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Research Article

THE ROLE OF ENVIRONMENTAL FACTORS IN THE CREATION AND DEVELOPMENT OF INDUSTRIAL ESTATES (CASE STUDY: INDUSTRIAL ESTATES OF RASHT CITY)

***Parviz Rezaei[1] and Ferzad Kareem Nader[2]**
[1]Department of Physical Geography, Islamic Azad University-Rasht Branch, Rasht, Iran
[2]Department of Natural Geography Islamic Azad University- Rasht Branch, IRAN
**Author for Correspondence*

ABSTRACT
The research area of this study was in Rasht city in northern Iran. The data used in this study consisted of existing data of industrial centers of Rasht city that had been received from Industries and Mines Organization and industrial estates of the province. These data were descriptively ordered as input maps, spatial information banks and were analyzed through integrated functions (GIS) from a variety of analysis functions and spatial analysis as well as index overlay model. The results of this study indicated that the major industrial activities in this area have been concentrated on two industrial environments, namely industrial city of Rasht and industrial city of Sefidrood on surfaces with very low slope in which the primary factors for industrial units including communications, energy and water have been prepared, but due to the limitations in the area concerning the provision of unit's lands in areas with application other than industrial, most of the units have been located in these locations and due to the high level of ground water and non-compliance with environmental regulations on waste disposal, fear of contamination in the area is not far from reality.

Keywords: *Industrial Estate, Geomorphology, Rasht City*

INTRODUCTION
Any kind of activity in the city needs its particular place and space. Therefore, it can be stated that each place acts as the related dish. Since human activities are spread in the city, the space should be such that while creating good situation for residents, has the least adverse impacts on the environment. Each urban planner should have a systematic and holistic approach toward the city and urban issues. With this analysis, how to establish activities in space would be effective in the optimization of spaces, especially in urban areas. Among the activities that play important role in generating income and job opportunities, industrial activities are of crucial importance. Any urban activities, including residential, official and industrial need space. Nowadays, most of the urban lands have been used for building, estates and offices, industries and other urban services. Separation of distance and space has been resulted in the separation of people who are willing to have direct interaction with organizations and services related to urban needs due to economic issues. Therefore, utilization of space and overcoming the distance as the main obstacle are among the fundamental geographical factors in locations and space interaction. Since different applications require specific locations, therefore, distance plays a major role in determining an appropriate location. Creating the right balance between different locations of lands and the application of human actions on them are essential. Following this idea, spatial planning and land management take place and appropriate locating becomes highly crucial (Khanifar, 2010).
The interactive regulation of human factors and environmental factors in order to create an organization based on optimized utilization of human and environmental potentials is called land use planning. Land use planning in the adopted principles through increasing the economic efficiency and promoting social justice, eliminating poverty and deprivation and creating balance and harmony in having a reasonable level if development and prosperity in geographical places and regions, establishment of land use consistent with the goal of balanced development and environmental protection, creating and strengthening inter- and intra-regional economic ties and harmonization of spatial, political effects and regional development policies as well as special topics act in a way that can verify long-term goals of

country and fulfill integrated management of land (National Center for Land). In simple terms, one should make use of land that natural characteristics (ecological) dictate; then, adapt these characteristics to their socio-economic needs (Makhdum, 1993).

The problem of determining locations for industrial projects and areas of industrial production is one of the most important investment issues and the main concern for managers and planners of a country that its purpose is land use planning in terms of industry based on the scale of the country, logical sequence of different fields of industry in the space of weighted proportional growth of different provinces in different branches of industry with full use of natural and human resources in order to obtain the maximum performance.

For a better understanding of the location for the construction of industrial units, having sufficient information about the environmental and geographical characteristics of the area is necessary. In this study, it was attempted to use the appropriate tools and methods in order to identify factors influencing the location of industry and presenting theoretical and practical framework and better and more accurate assessment of environmental factors in area to prepare suitable context for industrial activities in the area of study.

Now, two industrial estates in the study area with different authorities namely "Rasht Industrial City" and "Industrial City of Sefidrood" are active and each, according to establishment and duration of activity, embraces a number of different industrial units that the development of them has followed certain conditions according to political and economic situations of the country in which, based on the specific situation of the area, considering the environmental conditions is after other issues.

