area, they are often faced with environmental imbalance (Fernandez, 2009).

Accordingly, determination of industrial sites due to its social, economic, and environmental impacts is one of the key factors for regional planning. To determine the appropriate location, a wide range of factors should be considered so as to coordinate social and economic benefits and environmental sustainability (Leitham et al., 2000; Yamamoto, 2008), affected by factors like population growth, employment, land constraints, environmental protection and development, and industrial land use. Thus the uncontrolled growth of industry in some areas, especially environmental pollution, is prevented (Chiu et al., 2004; Mirata et al., 2005). Furthermore, existence of industrial areas and their rapid settlement development suggest that they are considerably potential for climate variability in those zones, wherein they are present and clearly increase the summer maximum temperatures (Giorgio et al., 2017).

One of the most important benefits of industrial areas is environmental protection, yet since the industries have a variety of contaminants and pollution gets accumulated in certain areas, the risks of these pollution' transmission to residential, educational, recreational, etc. areas are prevented. These areas could cause the displacement of industry around cities and villages, liberating big cities from pollution and congestion and leading to the creation of industry in small cities. On the other hand, if industrial areas are not designed and established in compliance with environmental criteria, it will reduce environmental efficiency (Yasuri, 2013).

In terms of industrial areas, there has been extensive research dedicated to finding selection and location criteria for such areas, e.g., the research by Shad et al. (2009) in their article, entitled “Design and Implementation of an Applied GIS for Industrial Estates Site Selection using Fuzzy, Weight of Evidence and Genetic Methods". Here, they argued about selection of industrial sites, taking into account industrial views and issues related to land use in two phases via aggregated models, different Index overlay properties, Fuzzy summation, gamma fuzzy, and Genetic and Weighted evidence models. It was found that Index overlay model was the best model for aggregating industrial estate site selection parameters, compared to Fuzzy, Genetic and Weighted evidence models (shad et al., 2009). Ahmadizadeh et al (2012) in an article, entitled "Application and Comparative Study of Analytic Hierarchy Process and Fuzzy Analysis in Land Suitability; Case Study: Birjand Industrial Areas", used Fuzzy logic and AHP method in GIS and determined some factors and criteria for industrial site selection, concluding that the current industrial area based on location with two fuzzy and AHP patterns was consistent with the principles of environmental sustainable development (Ahmadizadeh et al, 2012). Nasrollahi and Salehi Qahfarokhi (2012), in an article, entitled "Factors Affecting Locating Industrial Areas with Regard to the Indicators of Sustainable Development and their Prioritization via

Triangular Fuzzy Numbers", found that social and economic criteria were among the most important factors for locating industrial areas (Nasrollahi & Salehi Qahfarokhi, 2012). Rachdawong and Apawootichai in 2003, in an article titled "Development of Criterion Weights for Preliminary Site Selection: A pilot Project of Supanburi Industrial Estate" used the WLC method in GIS, considering 8 criteria for locating an industrial area. They concluded that analysis through GIS could speed up the process of suitable site selection (Rachdawong & Apawootichai, 2003). In 2012 Ziaei et al., in an article, entitled "Fuzzy and GIS Combined Modeling and Multi-Criteria Decision Making; Case Study: Birjand", employed a combined model of GIS and MCDA to come to this conclusion that the method assisted industrial site selection and urban and regional planning (Ziaei et al, 2012).

The rapid growth of Tehran in recent decades has caused many gardens and agricultural area to become industrialized ones, irrespective of environmental and climate properties of this urban and its surrounding cities, leading to several environmental problems like air pollution, water pollution, and –in general—the reduction of refining capacity and pollutant absorption in these areas. Due to the wide range of industries along with their effective role in Tehran's environmental pollution, it is necessary to develop a strategic plan to improve environmental performance. For this reason, this paper attempts to use the combination of GIS and SWOT methods to improve the results. Therefore, after identifying the current status of industries and favorable locations for the expansion of industries, the problems and potentials of the region are also perceived and strategies for reducing environmental impacts are presented.

MATERIAL AND METHODS

Tehran Province is about 12981 square kilometers large, located between 34 to 36.5 degrees north latitude and 50 to 53 degrees east longitude. It is in the southeast and center of the Alborz Mountain chain. In general, areas like Tehran, located on the central plateau and one of the largest subsidence of the northern plateau, have features such as high altitude, lack of rainfall, lack of suitable vegetation, slopes, and dryness (Yavari et al, 2007).

Table 1 presents the characteristics of Tehran's industrial areas.

