Optimal Localization of Green Spaces by Using GIS (Case Study: Region 2 of Dezful Municipality)

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Abstract
Nowadays, concept of cities without being effective green spaces in different forms isn't imagined anymore. Cities as the focuses of activity and human life have to follow the structure and function affected by natural systems so that they can guarantee their stability. Among this, green space as an essential and inseparable component of urban bodies plays an important role in metabolism of cities in order that deficiency of them can create serious disorders in city lives. The population of studied region, region 2 in Dezful city is estimated 113100 persons and its green space capitation is 3.11 square meters that this quantity has a significant difference compared to standard determined by United Nations (20-25 square meters per person). Considering the city located in warm and dry zone of the country, would redouble the necessity of regarding proper localization of green space for adapting climate, and according to population needs. Present paper is based on descriptive-analytic method, and emphasizes on functional aspect. In this regard, information layers such as map of vicinity to residential centers, educational centers, cultural centers, military centers, commercial centers, hygienic centers, religious centers as well as river were generated according to localization criteria. Results of the research in fuzzy logic valued region lands according to their importance in recognizing of optimal location. Afterwards, these lands were compared to the land use map, and it is distinguished that very good, good, and medium degree lands have located in the nearby distance from the residential, cultural, and educational centers which had further governmental ownership, and the lands with poor and very poor degree have located in further distance from compatible land uses, and they further located in proximity of industrial, administrative, hygienic as well as commercial centers which are mostly private. Thud they weren't suggested for creating green space.
Keywords*: Localization, Urban green space, Geographical Information System, Dezful City, Iran Country*

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1. Introduction

These days, existence of green space, and extension of it has become inevitable forever due to consequences of urban development and complexity of environmental difficulties. Cities as the focuses of activity and human life have to follow the structure and function affected by natural systems so that they can guarantee their stability. Among this, green space as an essential and inseparable component of the only bodies of cities plays an important role in metabolism of cities in order that deficiency of them can create serious disorders in city lives

(Majnoonian, 1995:6). The most important effect of urban green apace is its environmental function that signifies cities as an environment of human society, and it will increase environmental quality of cities (Pur Ahmad and colleagues, 2009:31). Thus, in addition to amount of green spaces accessibility to such spaces is also considered in studies of urban green spaces. Nowadays, accessibility to green space and possibility of spending leisure times in these spaces are one of main pillars of development. One of the most important purposes in urban studies is creation of balance. It has the highest degree of importance for urban planners. If the way of locating and distribution of urban services and land uses among them green space contains equivalence, whole groups of society will benefit from it as far as possible (Dadashi and colleagues, 2006:3).

Hence, if green space as a part of urban textures and also part of urban services is found essential, it will not be separated from urban society. Therefore, green space from viewpoint of quantity and quality should be symmetrical to physical volume of cities, buildings, streets, roads, people's demands mentally, spending times, and hygienic needs, and it should be established regarding ecological consequences of city as well as its future extension procedure in order to receive continual environmental efficiency as an active green space (Majnoonian, 1995:45). There is no doubt that urban green space should be regarded as the most fundamental stability factors of natural and human life in today urbanity (Esmaeeli, 2002:11) that if it is scheduled correctly, it will have desirable effect on treating of human's body and spirit (Shiri, 2006:32). Actually, this land use has a noticeable role in promoting of life quality for citizens based on its various functions, and due to this, it is a key factor in creating sustainable city.

Nowadays, attention to urban green space localization is one of unavoidable necessities in planning and urban management regarding potential importance that these spaces have from different viewpoints of ecology, society, economy, mentality, and etc. in urban environment.

Tow region of Ahvaz municipality with a population density of 113100 persons is counted in medium urban densities and generally used space limit of residential units and servicing components of them in medium urban densities are expressed as below:

50% of ground surface is residential space, 25% roadway and pedestrian space, 15% green space and sportive places, and 10% other servicing spaces(Shieh, 1990, 173-179). It should be noted that allocated capita in current state of studied region is equal to 78.2 M^2that this amount in addition to significant difference compared with 15 M^2 capita in medium urban densitiesis lower than acceptable capita of green space in the cities of Iran which is 7-12 M^2(Saeednia, 2000:83) and it also has a significant distance in comparison with suggested capita in comprehensive scheme of Ahvaz which is equal to 13M^2(Housing and urbanization, 2006).This study has tried to achieve optimal localization for creating green space in studied region based on special analysis methods in GIS and Fuzzy logic. Finally, the best lands for establishing new green space were distinguished in four regional groups including very good priority, good priority, weak priority, and very weak priority using the abilities of geographical information system and mentioned model.