The purpose of this study is to examine the available relations in relation to the location of industrial estates around Rasht city as well as their interactions with geomorphologic factors. Since, Guilan province enjoys a great geographical diversity; naturally, different environmental plains, beaches and mountains are not so far apart from each other and in fact, are adjacent.

This diversity of the landscapes has created different economic factors that can be seen in agriculture, livestock and mining industry.

The conducted studies on this field are related to identifying, planning and site selection of industrial units in 1878 by Shaghel. He was successful in using the gravity model in the establishment of industries. Another scientist in this field is Lawnhart who presented his theory in 1882. According to him, determination of industry subject depends on many important transportation factors.

Using this theory, Alfered (1909) proposed stronger theory in this context. According to this view, Vier considers the most suitable location for the industry where the cost of transportation of raw materials and the supply of goods to markets is minimal. Among the other theories in this field, we can be referred to Palander (1935), Hoor (1937), Shawernesha (1953), Egost (1956), Isa and Ravestron (1968), Vilson (1977). In most studied samples, the most important issues were economic factors and less has been paid to environmental factors.

The studies conducted in Iran are related to the published books and conducted studies in this field that the book by PooladDezh (1986) can be pointed out here. In his book, he has examined factors effective in the locating of industrial units and does not separate the role of environmental factors from other factors on locating process.

Gharenezhad (1995) in his book entitled "an introduction to the industrial geography of Iran", has examined the available industries in country and described the effective factors in the formation of this unit as well as their localization.

Razavian (1997) in his book entitled "localization of industrial units" has pointed out to the foundations of economy in locating the industrial units and has less paid to environmental factors.

Toolaei (1992) in his work entitled "the industrial localization" considers to role of available factors in locating industrial units as overall.

In the case of industrial estates locating, a limited number of studies are conducted. Most of the studies on the location of industrial estates have been conducted with different methods and locating models and in some cases; the available situation has been evaluated.

Shad *et al.*, (2008) in their study entitled "design and applied implementation (GIS) for locating industrial estates" used fuzzy models to perform genetic and marker weights. The results showed that in both levels, primary and semi-detailed have better and more optimized overlay model and performance index compared to other models.

Raeisi and Safieian (2010) concluded that considering environmental factors, four areas in the northeast Isfahan are suitable for the establishment of industries.

Nasrollahi and Salehi (2012) in their article entitled "the effective factors in locating industrial estates regarding sustainable development indicators and their prioritization, using triangular fuzzy number indicated that social, economic, environmental, infrastructure and planning factors are among the most important factors affecting localization of industrial estates that are consistent with sustainable development index. The results with hierarchically organization are indicative of the greatest impact of social and economic criteria in locating industrial estates.

Lamiran *et al.*, (2012) conducted a study entitled "locating industrial estates and areas regarding the environmental effects of industry (Case study: Semnan Province). The results of this study indicated that decision-makers in past planning have ignored the importance and value of natural and environmental resources and most of the industries in the country have been designed and started without regarding the environmental considerations. The results indicated that in some of the existing estates, the environmental capacities have not been considered. Finally, this study has suggested six areas for industrial users.

Mirzaei (2006) in his study entitled "the role of environmental factors in locating industrial units of west Guilan" concluded that the establishment of existing industries without considering environmental limiting conditions has been located and is the result of the lack of proper efficiency in comparison with other parts.

The Study Area

The study area of this research consists of Rasht City in Guilan Province. This province covers an area of 1427 square kilometers, including 6 sections: central, khomam, khoshkebijar, sangar, koochesfahan and lashtenesha and 18 sub-districts as well as 294 villages that 292 villages are inhabited and 2 villages are uninhabited. According to the official census in 2011, its population was 445,951 people that its relative density is 501 people per square kilometer among which 2.64% are urbanites. Also, 32% of the province population belongs to this city.

