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Design a New Model to Evaluate the Ecological Potential Land for Urban Development and Service (City of Zanjan)

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Abstract

This study aimed to design a new ecological model to be used in ecological land evaluation studies, using careful planning and sustainable resource in the region to develop a sustainable and comprehensive guide. The results show that the study area has grade 1 and 2 urban sustainable planning. Capability Grade 1 has area 149,724.25 hectares equal 22.2% that is stretched from East to West Range. Capability Grade2 has area about 18533.28 hectares equal 2.7% that located in the South, East and South-East. The results show that the greater extent of this range is the unsustainable site, which extends over 506,664.81 hectares, equivalent to 75.1% that areas compliance by the Environmental Protection area. Another important result of this study is unsuitable area for urban development and the range of services already seating workshops and industrial units. This is due to the arrival of adverse environmental effects. Therefore, this study has been focusing on reform of the status of land of use and the optimal use of the ecological potential.

Keywords

Ecological Capability Assessment, Urban Development, Geographic Information System, Linear Mathematical Model

1. Introduction

Rapid urban growth is usually associated with the destruction of agricultural

areas and natural [1]. People in different historical periods and in the process changed the landscapes of the natural environment and turn it into geographical environment; they tried locating the appropriate Settlement activity in appropriate place [2]. Attention to environmental considerations in the implementation of plans and projects, and attention to the balance between local needs and national interests are important. The unsustainable development has brought crisis to natural resources, habitat for wildlife, cultural heritage and economic and social elements, which put all generations at risk of destruction [3]. So it is very important to find the optimal way in addition to job creation, increased production and achieve self-sufficiency, increase gross margin and the like, the environment which the people living in cannot be damaged [4]. Study the effects of economic activities, is very important in particular on the establishment of industries in the area land according to its importance in the economic development of the country and also damages the environment. Improper use of resources means that these sources do not use as much power or capacity range if not used properly eternal and renewable natural resources [5].

According to general censuses, during the last 50 years, the population of Iran has experienced a three-fold increase, while population of cities has undergone a six-fold growth which has resulted in degrading environmental quality in many parts of Iran [6] [7]. Urban development and changes in land use patterns will be caused massive social and environmental impacts. These effects include decrease in natural spaces, accumulation of vehicles, loss of agricultural land to the production of high, impact natural drainage and reduced water quality. These kinds of hanges are linked by human activities in land use patterns [8].

There has been growing need for accurate assessment of urban growth so as to foster sustainable urban development strategy [9]. The recent urban transformations produced in cities indicate the need to propose new theoretical and methodological approaches in physical planning [10]. Based on the idea of complexity, it is required to integrate, in the analysis, multiplicity of interrelated factors involved in urban development [10]. In this line of thinking, theoretical and methodological approaches on physical planning to account for the complexity of urban dynamics are required. The understanding of the contemporary city requires a combination of micro and macro perspectives, integrating the multiplicity of interrelated factors involved in urban development that can provide alternatives to assessment decisions that guide intervention policies [11]. Assessment of ecological potential means objectifying the potential of the land in the form of executable applications and expectations [12]. Zanjan city is the case study in this research, which is used for assessment of ecological potential for urban development by in this area by using Analytical Hierarchy Process (AHP) and overlaying maps for comparison and the establishment of urban development, design by a mathematical model in geographical information system. Natural conditions of the region are facilitated, in particular Zanjan plain and communications as a potential part of the industry in this area. On the other hand, high levels of underground aquifers close to surface water resources of the li-

miting factors for the growth and development in this area. The results of this study can be used to analyze the current situation of urban land and services in this area and the establishment of new industries and establishing industrial location.

2. Study Area

Zanjan city is located in 47 degrees 25 minutes to 48 degrees 54 minutes east longitude and 36 degrees 27 minutes north latitude to 37 degrees to the equator is 15 minutes. This city in the northern part of the province, with an area located 6763 square kilometers.

The city center, is located between the orbits of 48 degrees 26 minutes east longitude and 26 degrees to 48 degrees and 34 minutes to 39 minutes to 36 degrees 41 minutes north latitude. Zanjan city is limited from north to Azerbaijan, Mianeh and Khalkhal, from the East Tarom city, from the south Abhar and Ijrod city and the West to the city Tarom, from the West to the Mahneshan city. The city is the largest city of the province is covered about 30 percent of the province. According to general censuses in 2017 population of Zanjan city has 486,495 [13].