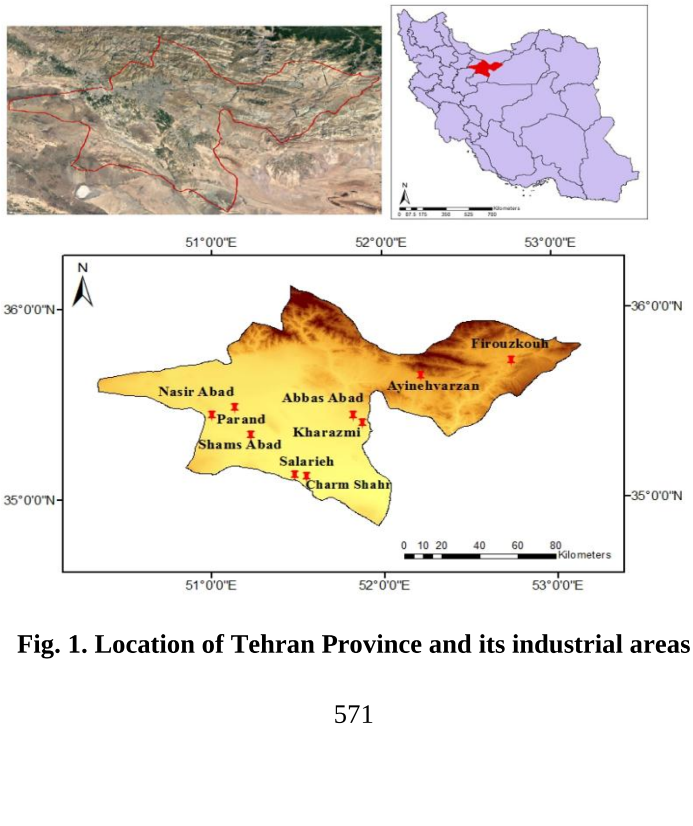


Fig. 1. Location of Tehran Province and its industrial areas

Table 1. Characteristics of industrial areas of Tehran Province

Industrial area	city	Location, (geographic coordinates of UTM)
Shams Abad	Rey	x: 521094.87 y: 391927.93
Abbas Abad	Pakdasht	x: 575437.80 y: 3922396.42
Kharazmi	Pakdasht	x: 580132.22 y: 3917746.85
Nasir Abad	Robatkarim	x: 512436.22 y: 3926640.11
Charm Shahr	Varamin	x: 550634.33 y: 3886446.48
Salarieh	Varamin	x: 544414.46 y: 3887412.50
Parand	Robatkarim	x: 500750.22 y: 3922490.35
Firouzkouh	Firouzkouh	x: 662112.81 y: 3962540.9
Ayinehvarzan	Damavand	x: 619988.129 y: 3941529.88