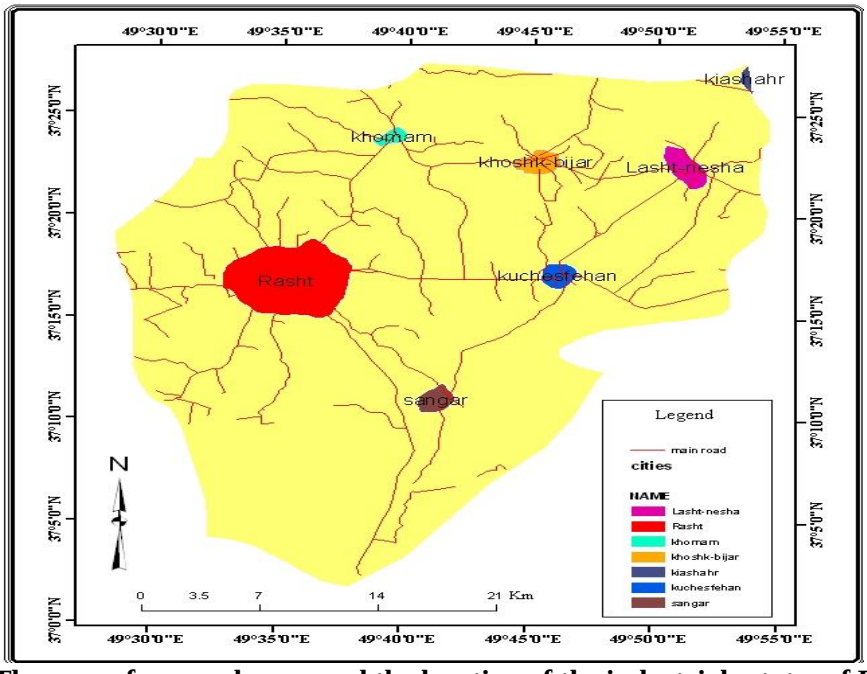

Figure 1: The map of research area and the location of the industrial estates of Rasht City

Table 1: The geographical location of industrial estates of research area

Industrial Complex Name	Longitude	Latitude
Rasht Industrial City	49° 37′	37° 10′
Sefidrood Industrial City	49° 33′	37° 17′

Two industrial complexes, namely Rasht Industrial City and Sefidrood Industrial City which have been established in different time and place are presented in Figure (1) and Table (1).

MATERIALS AND METHODS

Data and Methods

The data of this study have been gathered through observation, plan studies, maps of the status and data obtained from Industries and Mines Organization as well as industrial estates of Guilan province and were classified according to topographic data, geographic data, land use, communications, climate data and other descriptive data. Then, these data were analyzed using GIS and additional extension of AHP to this software during the process of data entry, data management, analysis and data processing and appropriate locations.

Preparing the Required Maps in GIS

According to the data provided and their entry into the GIS environment as well as the needs of the study and derived descriptive information (such as land use), for each information layer, the related descriptive table has been designed and finally, these layers have been created in the form of required maps based on Personal Geo database format in ArcGIS Software.

Table 2: List of layers required for the implementation of industry localization model in the region

ROW	Layer name	Producer organizations	Field Descriptive	References	Scale
1	Topography	Mapping	Elevation number	Aerial shooting	1:25000
2	Way	Management Planning	way Characteristics	Landsat images	1:25000
3	water resources	Water District	Quality parameters	(GPS)	1:1000
4	Geology	Geology	Geological formations	Aerial photos	1:250000
5	City	Mapping	Extent	Taken from Landsat images	1:25000
6	Land use	Management Planning	Land capability	Aerial photos	1:100000
7	Slope and direction	Scholar	Required data	Topography Layer	1:25000
8	Climate	Scholar	Climate Data	Data from weather stations	1:100000

Calculating Criteria Using AHP Model

In this study and based on AHP model, first, a matrix was formed that had been compared in its layers and based on the importance of each criterion to each other in pairs.

To calculate the weight of each criterion, the Expert Choice Software has been used. This software is produced for implementing Analytical Hierarchy Process that in general, the process is as follows:

Stage 1: Hierarchical Structure

Any decision-making in this software starts with a model as a hierarchical process. The simplest mode is a three-level hierarchy: the goal, criteria and alternatives. Of course, each of these criteria can be divided into the sub-criteria. Modeling starts with creating the goal and develops to the lower levels (Figure 2).