1.1 Case study

In this research, studied area is region 2 of Dezful municipality. This region is located between 32 degree and 0 minute to 32 degree and 58 minute of northerly latitude and 48 degree and 17 minute to 49 degree and 34 minute of eastern longitude. The area of the region exceeds 1198459381 square meters, and its population is 113100 persons in 1389. The climatic type of this city is partly dry with hot summers and temperate winters, and its annual average rainfall

is 250 millimeters. (Ahmadi, 2011: 6). Temperature of the city ranges from 3 degree centigrade in winter to 49 degree centigrade in summer. Regarding climatic conditions of this city and location in warm and dry region of Iran, doubles necessity of attention to optimal and proper localization of urban green spaces as recessional lungs of the city to modify climate (Statistical yearbook of Khuzestan province, 2006:28).

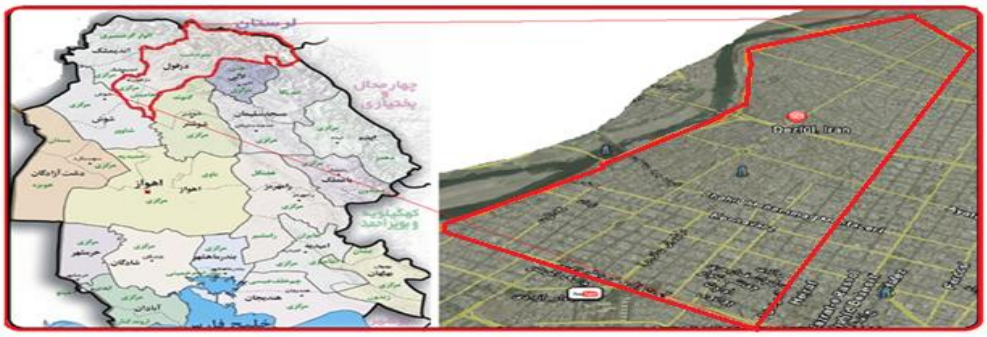


Figure1: Position studied region

1.2 Methodology

Method used in the present paper is descriptive-analytic, and its theoretical fundaments have been performed based on documentary, library, and observing studies, and referencing to the related organizations. Standards used for locating have been selected based on localization criteria. Effective factors, criteria, and constraints in form of map layers should be provided, processed and, analyzed in order to locate in geographical information system (GIS). In other words, economical-social, cultural and environmental aspects should be considered in performing every optimal localization projects in the parks of regarded regions, and proper location will be obtained by regarding mentioned aspects. These criteria are as follows.

Table (1): Specified standard criteria for locating urban green space

Standard distance to every land use	*Sort compatibility*	*criterion*	*Row*
150 m ≤	Compatible	Near to residential centers (m)	1
150 m ≤	Compatible	Near to cultural centers (m)	2
150 m ≤	Compatible	Near to didactic centers (m)	3
150 m ≤	Incompatible	Near to commercial centers (m)	4
500 – 1000 m	Incompatible	Near to industrial centers (m)	5
150 – 500 m	Incompatible	Near to urban installation centers (m)	6
150 m ≤	Incompatible	Near to arid land (m)	7
150 m ≤	Incompatible	Near to ministerial centers (m)	8
150 m ≤	Incompatible	Near to sanitary centers (m)	9
150 m ≤	Compatible	Near to river (m)	10