Zanjan plain from the North and North-West is limited to the Tarom mountains and the South-East and South the Soltanieh mountains. 1200 square kilometers, the total area of the plains aquifer which is equivalent to 71.9% of the total area of the plains and 25.5% of the area of study. "Zanjanrod" is the main river in this area. The maximum height of this area is 3200 meters and the river basins are at least 1130 m of surface water area [14]. The map number (1) is shown the position of the basin in the city of Zanjan (**Figure 1**).

Materials and Methods

Evaluation of Environmental Capability is means the possible use of the land for

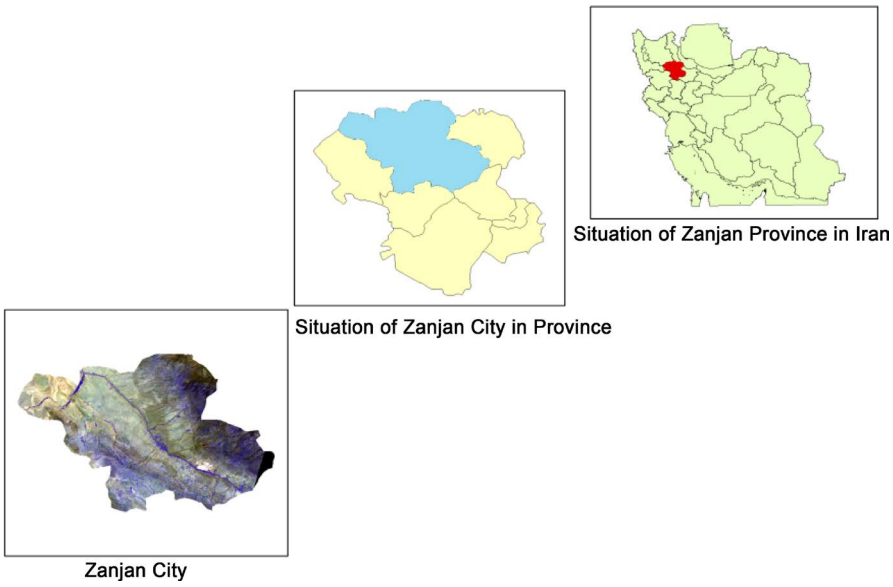

Figure 1. Position of the basin in the city of Zanjan.

use in agriculture, range management, forestry, aquaculture, military, engineering and urban development, industrial and rural in the framework of agriculture, industry, services and commerce [15]. These studies apply as a basis for decision-making and planning of land all over the world. This due to the need for choice and optimal utilization of ecological capability in the form of studies, planning and environmental management is in order to the principle of sustainable development [16].

In recent years GIS has contributed to research projects related to the environment. Assessment of ecological potential means objectifying the potential of the land in the form of executable applications and expected [17]. Thus land evaluation tool for planning strategic land use [18]. In this paper, the capabilities of GIS have been used to assess the ecological potential of Zanjan city. In this regard, due to urban development and service parameters specified in accordance with the following procedure were used overlaying maps.

- Preparation of digital data required includes topographical maps 1:25,000, capability map, vegetation and geology at a scale of 1:250,000.
- Identify the components of assessing ecological potential urban development and services by using expert opinions and studies and research documents and field.
- Urban field data to update and revise drawings in the study area by using global positioning.
- Using Mac Harg map overlay method.
- Determine the appropriate and inappropriate zones to determine urban land and services.

Procedures for map overlay (MacHag) and evaluation of ecological was used soil maps, map habitat for fauna, vegetation and surface water resources, geomorphology, geology and climatology. Based on the information gathered during the analysis and conclusions in the environmental unit was choice with ecological models built for applications, to selection of the most appropriate activities. Accordingly, it is worth recalling that in assessing the environment for rural and urban development and industrialization, all the components mentioned in the ecological model are not have same weight and some of the parameters to act as a key factor. The lack of appropriate conditions for them or not ready, even if there are other parameters, will be assessed an inappropriate study area, in order to facilitate the assessment of the components used were prioritized based on Mac Harg [3].

Priorities the parameters include water quantity, slope, rocks and soils, hydrology, position and shape of the earth, prevailing wind speed, direction of slope, vegetation, elevation and …, Process analysis and summary data for the study area for mapping the environmental units are as follows includes the class composition of ecological sustainability together:

- Overlapping the map Landform units with a type of soil map and provide base one environmental map unit.
- Overlapping the base map one by types of vegetation map and provide basic

two environmental units.