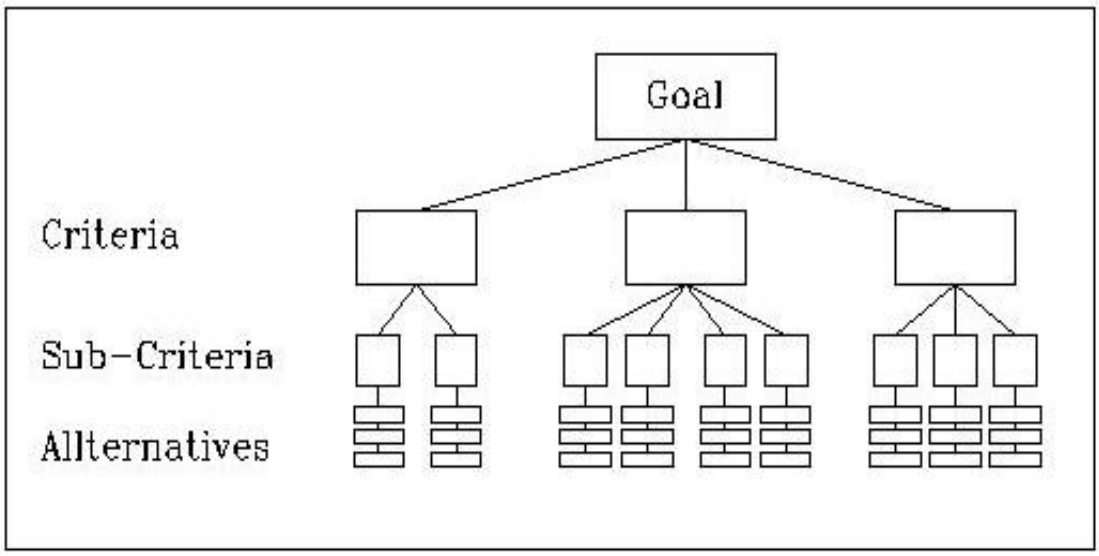

Figure 2: The model structure in Expert Choice Software

Stage 2: Paired Comparison

After creating the hierarchical structure, the next step is to evaluate elements with paired comparison. Paired comparison is a process for comparing the importance, preference or likelihood of two elements to higher level elements.

For this purpose, the following questions arise:

Which locations are preferred?

How much is this preference?

This finally leads to the paired comparison of alternatives to each criteria and also comparing criteria to the goals. Before paired comparison, we should be familiar with the types of comparisons and their modes.

Comparisons:

1.Importance: is used while comparing two criteria.

2.Preference: is used for comparing alternatives.

3.Likelihood: is used to compare the likelihood of utilized output and has application in alternatives and criteria.

Stage 3. Observing the results

After paired comparison and calculating the relative weights of alternatives and criteria, it is necessary to calculate the final weight of each alternative.

RESULTS AND DISCUSSION

Research Finding

In this study, the topography factors, road, water resources, geology, city limits, land use, slope and climate for modeling suitable industrial complexes have been examined. For each of the factors, a distance map was prepared. Then, each of the maps was divided into several classes and due to the importance of each class, a value between 1 (the worse) to 10 (the best) was given to them. After obtaining the relative weight of criteria and sub-criteria by multiplying the sub-criteria by criteria, the final weight is obtained by the software. Then, entering the final weight to data tables, the criteria for locating data maps have been produced by these tables.