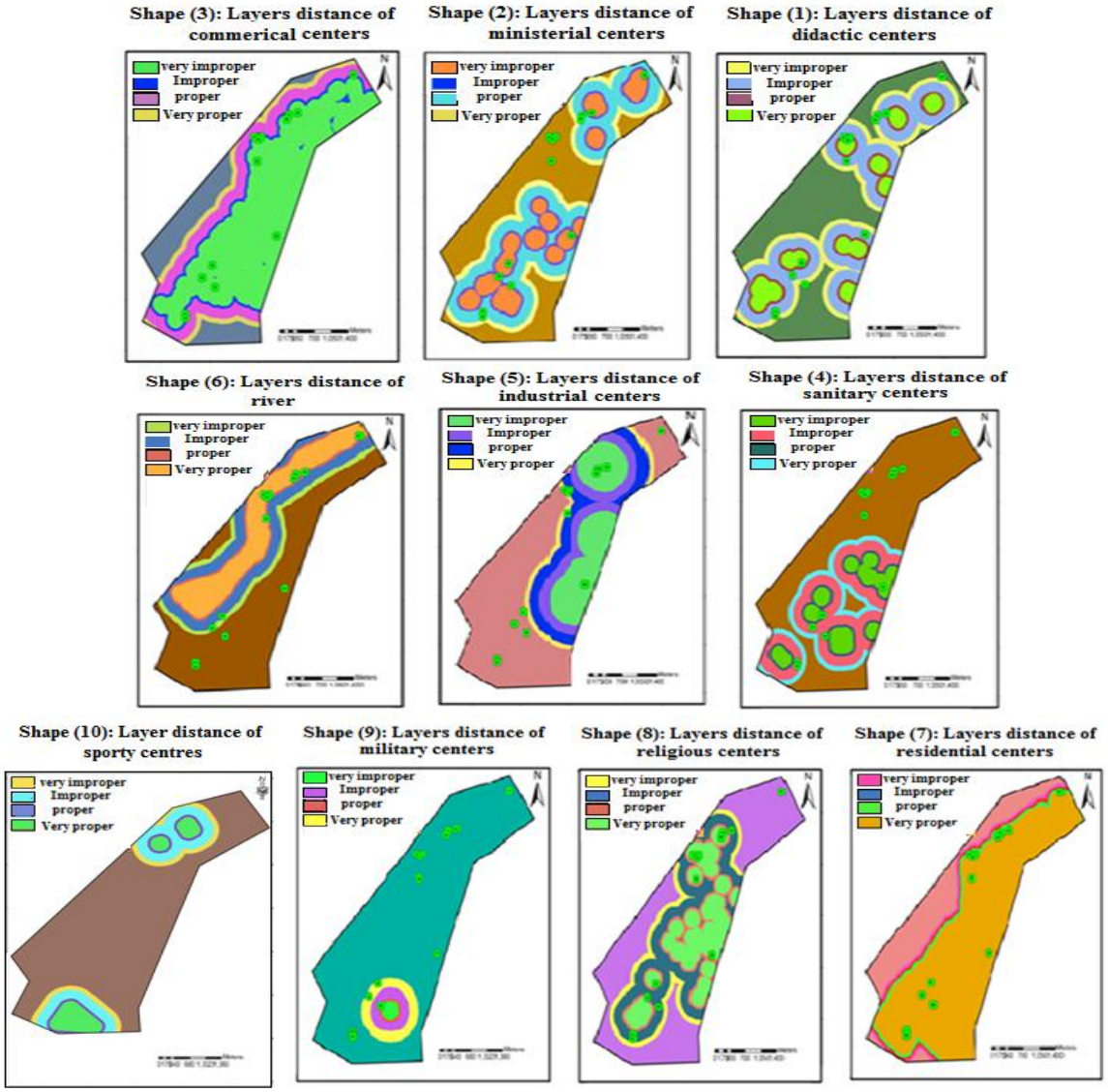
Reference: (Hosseini, 2002) & (Varesi and colleagues, 2008)

Regarding localization process as a multi-criteria decision making unit and as it is performed using raster model, it is important to consider one thing about the selected software that it

should support raster model in addition to vector model. Moreover, mentioned software should have the capability of using multi-criteria decision making. In this regard, Fuzzy logic in ARCGIS10 space has been applied in order to analyze information layers.

2. Preparation of layers for importing to GIS

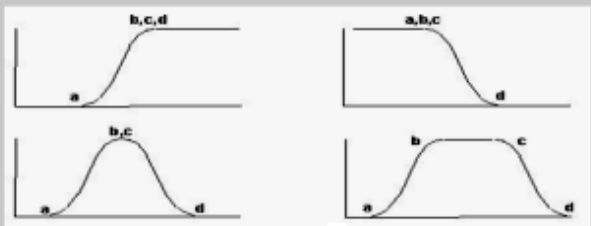
After generating various information layers, they were converted in form of operational map layers in regarded GIS spaces for analyzing so that they can be prepared for operation of normalization and performance of models. This stage is a process including reception of data, variation of format, geo-referencing, controlling, and predicating of data (Farajzadeh, 2005:8). Data has been imported to geographical information system including digital maps of current land use situation, and digital map of residential centers, educational centers, cultural centers, river, administrative centers, industrial centers, and military centers layers which new layers like maps of Figure (1-10) have been generated using current data. These layers are: distance from residential centers, distance from cultural centers, distance from military centers, distance from commercial centers, distance from industrial centers, distance from remedial centers, and distance from the river.