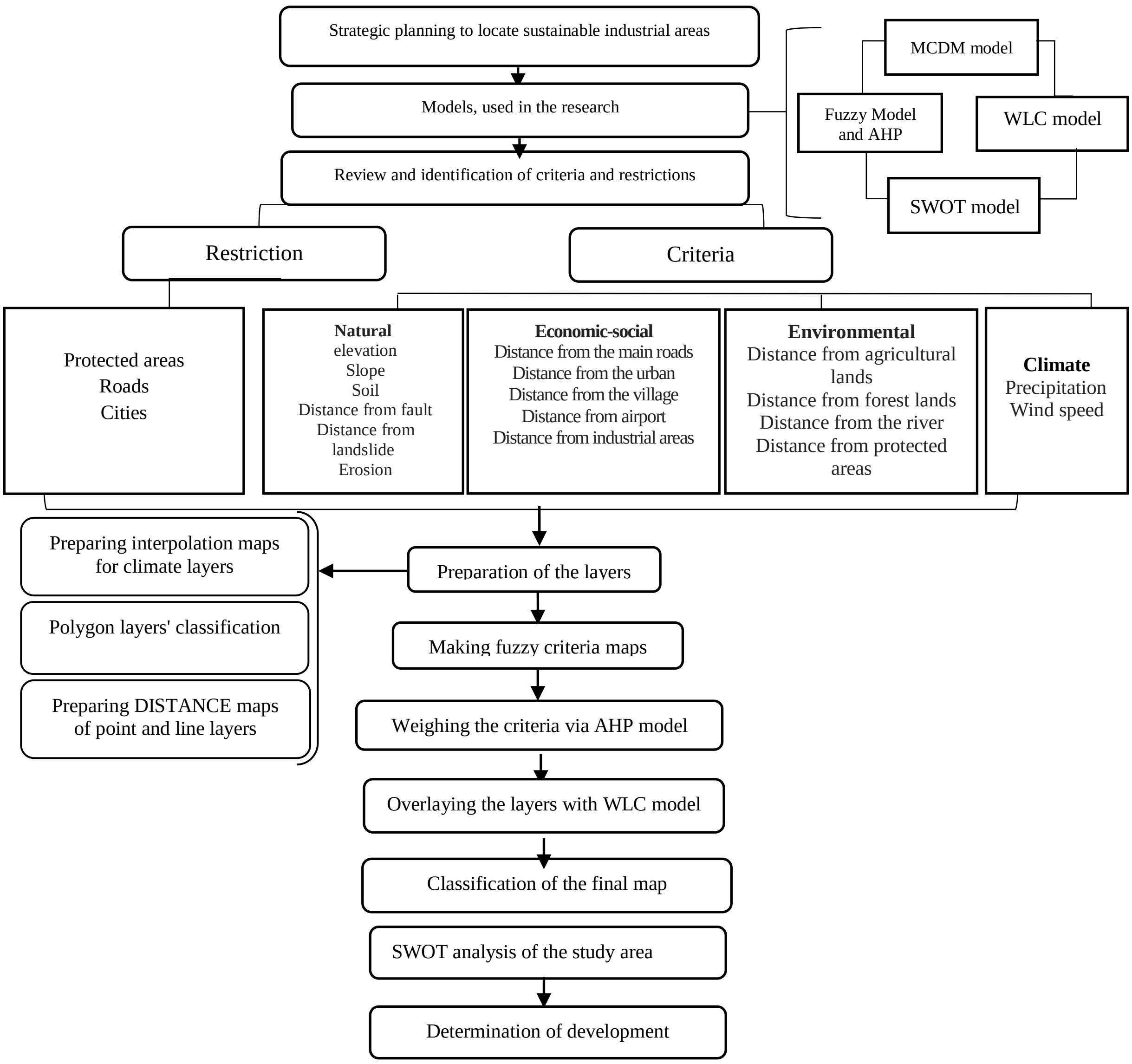


Fig. 2. Conceptual model of locating industrial areas

There are five main steps for the current research: The first one selects the criteria and prepares and evaluates the layers, using the fuzzy method, while the second one weighs the layers via Analytical Hierarchy Process (AHP). In the third step, the layers are weighted by linear combination (WLC) and as for the fourth one, the restriction layers are extracted from the final map with the final step concerning analysis of the case study by means of the SWOT method, not to mention the presentation of strategies for the establishment of industrial areas. Figure 2 summarizes the location analysis of industrial areas in Tehran Province.

First Step - Review and Selection of Criteria and Making Fuzzy Criteria Maps: Table 3 gives the appropriate criteria for locating. Selection of criteria is based on library resources, Internet resources, and characteristics of the studied area, presented below:

A. Climatic parameters

1. Precipitation: The amount of rainfall in the area is one of the factors affecting the construction of an industrial areas that will have an impact on construction and facilities. In this way, the greater the regional rainfall, the more the points awarded to the region (Hashemian et al., 2013).

2. Wind speed: Wind speed in the area is one of the factors affecting the location of industrial areas, since the wind can transmit pollutants from industrial areas to other places, posing some dangers to residents of the surrounding area.

B. Environmental parameters

1. Distance from the river: Rivers are natural factors on earth that form special residences and recreation areas. Wind turbines, located along the coast and adjacent to the rivers, will bring undesirable effects on the appearance of these areas, which are also ecologically the habitat of many birds. Hence, it is always important to take care of them.

2. Land use: The status of different uses in terms of construction of industries and environmental impacts can be considered. Forest and agricultural lands should not be allocated to industrial use and development must be carried out in land units that minimize the damage to vegetation. (Fataei, 2013).

3. Distance from Protected Areas: Wildlife in an area is considered one of its ecological needs. Their protection means protecting the region's ecosystem; therefore, the noise and all kinds of pollution from industries as well as transportation in the region, causing the destruction of wildlife or triggering their migration from the region, are included (Rachdawong & Apawootichai, 2003).

C. Economic and social parameters

1. Access to the communication network: The availability of communication channels is very important for quick and easy access to the provincial capital and other parts of the country, specifically, concerning exchange points from ports and customs for determination of industrial areas' location (Rachdawong & Apawootichai, 2003).

2. Distance from cities and village: Cities and settlements with large populations may be affected by industrial areas in terms of safety, noise, landscape, and pollution, so they should be protected from the appropriate distance.

D. Natural parameters

1. Erosion: Land erosion is a major factor for construction. The areas at high altitudes can have characteristics like high slopes and igneous rocks that indicate low soil depth and high erosion in them.

2. Faults and Seismicity: Fault lines as seismic lines are important for planning and development. Fractures, resulting from faults, can have many impacts on

sediments and rocks of the area in different directions (Sobhan Ardakani et al., 2013).

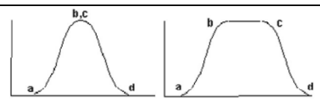
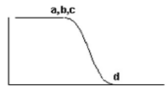
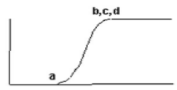
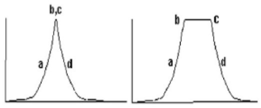
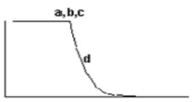
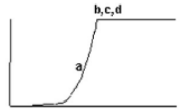
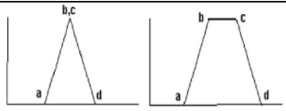
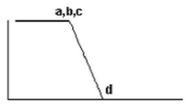
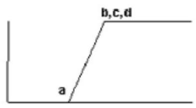
3. Slope: Flat areas have lower slopes and less preparation costs. Therefore, slope is one of the most influential parameters for selection of industrial site.

4. Elevation: Elevation should be in a way not making construction and transfer of equipment difficult.

Fuzzy modeling approach: Initially, Professor Askar Lotfi Zadeh developed Fuzzy logic under uncertain conditions. The fuzzy theory can formulate many unambiguous and incorrect variables, systems, and concepts, providing control and decision making with uncertainty. The ability of GIS systems in Raster Map Analysis makes it possible to execute different approaches such as Fuzzy, since the negative and positive threshold data (0 to 1, not in a binary format) would determine the degree of membership of the variables. The fuzzy logic approach creates more flexible compositions of weighted maps and can be easily executed, using GIS modeling language (Lee et al., 2012).