After determining the weight of criteria and sub-criteria, the consistency in judgments is evaluated. If the consistency is ≤ 0.1, the consistency in the case of judgments is acceptable; otherwise, the judgments are revised. Table (3) shows the levels of weighting the data layers in AHP model for locating industrial complexes:

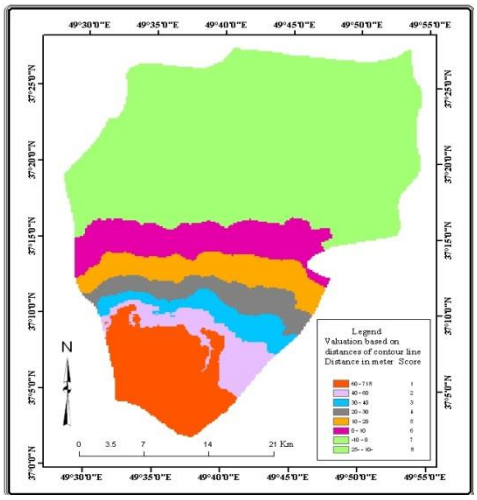

Figure 4: Map of valuation based on height difference

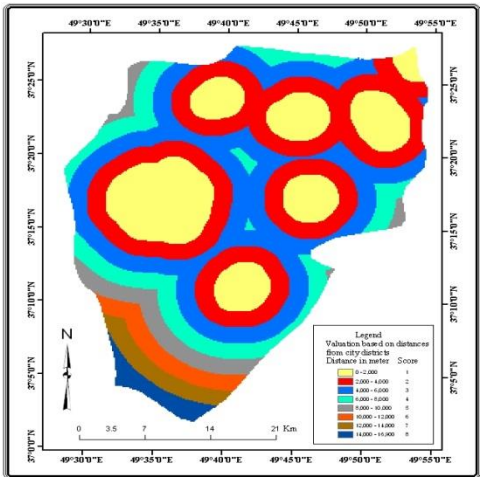

Figure 3: Map of the valuation based on the distance of the metropolitan area

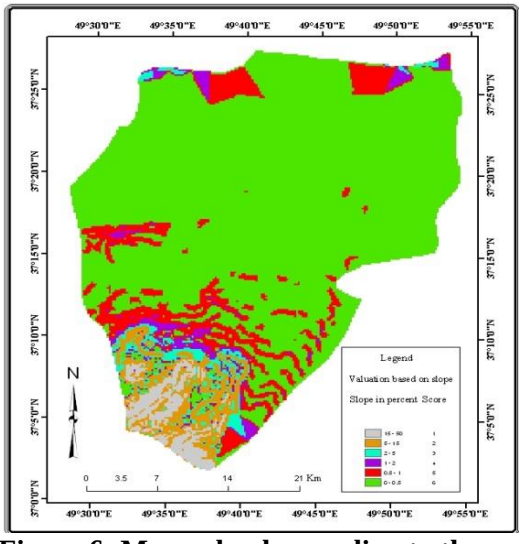

Figure 6: Map valued according to the amount of tilt

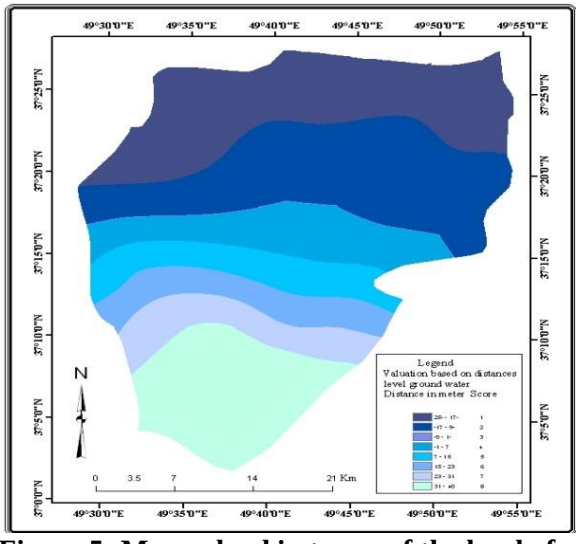

Figure 5: Map valued in terms of the level of underground water

Creating the Required Layers

In this stage, according to the collected data, such as slope and topographic maps, network locations, metropolitan area, the location of industrial zones and geological maps and land uses, new information layers including the distance from the communications network, distance from the metropolitan area, distance from the industrial centers, slope and land use maps and finally, converting map into raster map are obtained.

