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RESEARCH ARTICLE

GIS Techniques for Suitable Locations for Urban Green Space in District 2 of Tabriz, City, Iran

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Study Area: Tabriz, Iran
Coordinates: 38°04'N 46°18'E

Key words: Geographical information system , Multi Criteria Analysis (MCA), Analytical Hierarchy Process (AHP), Local Recreational Park

Abstract

GIS technique also used to determine whether the land resource is suitable for some specific uses and to determine the suitability level. The case study area occupies an area of about 3148 hectares in Tabriz city. This paper uses GIS and tools in assessing the suitability of local parks of the city of Tabriz in East Azerbaijan in Iran. The first objective of this paper is a study of neighboring, compatibility, accessibility and other physical factors effective in the suitability of local parks of the study area; the second objective is evaluating the spaces suitable for parks distribution in the study area and the third is a study of social factors that effective in the suitability of local parks. The result suggests that 36.4% of local parks of study area are completely compatible with adjacent land uses, also study of suitability of local parks suggest that 46.6% of these parks are in high suitability status, 27.3% are in moderate and 9.1% are in low suitability situation.

Introduction:

Land suitability analysis is the process of determining the suitability of a given tract of land for a specific use (Steiner *et al.*, 2000). Progress in computing sciences, including Geographical Information Systems (GIS) and Multi-Criteria Decision Analysis (MCDA) can help the planners to handle this complexity. The recent literature is replete with proposals combining GIS and MCDA which fulfil the above-mentioned objectives upto far extent.

Urban green and open spaces are among nature survivors in cities, which suffer from qualitative and quantitative changes due to improper urban developments. Moreover, these developments are associated with many ecological, economic and social effects (Jim & Chen, 2008). Importance of urban green spaces is widely realized in all the societies in social performance, biodiversity conservation and other ecological processes for eco-friendly development. Increasingly, former urban planning methods paid less attention to environment and environment surrounding cities, which led to much criticism (Gomez & Salvador, 2006). To confirm multiple roles of green spaces, a certain level of quality development and distribution of green spaces in urban areas should be considered, which must be considered as a part of environmental sustainability agenda. Achieving this goal requires an integrated approach and a structure in relation to planning, monitoring, design and protecting urban green spaces to improve environmental sustainability in cities (Haq, 2011). Today, green space planning has become a priority in urban planning and requires an integrated approach to achieving sustainable urban environment (Waldheim, 2006). Well planned green spaces increase urban environments quality, providing opportunities for people to come closer to nature (Moseley *et al.*, 2013). The influence of the urban green space is determined by its proper planning on location so that the city management should be locally adapted strategies for the planning and management of their urban green space (Pretzsch *et al.*, 2015). Urban green space has great potential for promoting life quality that allows citizens to achieve health benefits (Zhang *et al.*, 2015). Rapid growth of cities is becoming the risk for sustainability of cities and the citizen's quality of life (Riffat *et al.*, 2016). Therefore, special attention must be given to the promotion of ecological green spaces in order to improve their productivity, because within cities, valuable ecological elements are reducing fast (Zangi & Rakhshani, 2009). Accordingly, experts believe that one of the main ways to deal with the present situation is to strengthen the relationship between urban people with their ambient nature (Shahivandi, 2006). Today, cities require particular attention in terms of restoration of nature falls in urban areas.

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Methodology:

The techniques adopted in the various approaches of decision analysis are called Multi Criteria Decision Methods (MCDM). These methods incorporate explicit statements of preferences of decision-makers. Such preferences are represented by various quantities, weighting scheme, constraints, goal, utilities, and other parameters. They analyze and support decision through formal analysis of alternative options, their attribute, evaluation criteria, goals or objectives, and constraints. MCDM used to solve various site selection problems (Badri, 1999). Analytical Hierarchy Process (AHP) is one of useful (MCDM) methods for decision making that applied in assessment of suitable area required for different land uses. This method is able to combine whit GIS tools and applied in suitable analysis. The AHP, developed by Saaty (1987), is based on a pair-wise comparison of the indicators. By applying the AHP, several identified indicators could be ranked based on the preferences made by several involved parties. In this paper we attempt to apply methods combine with GIS tools for suitability analysis process. Following the Fig.-1 the criteria which were applied in this paper described in 10 factors.