In this model, the membership of an element in the collection would be defined in a range of 1 (full membership) to zero (non-membership) (Bonham-Carter, 1991). So the Membership Fuzzy operating instruction is used. Actually, the definition of the Fuzzy membership (or standardizing the criteria) is one of the main steps of Multiple Criteria Decision Making (MCDM). Fuzzy membership functions are categorized from two aspects: Type and Shape. The former are themselves categorized into S-shaped (Sigmoidal), J-shaped (J shaped), and linear varieties, while the latter includes monotonic increase, monotonic decrease, and symmetric shape (Eastman et al., 1993). (Table 2). Table 3 presents the weights and control point of criteria, based on expert opinions and reviews of scientific articles and technical reports. Fig. 3 shows digital layers of Fuzzy membership.

Table 2. Categorization of Fuzzy Membership Functions

Fuzzy membership function shape				
Symmetric	**Monotonic decrease**	**Monotonic increase**		
			Sigmoidal	Fuzzy membership function type
			J-shaped	
			Linear	

Second Step: Weighing the Criteria Using the AHP Method: The study used multi-criteria evaluation techniques to determine the importance of the criteria, themselves. These techniques are based on ideal point analysis, with AHP being one of the most common MCDM as well as a flexible decision-making tool for multi-criteria problems, incorporated into GIS-based sitting procedures (Mosadeghi et al., 2015). First developed by Satty in 1980 to help decision makers, AHP arrives at the best decision in a case of multiple conflicting objectives (criteria), organizing and evaluating the relative importance of selected objectives as well as relative importance of alternative solutions. In other words, this method is a common decision-making technique, which can be used to analyze and support decisions with multiple objectives. For so doing, a complex problem is divided into a number of simpler problems within the hierarchy (Wang et al., 2009). By using the AHP method, the criteria (factors) are compared both pair-wise and reciprocally in each level and the numerical priority is allocated.

Third Step: Overlaying the Layers with WLC Model: WLC is the commonest technique for analysis of multi-scale evaluation. It is based on the average weight content, combining the layers, obtained from the calculated weights, with the analyzer or decision-maker being based on relative importance, weighted directly to the scales. Afterwards, by multiplying relative weight in feature value, a final measure can be obtained for each option. Once this final value has been specified for each option, alternatives with higher values will be the most proper ones for the desired purpose, which can be considered as determination of earth proportion for a specific operation or evaluation of a particular occurrence potentiality. In this method, decision making principle calculates the value of each Ai options through the following equation:

$$A_i = \sum_{j=1}^{n} W_j \times X_{ij} \quad (1)$$

where j is the j^{th} criterion weight, a value for accepting the position in relation to criterion j that can indicate the appropriate degree of location I in relation to criterion j. N represents the total number of criteria and Ai is a value, which will attach to location I. In this method, the total weight should be equal to 1; otherwise, in the last stage, Ai should be divided by the sum of all weights, hence confining it between 0 and 1. Higher or lower amounts of this value could be due to an appropriate or inappropriate alternative, and weight normalization can be omitted. In the end, the ideal option will be the one with higher amount of Ai (Malczewski, 2006).

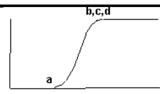
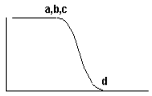
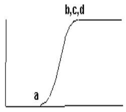
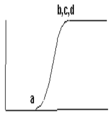
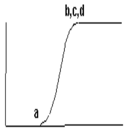
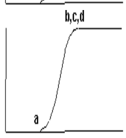
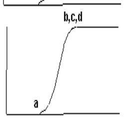
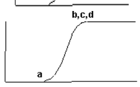
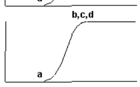
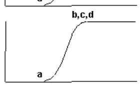
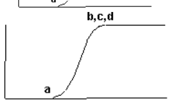
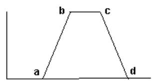
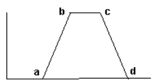
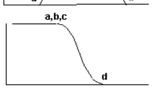
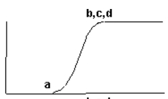
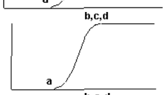
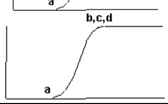
Fourth Step: Extracting the Restrictive Layers: At this stage, in order to identify the appropriate areas for industrial areas, the protected areas, cities, and roads will get omitted from the final composition map.

Fifth Step: Analysis of the Study Area with the SWOT Model: SWOT Analysis is a commonly used tool to analyze external and internal environments simultaneously in order to acquire a systematic approach as well as support for a situation in need of decision (Kurttila et al., 2000; Kangas et al., 2003; Yuksel & Dagdeviren 2007). The most considerable internal and external factors for the industrial area's future are referred to as strategic factors. In SWOT these factors are grouped into four parts called SWOT groups, namely the strengths, weaknesses, opportunities, and threats. By applying SWOT in strategic decisions, the purpose is to select or constitute and implement a strategy, resulting in a good fit between the internal and external factors (Kangas et al., 2001). Moreover, the chosen strategy also has to be in line with current and future purposes of the decision makers (Kajanusa et al., 2004). This analysis involves systematic thinking and comprehensive diagnosis of factors relating to a new product, technology, management, or planning (Kahraman et al., 2008).