Reclassification of Data

The next stage that is one of the main stages of locating using geographical information system, the data is reclassified and layers are valued. Reclassification is essential for the combination of layers and during this operation; whole layers are measured by the same scale. In this stage, layers are scored based on the distance from the use. In this study, the distance from the layers has been divided into 10 groups. For the layers, the less distance from the network, the more score would be and vice versa. For layers such as distance from metropolitan area and water resources, the opposite is true. It means that, the more distance and depth, the more score and vice versa.

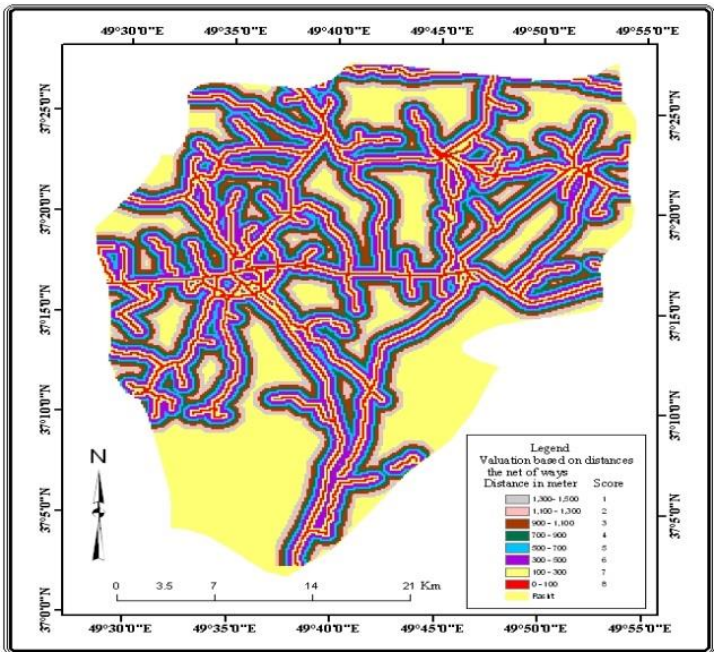

Figure 7: Valuing map based on the distance from communications

The Entrance of Final Weight to GIS

After valuation of data layers, all data layers in locating should be integrated. In integrating the layers, the new layer or output from integrating two or several layer is obtained. Therefore, the layer attributed to any position in the output layer is a function of the entrance layer values. The examination of overlapping layers was performed using overlay model of indicators that finally, it has been shown that as determined, the related areas are not suitable for industrial uses.

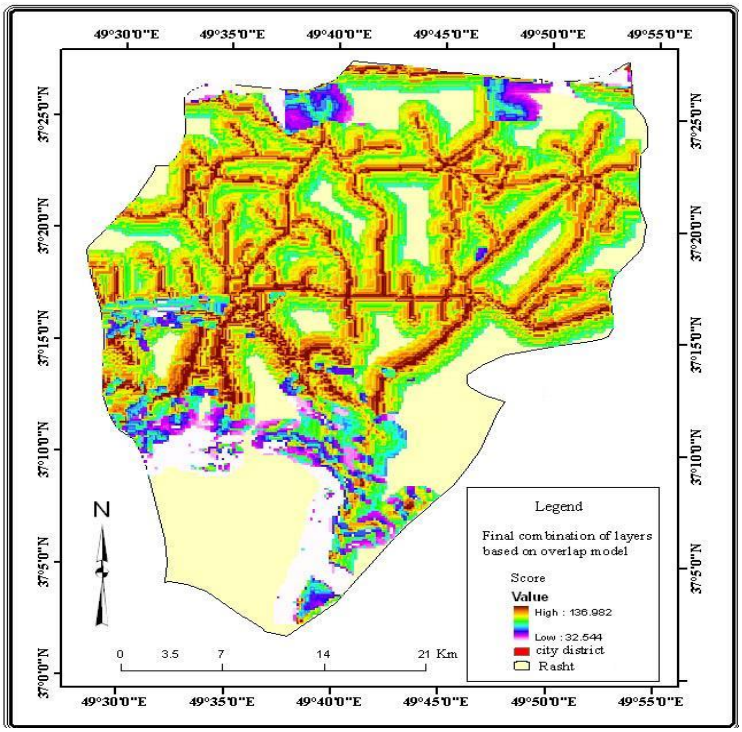

Figure 10: The final map of localization

Table 3: The levels of weighting the data layers in AHP model for locating industrial complexes