- Overlapping the basic two environmental units with a density of vegetation map and preparing the final map of environmental units.
- Preparation of the environmental units with the acquisition and development of unsustainable ecologically properties.

After the preparation of base maps, these maps were extracted in to 3 combined in ArcGIS that in the first were extracted the elevation and slope direction landform maps. In the next step of overlaying a Landform map with a type of soil and vegetation map is created the environmental final map. Preparation of the features of environmental (ecological sustainability characteristics) and complete the acquisition and development of properties, ecologically unstable environment with the next stages of work.

Process of data analysis for environmental map units of Zanjan city includes a combination resource of ecologically sustainable map. Differences of assessment ways are used in the type of ecological potential ecological models [12]. The purpose of designing a new model of urban development and land services, which is achieving a linear mathematical model for the evaluation of ecological capability. The concept is an appropriate and scientific way to identify and Valuation Effect on the ecological capability is the most important stage of the decision-making and planning [12].

In designing a new method of assessment of ecological capability of Iran to establish urban development and services identify 16 factors of the Ecological: The height above sea level (EV), percent slope (So), aspect (As), moisture content annual (Ch), the mean annual rainfall (Cp), the mean annual temperature (Ct), the development of brown field land (PI), soil drainage (dr), depth (ds), gravel percentage of soil (Ps), soil gradation (Pg), soil (Ts), lithology (Mr), groups of hydrological the soil (Hs), the preservation of a species of tree and shrub natural (Tn), the field of environmental protection (Cn), the value of animal (mammals) (Fv). In the **Table 1** decided the value and importance of urban development and services specified. As can be seen in the table despite the adverse conditions in an environmental unit, cause the points of urban development and services [12].

3. Discussion and Conclusions

However, the absence indicates that the assessment of the ecological environment before project implementation can avoid the potential dangers of the future and arrange all of human needs about the types of land use, exploitation and enjoyment. And the land use according to their ecological potential and socio-economic needs. By implementing this process, it is hoped that in future it would not occur environmental crises, at least at the regional level. Hence with this review Iran is into Environmental Assessment automatic interpretation of the data by using computers [19]. Iran has been widely used simple overlaying technique where the main theme is quality combined with an analysis based on a

Table 1. Different classes of ecological factors affecting in Iran ecological capability evaluation to establish urban land and services [12].

Soil gradation (Pg)		Average rainfall (Cp)		Mean annual temperature (Ct)		% Relative humidity (Ch)		Aspect (As)		Percent slope (So)		Above sea level (EV)		Ecological factors, many classes
value	Great	value	Great	value	Great	value	Great	value	Great	value	Great	value	Great	
1	Superfine	0	50	1	18ċ	1	40%	556	North	284	Less than 2%	10 number mean 301	Less than 1000	1
0	Fine	1	51 - 200	1	18.1 - 21	1	40.1 - 60%	400	North East	271	5 - 2	51 number mean 241	1000 - 1400	2
1	Coarse	2	201 - 500	2	21.1 - 24	1	60.1 - 80%	371	East	394	8 - 5	148 number mean 359	1400 - 1800	3
0	Average	4	500 - 800	1	24.1 - 30	0	More than 80%	421	South East	494	12 - 8	100 number mean 623	1800 - 2200	4
		1	800 - 1200	0	More than30			349	South	572	15 - 12	130 number mean 625	2200 - 2600	5
			1201 - 3000					385	South west	330	30 - 15	105 number mean 62716	2600 - 3000	6
								370	West	270	30 - 65	38 number mean 545	3000 - 3400	7
								387	North west	125	More than 65%			

Continued

Hydrologic soil groups (Hs)		Depth (Ds		Orientation transformation soil (PI)		Soil (Ts)		Lithology (Mr)		Ecological factors, many classes
value	Great	value	Great	value	Great	value	Great	value	Great	
1	A	6	30 cm	9	Unevolution	1	Sandy	7	Marl type I, II	1
4	B	2	31 - 60	1	Evolving	0	Sandy-loam	19	Dolomitic limestone	2
1	C	4	61 - 1200	3	Semi-developed	0	Sandy clay	8	Limestone December Aurore	3
7	D	0	121 - 1800	0	Evolved	0	Sandy clay loam	10	Sandstone	4
		1	More than 1800			8	Sandy clay loam	14	Alluvial Fans	5
						0	Loamy	1	Schists and conglomerates	6
						0	Loamy clay	0	Gneiss	7
						0	Sandy loam	0	Salt	8
						0	Sandy clay loam	4	Floodplain	9
						0	Sandy clay loam	0	Alluvial terraces	10
						2	Clay	0	Ophiolite	11
						0	Sandy clay	0	Calcite marble	12
						2	Loamy clay	0	Sand dunes	13
						0	Sandy clay loam	11	Gypsum	14
						0	Sandy clay loam	0	Flabby	15
						0	Silty	0	Sediments of the continental shelf	16
						0	Silty loam	0	Quartzite	17
						0	Silty clay loam	6	Conglomerate	18
						0	Silty clay	20	Tuff	19