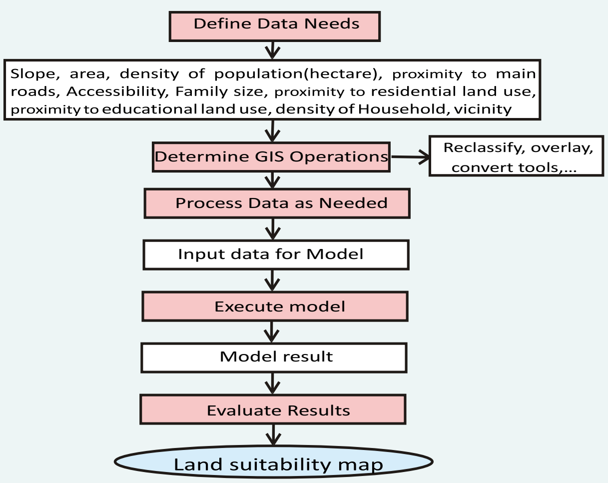


Figure-1: Flowchart & tools applied in the study

In this study we applied pair wise Comparison Matrix for weighting of criteria (Saaty, 1994). This method involves pair-wise comparisons to create a ratio matrix. As input, it takes the pair wise comparisons of the parameters and produces their relative weights as output.

Presently, AHP method is very popular in defining weight of alternative comparison actors. It was developed by (Saaty, 1980). Using pair-wise comparison matrix relative preference opinion of experts of all factors can be synthesized into a general weight of each factor.

City of Tabriz is located in East Azerbaijan province in country of Iran. This city includes 9 districts for supplying urban service area. In this paper study area include one district of 9 Tabriz city districts. This Study area occupies about 3148 hectares of district number 2 in Tabriz city.

Camparison matrix: i- Equal importance; ii- Equal to moderate importance; iii-Moderate importance; iv-Strong importance; v- Moderate to strong importance; vi-Strong to very strong importance; vii- Very strong importance; viii- Very to extremely strong importance; ix-Extremely importance.

Table -2: Pair-wise comparison matrix and weights of importance for the evaluation criteria-1

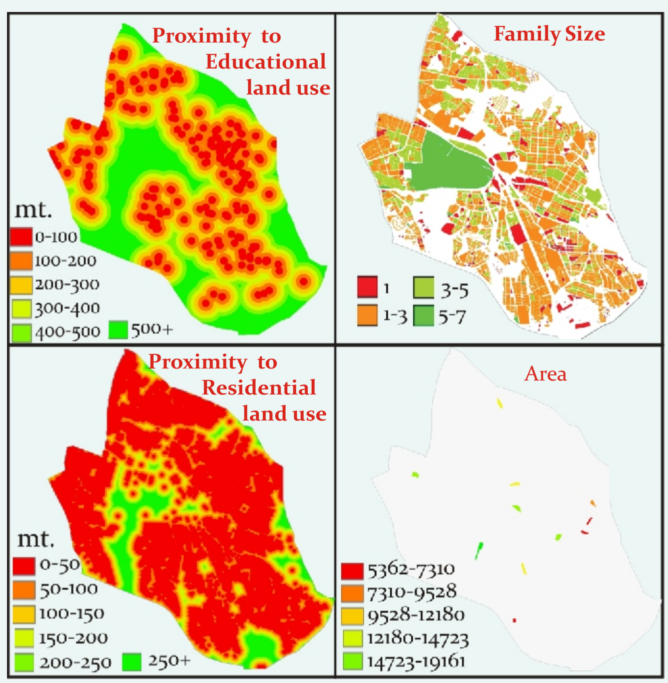
Factors	a	b	c	d	e	f	g	h	i	j	Weight
a	1	3	4	4	5	5	6	6	7	9	0.0773
b	1/3	1	3	3	4	5	5	6	7	8	0.2105
c	1/4	1/3	1	2	3	4	4	5	6	7	0.1379
d	1/4	1/3	1/2	1	2	3	4	5	6	7	0.1094
e	1/5	1/4	1/3	1/2	1	2	3	4	5	6	0.3024
f	1/5	1/5	1/4	1/3	1/2	1	2	3	4	5	0.0551
g	1/6	1/5	1/4	1/4	1/3	1/2	1	2	3	4	0.0398
h	1/6	1/6	1/5	1/5	1/4	1/3	1/2	1	3	4	0.0318
i	1/7	1/7	1/6	1/6	1/5	1/4	1/3	1/3	1	3	0.0213
j	1/9	1/8	1/7	1/7	1/6	1/5	1/4	1/4	1/3	1	0.0146

a-Accessibility; **b**-Population density; **c**-Family size; **d**-Household density; **e**-Compatibility; **f**- Proximity to main road; **g**-Proximity to residential area; **h**-Proximity to education land use; **i**-slope; **j**-area.