RESULTS AND DISCUSSION

The results, obtained by evaluating standardized criteria in accordance with fuzzy membership function in industrial area location, revealed that the criteria and sub-criteria had been categorized into four types, viz. climatic, environmental, economic-social, and natural as well as 18 sub-criteria, the values and the type of membership function of which can be seen in the following table:

Table 3. Standardized criteria and sub-criteria with fuzzy membership functions

Criteria	Sub-Criteria	Fuzzy Numbers a	b	c	d	Weight	Function Type
climatic	wind speed	2.5	4.5	-	-	0.154	
	precipitation	25%	-	-	40%	0.028	
environmental	distance from agricultural lands	500	5000	-	−	0.051	
	distance from gardens and forest lands	500	5000	-	−	0.048	
	distance from river	500	1500	−	−	0.042	
	distance from protected areas	3000	5000	-	-	0.062	
	distance from flood line areas	1000	6000			0.039	
economic-social	distance from urban	1000	10000	-	-	0.043	
	distance from village	1000	5000	−	−	0.036	
	distance from airport	1000	5000	−	−	0.032	
	distance from industrial areas	2000	4000	-	-	0.1	
natural	elevation	500	1000	1500	2000	0.130	
	slope	3	10	20	100	0.077	
	soil	1	9	−	−	0.029	
	distance from fault	1000	10000	−	−	0.032	
	distance from landslide	1000	7000	−	−	0.031	
	erosion	1	8	−	−	0.034	

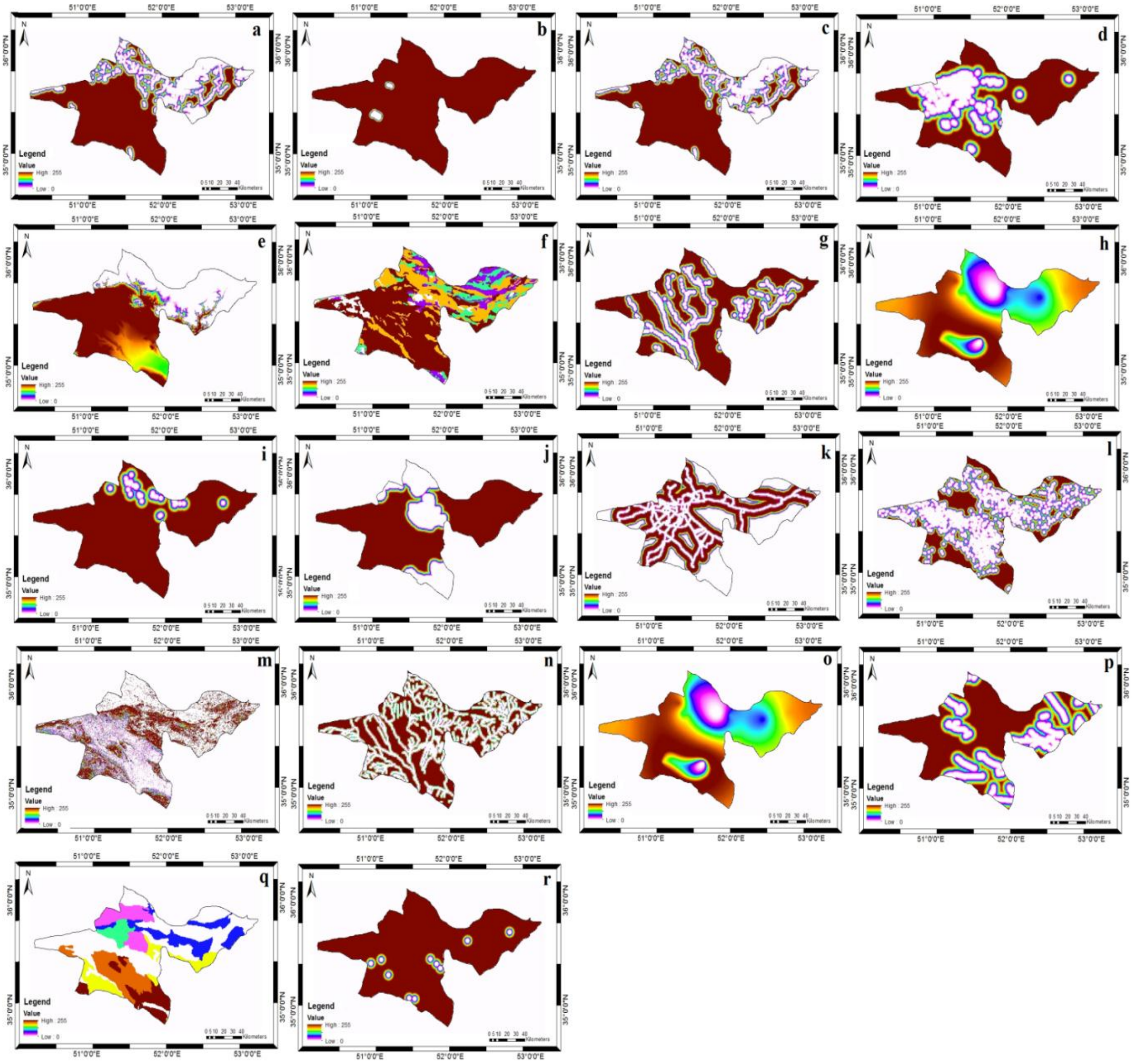


Fig. 3. (a) distance from agricultural lands, (b) distance from the airport, (c) distance from gardens and forest lands, (d) distance from urban areas, (e) elevation, (f) erosion, (g) distance from flood line, (h) wind speed, (i) distance from landslide, (j) distance from protected areas, (k) distance from main roads, (l) distance from villages, (m) slope, (n) distance from river, (o) precipitation, (p) distance from the fault, (q) soil, and (r) distance from industrial areas