Continued

Gravel percentage of soil (Ps)		Drained soil (Dr)		Ecological factors, many classes
value	Great	value	Great	
2	2% - 15%	0	perfect	1
4	16% - 50%	13	Good of average	2
7	51% - 90%	0	Incomplete average	3
0	More than 90%	0	Poor incomplete	4
		0	Poor	5

Continued

The field of protection (Cn)		January valuable species (mammals) (Fv)		Protecting the natural tree and shrub species (Tn)		Ecological factors, many classes
value	Great	value	Great	value	Great	
0	National Park	1	*Acinonyx jubatus*, *Equus hemionus*, *Cervus dama*, *Meso potamica*, *Gazella dorcas*, *Selenarctos thibetanus*	0	*Zelkova carpinifolia*, *Buxus sempervirens*, *Taxus baccata*, *Populua Caspica*, *Cupressus semperviren*	1
1	protected area	1	*Ovis orientalis*, *Capra aegagrus*, *Canis lupus*, *Panthera pardus*, *Martes foina*, *Felis catus*, *Ursus arctos*	36	*Juniperus polycarpos*, *Platycladus*, *Acer monspessulanum*, *Cerasus avium*, *Quercus brantii*	2
0	Wildlife shelter	1	*Vulpes vulpes*, *Meles meles*, *Hyaena hyaena*, *Mustela nivalis*	11	other species	3
0	National natural monument	1	*Sus scrofa*, *Hystrix indica*, *Sciurus anomalus*, *Canis aureus*, *Ochotona sp*			4
0	Biosphere reserves		other species			5
0	Reserve forest					6
0	Forest Park					7
0	Forest plantations					8
0	Nature Park					9
0	World Heritage					10
0	National monuments Pilgrimage					11
0	Antiquities					12
1	Other area					13

References: [12].

system approach [19] [5].

Ecological potential area has power for urban development and services, which a grade 1 and 2; areas with environmental restrictions do not have the ability to grade 2; grade 1 can be eligible to be considered within the study. The grade 1 have been identified spots in the West to East area 149,724.25 hectares (22.2%), the grade 2 spots in the East, Southeast and southern area 18,533.28 hectares (2.7%). Overlaying weight, a powerful geographic information system environment by combining these tools, which with the way of questionnaire and

qualitative methods to promote a little bit. This study is provided to define a model community for urban land use and services in the area and promotes it from the qualitative to the quantitative determination of the weight of the layers of information and maps of existing raw material for overlaying weight in the GIS environment. The Table 2 ecological potential of area is presented by Makhdom method.

Preference was proposed and optimized applications were introduced in Figure 2 the results.

Accelerating urban growth and land use/cover changes places increasingly pressure on the natural environment and human welfare and have become a global concern. Iran, as a developing country, is also experiencing growth of its

Table 2. Classes ecological potential area of study Makhdoom.

Row	Name	Area of Hectares	Percent
1	Class one urban development	149,724.25	22.2%
2	Class two urban development	18,533.28	2.7%
3	Inappropriate	506,664.81	75.1%
	Total	674,922.34	100%

References: the authors calculate, 2017.