2. Normalization of maps in Fuzzy logic

In Fuzzy logic, each region receives a membership value (μx) according to the value which every criterion considers that it demonstrates amount of the region`s desirability. This means that the higher each region contains membership value, the higher each region would acquire desirability amount. In this logic, any layer is placed in a scale between 0 and 1 or a fraction of 1. In these scales, larger numbers will have more desirability. It means that number1 contains the highest desirability, and number0 is lack of desirability, and range of values are placed between the two numbers that as it is become closer to number1, the desirability would increase. In addition to choosing scale for generating Fuzzy maps, type of Fuzzy function should be surveyed, and selected more suitable function for regarded criterion. The most popular functions that can be indicated are: Gaussian, Linear, Large, Small, Near, and Shape (Etesam, 1997). Mentioned functions are in selected ARCGIS10 and IDRIS space, and in addition to these functions the user can definite the function depending on his or her needs (Figure A to C). (In the present research, criterion maps have been normalized using these functions in ARCGIS10 software, and its values have been converted to comparable units from 0 to 1.)

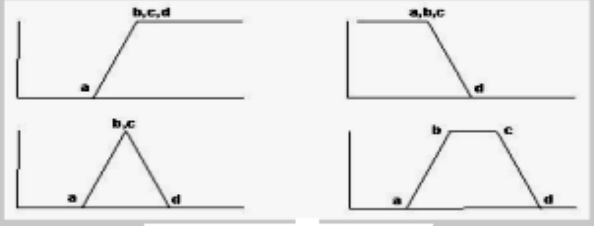
$$\alpha = (x-a)/(b-a) * P_i / 2$$
$$\text{if} \quad x \succ b \quad \Rightarrow \quad \mu = 1$$



Shape (A): Sigmoidal Function

$$\mu = 1 \Big/ \left(1 + ((x-a)/(b-a))^2\right)$$
$$\text{if} \quad x \succ b \quad \Rightarrow \quad \mu = 1$$