Results :

Results are Summarized in the following figures & tables.

Figure-2: Criteria layer Maps



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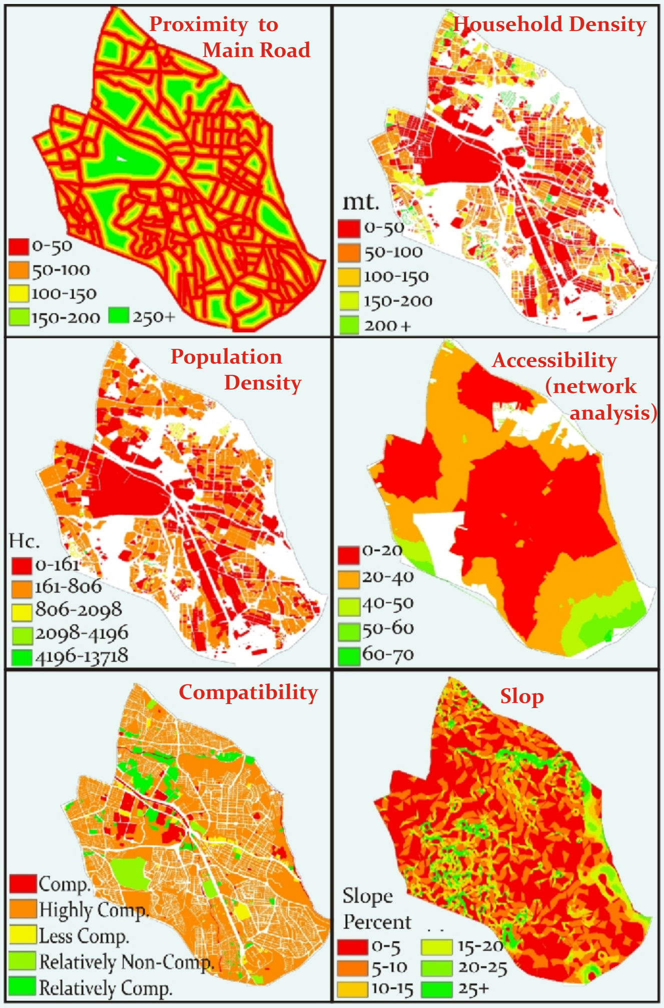

Table (3): characteristics of Layers

Proximity to Educational Land use

No	range	score	class
1	0-100	9	Extremely suitable
2	100- 200	7	High suitable
3	200- 300	5	suitable
4	300- 400	3	Moderate suitable
5	400- 500	1	Less suitable
6	500 +	nodata	nodata

Proximity to main road

No	range	score	class
1	0- 50	9	Extremely suitable
2	50- 100	7	High suitable
3	100- 150	5	suitable
4	150- 200	3	Moderate suitable
5	200- 250	1	Less suitable

Household density

No	range	score	class
1	0- 50	1	Less suitable
2	50- 100	3	Moderate suitable
3	100- 150	5	suitable
4	150- 200	7	High suitable
5	200+	9	Extremely suitable

Compatibility of land uses

No	range	score	class
1	High compatibility	9	Extremely suitable
2	low compatibility	7	High suitable
3	indifferent	5	suitable
4	Relatively non compatible	3	Moderate suitable
5	Less compatibility	1	Less suitable

Accessibility (network analysis)

No	range	score	class
1	0 - 20	1	Extremely suitable
2	20- 40	3	High suitable
3	40- 50	5	suitable
4	50- 60	7	Moderate suitable
5	60 +	9	Less suitable

Proximity to residential Land use

No	range	score	class
1	0 - 100	9	Extremely suitable
2	100- 200	7	High suitable
3	200- 300	5	suitable
4	300- 400	3	Moderate suitable
5	400- 500	1	Less suitable
6	500 +	nodata	nodata

Population density

No	range	score	class
1	0 - 150	1	Less suitable
2	150- 300	3	Moderate suitable
3	300- 450	5	suitable
4	450- 600	7	High suitable
5	600 +	9	Extremely suitable

Family size

No	range	score	class
1	5- 7	9	Extremely suitable
2	3- 5	7	High suitable
3	1- 3	5	suitable
4	0- 1	3	Moderate suitable
5	0	restricted	Less suitable