Table 4. Restrictions on locating industrial areas

Restrictions Layers	Buffer
buffer zone from the main road	250 meters
buffer zone from the urban	500 meters
buffer zone from protected areas	1000meters

Restriction maps are constructed, using the Boolean Method. They happen to be zero and zero, so that zero values are inappropriate for industrial areas. Figure 4 illustrates these maps.

Various fuzzy combinations were used to combine standardized sub-criteria with fuzzy membership functions, after applying the weight.

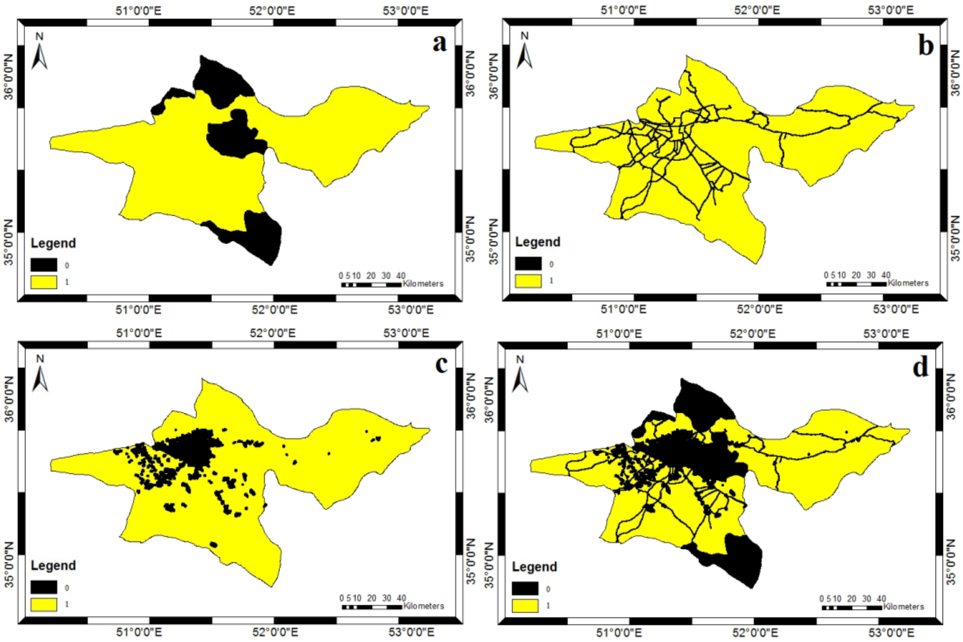


Fig. 4. (a) protected areas, (b) transportation network, (c) urban areas, and (d) final restrictions map

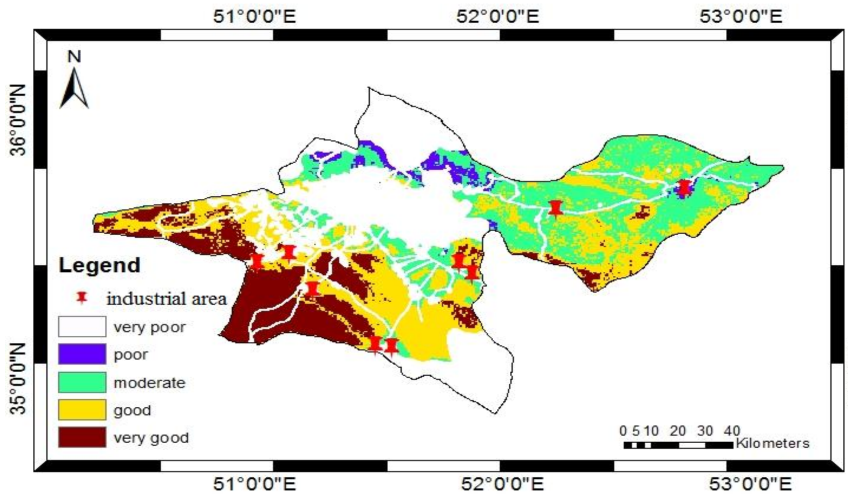


Fig. 5. Final land suitability map for establishment of industrial areas

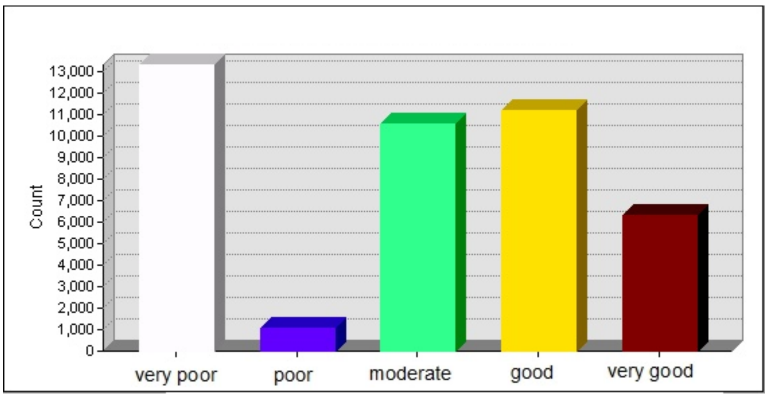


Fig. 6. Characteristics of locating the Map of Tehran Province Industries in GIS

Table 5. Characteristics of locating map of the industrial areas in Tehran Province