Shape (B): J-Shape Function



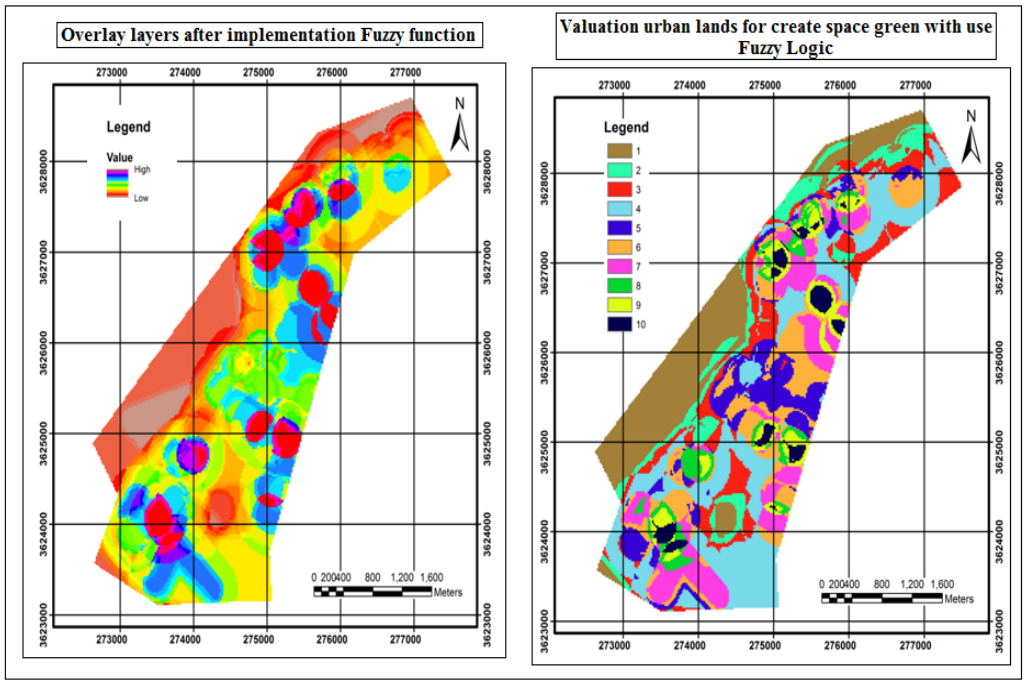
Shape (C): Linear Function

One important point about choosing type of functions in this stage regarding normalization of layers performed for inconsistent and consistent land uses in this paper is paying attention to type of selected functions. For instance, in consistent land uses the closer distance land uses are to green space, the higher efficiency will be. According to this, type of selected function for these land uses should be defined based on localization criteria meaning classes with lower distance receive higher value. Therefore, this definition is harmonized to Small function. As for the inconsistent land uses, mentioned orders will be performed meaning the further distance green space from these land uses, the higher efficiency will be. Hence, according to performed classification classes with higher Distance in this land use receive higher value and, this definition is harmonized to Large function. One of the other effective factors in normalization of Fuzzy maps is specifying the threshold called control points. Another point which should be regarded about selecting function is its decreasing or increasing type (Valizadeh & Shahabi, 2008). Decreasing type means becoming minim or descending function, and increasing type means becoming extreme or additive function. For example, as for the commercial centers the more distance, the better. Therefore, here additive function is applied. Amounts of threshold and type of Fuzzy function have been represented in table (2) to normalize criterion maps in Fuzzy logic.

Table (2): Amounts of threshold and type of Fuzzy function to normalize criterion maps in Fuzzy logic

Name function Fuzzy	Sort function fuzzy	Threshold quantity		Name criterion	Row
		D or b	C or a		
Small	Degressive	150	450	Distance of residential centers (m)	1
Small	Degressive	150	450	Distance of cultural centers (m)	2
Small	Degressive	150	450	Distance of didactic centers (m)	3
Large	Additive	150	500	Distance of commercial centers (m)	4
Large	Additive	500	1000	Distance of industrial centers (m)	5
Large	Additive	150	500	Distance of urban installation centers (m)	6
Large	Additive	150	500	Distance of arid land (m)	7
Large	Additive	150	500	Distance of ministerial centers (m)	8
Large	Additive	150	500	Distance of sanitary centers (m)	9
Small	Degressive	150	500	Distance of river (m)	10

Finally, after normalizing layers and applying proper function for each layer, in the next step, all standard layers in Fuzzy Overlay were merged according to proper function, and in the last step, land uses with higher priority were recognized for creating green space (Figure3).



4. **Conclusion**

With the emersion of environmental crisis in cities and reduction of people`s general life level, treating urban spaces and preserving environment have become significant importance for the future generations. Hence, considering the green space has a privileged place in spatial development plans for achieving balanced and stable development. In the present world, since environmental pollutions are increasing in most cities, coordinated and impartial spread of parks and green spaces has more effective importance in creating environmental sustainability of cities.

In this research, site selection of urban green spaces was studied and analyzed using Fuzzy Logic in order to present optimal and effective pattern of green space distribution of region 2 in Dezful city. Analyzing of results generated via this model in GIS space and its adaptation to land use map of Dezful city indicates that regions with very good degree are close to residential, educational, and cultural centers, and are far from incompatible land uses, and functional radius of existing parks. In addition, many of governmental centers (such as educational centers, military centers, administrative centers, and etc.) are placed in this limited area. Therefore, problems of existing lands will reduce by changing their function and converting them to green space from viewpoint of ownership. Lands with good and medium degree in studied region are placed close to educational, residential, and cultural centers, and are far from functional radius of existing parks as well as the ownership of these lands belongs to government. Thus, if the land uses change, there will not many problems. Changing land use of the lands with weak degree will face with problems due to placing near incompatible land uses such as industrial, remedial, administrative, and commercial centers on one hand, and being private of these land`s ownership on the other hand. Therefore, these lands are not suggested for creating green space. Another kind of priority lands for green space land use is the lands with very weak degree. These lands were not suggested for creating green space because of placing near functional radius of existing parks, and far distance from residential, educational and cultural centers as well as placing in operational area of incompatible installation. Results of the study represent function and importance of Fuzzy Logic in site

selecting of green space and presentation of optimal scattering pattern based on population criteria and their requirements.

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