Slope

No	range	score	class
1	0- 5	9	Extremely suitable
2	5- 10	7	High suitable
3	10- 15	5	suitable
4	15- 20	3	Moderate suitable
5	20-25	1	Less suitable
6	25 +	restricted	restricted

Area of existing local parks

No	range	score	class
1	14723- 19161	9	Extremely suitable
2	12180- 14723	7	High suitable
3	9528- 12180	5	suitable
4	7310- 9528	3	Moderate suitable
5	5362-7310	1	Less suitable

To combine weight, score and constraint coefficient of various criteria factors, MCA method was appropriate (Carver, 1991, Rao, 2005). In model builder process the reclassify these grid themes using the reclassify tools

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Process. Models are represented as sets of spatial processes, such as classification, and reclassification and overlay techniques. Each of the input themes is assigned a weight influence based on its importance. The last step in the suitability model is to combine the reclassified outputs (the suitability maps) of Slope, Area, the Density of population, Distance to main roads, Accessibility, Family size, Distance to residential land use, Distance to educational land use, the Density of Household and Vicinity maps.

Figure-3: Local parks land use suitability Model builder process.

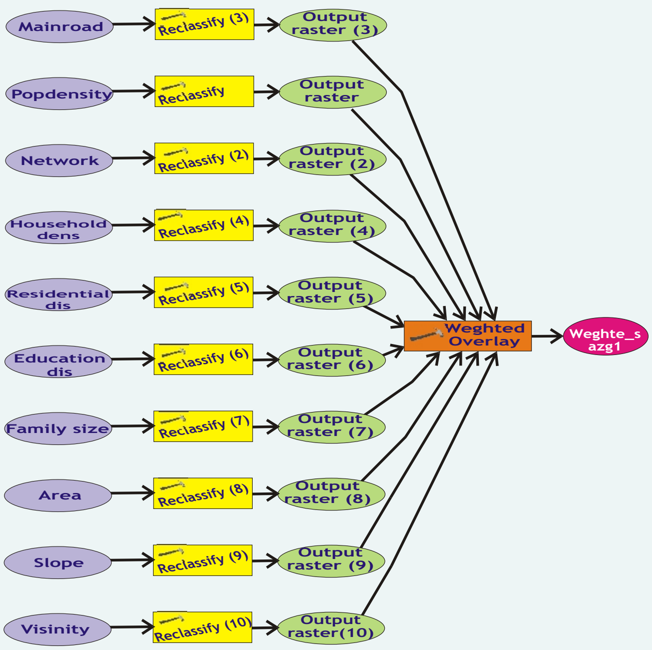

Figure-4: Local parks Land use Suitability Map

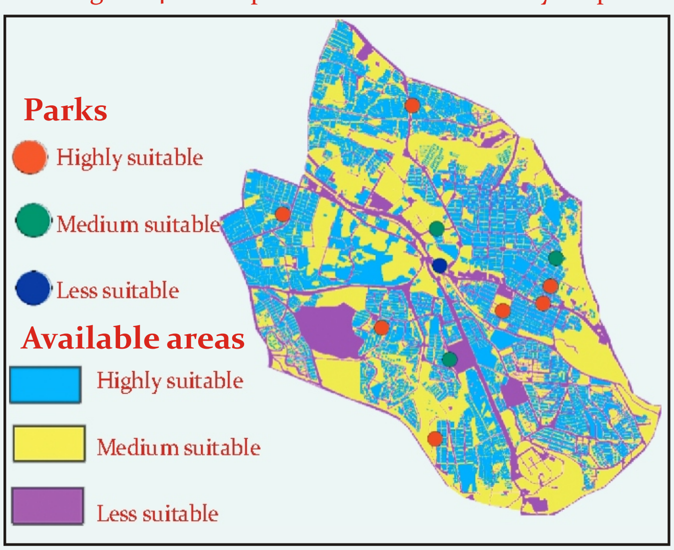

Table-4: Local Parks Suitability

Park Name	suitability	%
Fadak, Zafraneye, Sahand, Zeytoon Daneshamooz, Nahalestan, Tooba	Highly suitable	64.6
Babataher, Rjayishahr, Valiasr	Medium suitable	27.3
Rahnemayi	Less suitable	9.1

Conclusion:

The final suitability map is produced by combining all the maps together. Weights can be assigned at the same time as combining the suitability maps. The final suitability map for locating sites for the local parks is shown below. The high suitable parks have been located in the most suitable locations and the least suitable parks are in the low suitable area. According to result map of suitability analysis, the following table (3) and figure (6) represents the suitability of each park in district 2 of Tabriz city.

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