Class	Area (ha)	Percent (of the province)
Very poor	467059,1958	25
Poor	115395,5416	6.3
Moderate	459991,3968	25
Good	548565,3184	30
Very good	240191,9295	13

Table 6 and 7 list the most important internal and external factors, respectively. The former considers the internal factors for environmental management of industrial areas of Tehran Province. The strengths and weaknesses are graded as follows: 4= strong strength, 3= weak strength, 2= low weakness, and 1= severe weakness. According to the table, in terms of strengths, the highest weight was 0.123 and the lowest, 0.041. As for the weaknesses, the highest one was 0.068 and the lowest, 0.035. Having multiplied the weight by the degrees, one could see that it was equal to the weighted score, while the sum of weighted scores was equal to the total score of internal factors. The average of these scores was 2.5 and the maximum, 4. If this number is above 2.5, the environmental pollution will be in a favorable condition in terms of internal factors. According to the table, the sum of these values was 1.123.

Table 7 presents the external factors' evaluation matrix for the most important opportunities and threats in Tehran province in terms of the environmental pollution of industrial areas. The opportunities and threats are graded as follows: great opportunity is equal to 1 and 2, while weak opportunity is 3. Also, severe threat is 1 and weak threat, 4. These factors have been expressed quantitatively in order to avoid any misunderstandings and intuitive judgments. Finally, the total weight was written, which in case of being higher than average (2.5), means that the advantages of external opportunities are properly used and the threats faced by the organization are avoided. The maximum weight for total factors was 4. As it can be seen, the highest and lowest weight in opportunities and probabilities was 0.116 and 0.046, and the sum of these values was 2.13.

Table 6. Internal Factors Evaluation Matrix (IFE)

Strengths		Weigh	Score	Weighed Score
S1	Appropriate distance between industrial areas and cities	0.064	2	0.128
S2	Proper slope in the southern parts of the province	0.123	4	0.492
S3	Proper location of the province in Iran	0.041	1	0.041
S4	Proper elevation for construction in the central and southern parts of the province	0.094	3	0.282
S5	Low concentration of industries in the north of the province	0.049	2	0.098
S6	Security of southern parts of the province in terms of distance from slide centers	0.083	3	0.249
S7	Very low soil erosion in the southern parts of the province	0.045	3	0.135
	Weaknesses			
W1	Proximity of some industrial areas with agricultural land in the south of the province	0.055	2	0.11
W2	Proximity of some industrial areas with gardens in the north of the province	0.049	2	0.098
W3	Existence of landslide centers in the northern part of the province.	0.038	3	0.114
W4	Presence of traffic in industrialized areas	0.068	2	0.136
W5	Lack of green corridor in the vicinity of the industrial areas	0.041	1	0.041
W6	Environmental turbulence in the vicinity of industrial areas	0.035	1	0.035
W7	High wind speed in the north of the province	0.063	4	0.252
W8	Soil erosion in the northern parts	0.045	3	0.135
W9	Proximity of some industrial areas to faults	0.038	2	0.076
W10	Proximity of some industrial areas to protected areas	0.063	2	0.126
	Total internal factors	1		1.123

Table 7. External Factors Evaluation Matrix (IFE)

Opportunities		Weigh	Score	Weighed Score
O1	Expansion of clean industries around cities	0.082	3	0.246
O2	Existence of environmental laws, prohibiting the construction of an industrial area on natural lands	0.089	2	0.092
O3	Government incentive projects to reduce industrial pollution	0.046	2	0.178
O4	Government support for non-proliferation of industries	0.050	2	0.1
O5	Studies on plants' resistance to pollution	0.055	1	0.055
O6	Application of construction rules to build industrial estates in safe areas	0.073	1	0.073
	Threats			
T1	Noise and visual pollution in the vicinity of industrial areas	0.163	4	0.652
T2	Lack of water resources and water crisis in central Iran	0.097	3	0.291
T3	Destruction of natural landscapes and undesirable ecological effects	0.116	4	0.464
T4	Physical expansion of Tehran due to inland and outland regional migration	0.059	3	0.177
T5	Low construction safety in earthquake-prone areas	0.065	2	0.13
T6	Exacerbation of environmental pollution due to industrial concentration	0.105	4	0.42
	Total external factors	1		2.13

In order to determine the strategic position of the study area, it is needed to determine the scores, derived from both Internal Factors Evaluation Matrix (IFE) and External Factors Evaluation Matrix (IFE) in their vertical and horizontal dimensions so that the location of the area can be determined and appropriate strategies can be defined for it. This matrix, which matches the SWOT matrix and specifies the strategies for the region, is presented in Fig 7.