Criteria	weight	Sub-criteria	weight	Compatibility Index	Criteria	weight	Sub-criteria	weight	Compatibility Index
Topography	0.12	-10--25	0.215	0.09	Communication ways.	0.081	0-100	0.319	0.09
		-10-0	0.215				100-300	0.225	
		0-10	0.213				300-500	0.155	
		10-20	0.192				500-700	0.105	
		20-30	0.075				700-900	0.070	
		30-40	0.052				900-1100	0.066	
		40-60	0.021				-1300 1100	0.040	
		60-400	0.017				-1500 1300	0.019	
Depth of groundwater	0.067	0-1	0.024	0.03	the Distance from metropolitan area	0.032	0-2	0.018	0.09
		1-2	0.033				2-4	0.026	
		2-3	0.048				4-6	0.041	
		3-4	0.071				6-8	0.063	
		4-5	0.106				8-10	0.099	
		5-6	0.157				10-12	0.153	
		6-7	0.231				12-14	0.237	
		7-8	0.331				14-16	0.363	
Geology	0.257			0		0.181	0-0.5	0.394	0.10
							0.5-1	0.268	
Land use	0.206						1-2	0.159	
							2-5	0.093	
Climate	0.055				Slope		5-15	0.065	
							15-200	0.020	

According to the written agreements, industrial estates should not have any inconsistency with the detailed, comprehensive and conductor design of cities and should be considered for light industries, should not be located in gardens or agricultural fields, sanitation and solid waste be possible through inexpensive and harmless system and be at the distance of 80 kilometers from cities with more than 1 million population. Unfortunately, the industrial complexes of Rasht city do not have these characteristics (Department of Urban Planning, 25).

The number of factors affecting choosing an appropriate location, the use of applications and attitudes toward location processes make the establishment of industries necessary. Technology development through changes in the nature and volume of data, an alternative source of energy and its transmission, the balance between labor and machinery and the scale and capacity of production have influenced the methods of locating industrial sites in a way that is parallel to developments, the limitations of locating have been eliminated.

Resources have a determining role in the localization of production activities. In broader view, the environmental conditions include rugged units, mines, climates and water resources. In the past, human life and his activities were highly under the environmental conditions. Nowadays, due to human capabilities in utilizing facilities, efficient techniques have changed the situation for his benefits.

In the past decades, irregularities and distribution of industrial units have led to problems for Guilan province and have endangered the life of people and beautiful nature of this area. In this area, the existing industries consist of wood products, non-metallic minerals, machinery and industrial products, food and beverages, textiles and furniture production. This industrial complex consists of problems in terms of composition and texture and characteristics of the region. It should be noted that given the priority of agriculture in Guilan province, the adverse environmental effects of the industrial complexes cause critical issue in this region.

The conducted studies show that the establishment of industrial sites regardless of the limiting environmental conditions is located and as a result, lacks proper returns compared to other regions that have suitable climate conditions. For most of the industrial units of Rasht city, the limitations of land uses

are inevitable. It is suggested that with respect to land use planning, special attention should be given to natural resources and the capabilities of region.

The study area is suitable for the development of the textile industry. But, it should be noted that humidity is good for textile industry, but not for workers. It should be planned to prepare a suitable environment for work and production. Workers should be the indigenous people, so that they are familiar with the climate.

The wood industry and wood products have not any climatic problem. But, deforestation damages the vast reserves of the province and country and particular attention should be given by the authorities.

Due to the proximity of the industrial complexes to residential areas, it should be attempted to produce the least pollution using modern technologies and recovering them for using in production cycle and preserve agricultural fields against these threats.

Climate plays an important role in locating industrial units. Among the climatic elements, raining, wind, temperature and humidity have important roles in locating industrial units. But, the most important point that should be noted here is that the role of climate in locating industrial sites should be based on a systematic view and be symmetrical with other environmental and socio-economic factors

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