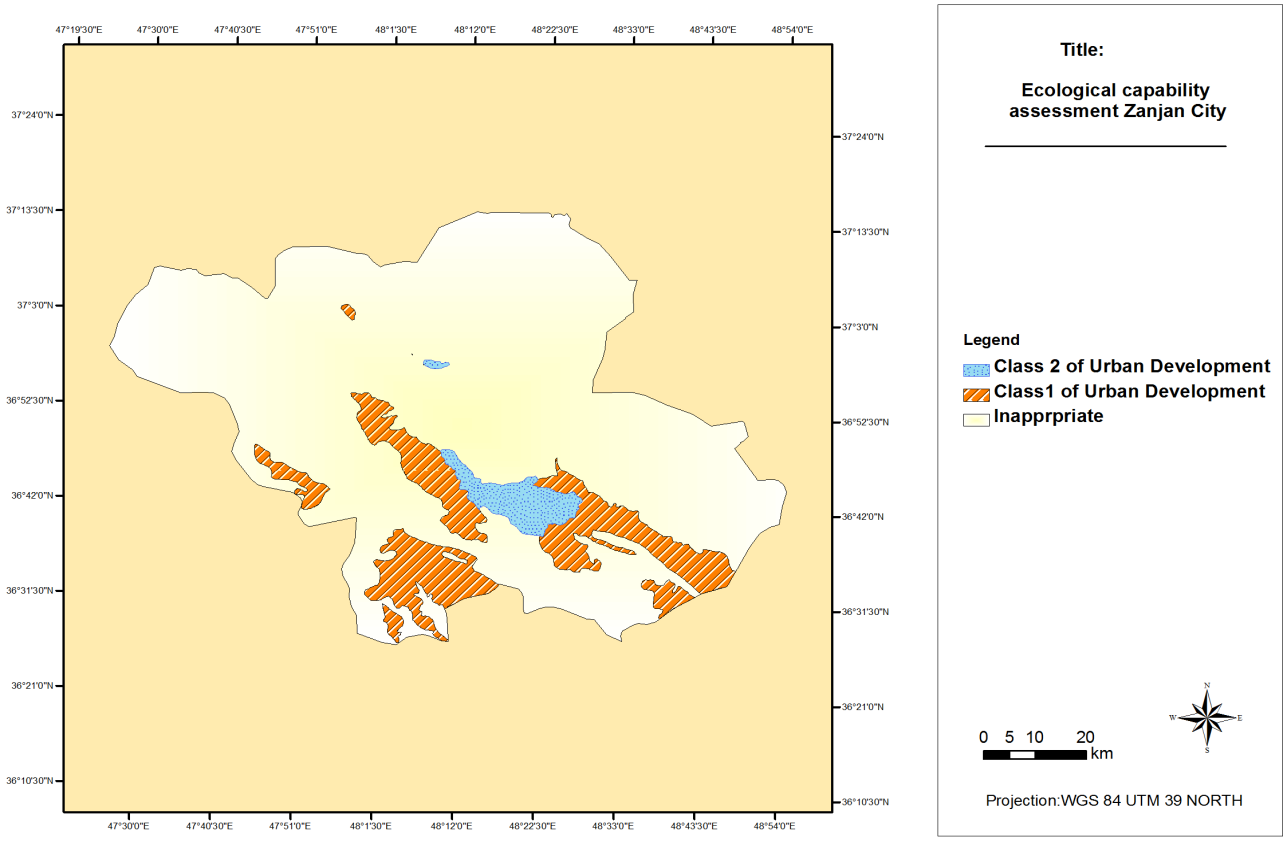

Figure 2. 22.2% class 1 appropriate area, 2.7% class2 of appropriate area and 75.1% in appropriateare. Map the urban development, industrial, rural, military and engineering classes 1 and 2 in Zanjan city by the assessment of ecological potential overlap.

urban areas during the last decades by high rate of rural urban migration along with rapid socio economic and political changes that has resulted in degrading environmental quality in many parts of Iran [20].

Overlaying weight is one of the effects of the application of GIS techniques, overlaying plain where the main theme of quality is combined with analysis based on systemic approach, although current models in the country's overall so for the detection of ecological potential special areas needs of indigenous and local models. The results of the present study and in order to optimize the deployment of industrial units in the study area are offer with minimal environmental impact following suggestions:

- The necessity of assessing the ecological potential to implement the optimized user in every region as the strategic planning of land use in the region.
- Using the socio-economic indicators—culture as complementary capability assessment natural environment and urban services in the study area.
- Environmental impact assessment after evaluating the development of the region in order to prevent damage to the environment and conserve natural resources.
- Providing infrastructure and services and introducing this infrastructure for growth and urban development in the study area.
- Planning for the industries development by related ecological potential.
- Using the GIS to implement the location of industries in the region on the map and prepare a database for the management and future planning.
- Use the applications of GIS and remote sensing to assess the ecological potential in the study area.
- Uniform evaluation methods of ecological potential.
- Operational capability assessment studies and environmental impact assessment in provincial development programs.
- Provide specialized training to functional and strategic experts in the field.

Justify managers and decision makers to value the fundamentals of the subject.

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