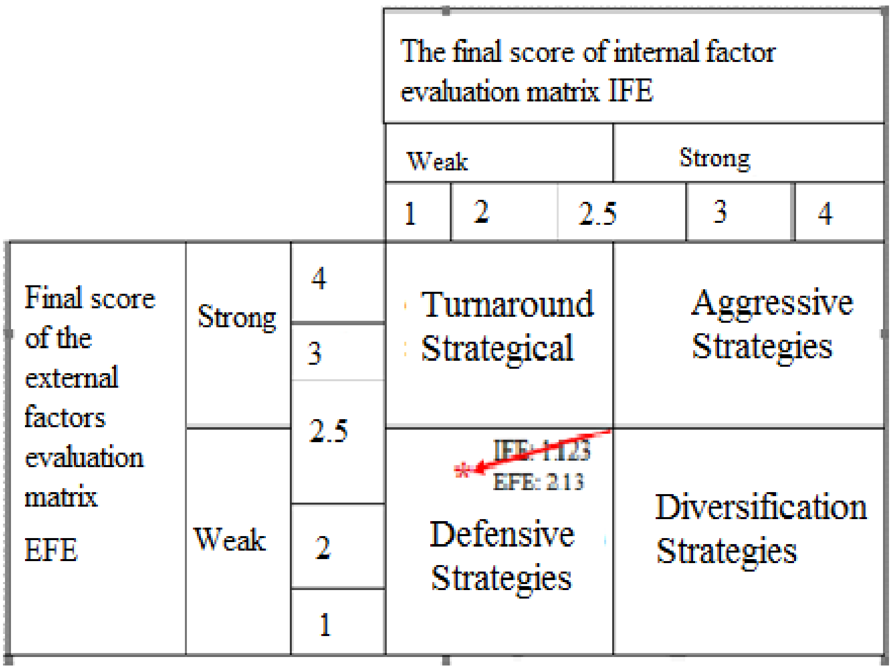


Fig. 7. The strategic position of the study area

Table 8. Strategies for locating industrial areas in Tehran Province

Strategies	Threats (T) Strategies (TS)	Opportunities (O) Strategies (SO)
Strengths (S)	1- Decrease migration to Tehran by distributing industrial areas in neighboring provinces. 2- Increase the safety of construction in areas with low landslide 3- Reduce undesirable ecological effects by expanding industries in appropriate topography 4- Reduce the environmental pollution by creating green spaces 5- Reduce the visual pollution by creating the appropriate distance from urban areas	1- Air conditioning by creation of green spaces 2- Decentralization through government support for non-polar expansion of industries 3- Construction security in the south of the province with a suitable topography and soil 4- Temperature improvement by preventing the concentration of industry
	Strategies (WT)	Strategies (WO)
Weaknesses (W)	1-Create an environmental discipline by increasing the distance from urban lands and suitable ecological lands 2-Regulate the traffic by improving the access 3-Prevent air pollution by expanding industries in areas with low wind speed 4-Prevent water crisis with the expansion of non-polar industries	1-Reduce noise and visual pollution by expanding clean industries in urban areas 2-Increase the safety of construction by applying building rules 3-Prevent destruction of gardens and forest lands by applying the rules that prohibit the construction of industrial settlements on natural lands 4-Reduce air pollution by planting plants, resistant to contamination, in the vicinity of industrial settlements

CONCLUSION

The present research evaluated the impact of industrial areas on environmental status of Tehran province, using GIS and SWOT models. Then, in cooperation with experts and maps of GIS, the main problems and potentials of the region were identified. The location map for industrial areas was classified into five classes (very poor, poor, moderate, good, and very good), with the first class (very weak) representing the most inappropriate places for settling industrial areas, having an area of 467059.1 hectares, i.e., 25% of the region area. Most of these unsuitable areas for the establishment of an industrial areas were in protected areas, roads, or urban areas. The second class (weak) was 115395.5 hectares large, i.e., 6.3% of the total region area, where the Firouzkouh industrial park is located. The third class (middle) covered an area of 459991.3 hectares, 30% of the total area. The Ayineh Varzan, Charm Shahr, Salarieh, Kharazmi, and Abbas Abad industrial parks are in this class. The fourth class (good), with an area of more than 548565.3 hectares, was located in the south and southwest of Tehran, being the location of Nasir Abad industrial park. The fifth class, which included authorized areas for establishment of the industrial areas, was 240191.9 hectares large (13%), the location of two industrial parks, namely Parand and Shams Abad. According to the analysis of internal and external factors evaluation matrix, the internal factors' score was 1.123 and the external factors score, 2.13; therefore, based on the principles of strategic management, the strategic position of this research was determined in the "defensive" area. To put it in other words, the weaknesses of this factor surpassed its strengths and the organization did not have a favorable status according to the research findings. As for the analysis of external factors, the score of the research factor was below 2.5 and it can be deduced that the threats of this factor outmatched and overcame its opportunities, so strategies should be set to prevent environmental degradation. Since this research examined the environmental and ecological status, its results can give authorities of the region and the province a good view of environmental issues. It is also possible to plan in future, taking into account the issues, problems, and potentials of the region. Finally, given the identified limitations and advantages, strategies can be set for achievement of a sustainable environment in the province.

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