

Locating Cultural Centers in Shiraz (Iran) Applying Geographic Information System (GIS)

R. Mokhtari Malekabadi, S. Ghaed Rahmati, and S. Aram

Abstract—Optimal cultural site selection is one of the ways that can lead to the promotion of citizenship culture in addition to ensuring the health and leisure of city residents. This study examines the social and cultural needs of the community and optimal cultural site allocation and after identifying the problems and shortcomings, provides a suitable model for finding the best location for these centers where there is the greatest impact on the promotion of citizenship culture. On the other hand, non-scientific methods cause irreversible impacts to the urban environment and citizens. But modern efficient methods can reduce these impacts. One of these methods is using geographical information systems (GIS). In this study, Analytical Hierarchy Process (AHP) method was used to locate the optimal cultural site. In AHP, three principles (decomposition), (comparative analysis), and (combining preferences) are used. The objectives of this research include providing optimal contexts for passing time and performing cultural activities by Shiraz residents and also proposing construction of some cultural sites in different areas of the city. The results of this study show the correct positioning of cultural sites based on social needs of citizens. Thus, considering the population parameters and radii access, GIS and AHP model for locating cultural centers can meet social needs of citizens.

Keywords—Analytical Hierarchy Process (AHP), geographical information systems (GIS), Cultural site, locating, Shiraz.

I. INTRODUCTION

URBANIZATION is one of the phenomena of human society in recent centuries. The process of urbanization is a double-edged and grotesque process; this process creates both constructive and destructive effects in towns. On the one hand, it provides the possibility of assembly of persons, goods, services and opportunities while fragmenting and weakening places, traditions and available networks. In line with capacities and new talents which are created through focusing and economic growth, the dangerous consequences and effects of marginalization process are created [1].

In the eighteenth century that cities were first formed, two views about the effects of urbanization on social life were dominant. Some regarded cities as manifestation of "civic virtue" that was the source of dynamic and creative culture. For this group of authors, cities provide the greatest opportunities for economic and cultural development and give

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the necessary tools to have a comfortable and satisfying life. Some see cities as a burning fire full of smoke which is from an agitated crowd who are distrustful of each other and all are steeped in crime, violence and corruption [2].

Urbanization in Iran was accompanied by significant growth in the last decade, but it has not been away from the problems and negative consequences. Part of these problems is due to the lack of attention to the cultural dimension of urban life. Accompanying culture, city and citizen is one if the complex issues which need to be attended by authorities. One of the centers that can promote culture of citizenship is providing cultural sites whose optimal locating can be accountable to many challenges of citizens' culture of Shiraz.

This study, considering the opinion of cultural experts and demographics of the nine city districts, seeks to answer these questions: where is the optimal location for constructing cultural centers in Shiraz? And whether locating cultural centers have been done based on the social needs of citizens?

II. STATEMENT OF THE PROBLEM

In large cities that infrastructures have been developed in different periods, the development of urban structures creates new problems for the city. These issues are not a problem in cities that are not quite large, but as the rate and extent of urban population and their facilities expand, there is a need for more planning for the development of urban facilities. Attending such issues not only reduces urban problems, but also reduces costs and ultimately reduces the pressure on citizens and lowers financial burden on municipalities and government agencies [3].

Cultural center is the place where there is one or more cultural institutions. Usually, in cultural centers, there is an opportunity for training various cultural and social affairs and training various arts and crafts such as painting, pottery, needlework and etc. Some cultural centers also have their own publications and libraries. Many cultural centers are for work (specialist) that is they center their activities on a group or a performed action. These centers are required for the promotion of culture and passing of time for cultural affairs.

Cultural locating in Shiraz has not followed a specific pattern and is performed based on the features and capabilities of the municipality and according to the case. One of the most important external aspects affecting the increased use of cultural centers is the geographic distribution of these sites in the context of cities, especially in big cities and if the principles, rules and standards are not followed, people will use the cultural centers unwillingly and without motivation. Among problems of incorrect positioning of cultural sites, one can point to transfer, traffic, imbalance in regional distribution

and etc. The issue in this study is: What is the distribution of cultural sites in Shiraz? How these centers perform their activities? And since these centers are not located based on social needs of citizens, considering the population parameters and radii access, and using GIS and AHP model for locating cultural centers can satisfy social needs of citizens.

III. LITERATURE REVIEW

Cultural studies and emphasis on social sciences were in vogue in the 1940s and 1950s. Then, this enthusiasm declined sharply. But over the past 50 years due to moving to a new cultural pattern of development, i.e. human development, a renaissance occurred in cultural studies. A number of applied and scientific studies have been carried out on locating different applications using GIS in the world and Iran; however, in urban areas, due to the complexity of the influential processes and the impact of various factors in location finding, the use of GIS alone is not sufficient and various studies conducted in the recent decade show it clearly in academic and administrative terms.

De la Peña [4] in a study investigates the cultural and social policies for indigenous people in Latin America. He argues that during "the twentieth century, social and cultural policies toward indigenous peoples in Latin America have been closely related to *indigenismo*, an ideological movement that denounced the exploitation of aboriginal groups and strove for the cultural unity and the extension of citizenship through social integration and "acculturation." (2005, p.717)

Tall et al [5] in another study used integrating GIS and multi-criteria evaluation method for evaluating suitable land for four ecological zones, natural protection, forests, residential and industrial areas. The method proposed in their paper will provide one layer for each of these four uses, and a final layer which can propose the best application for every piece of land.

Faraji Sabokbar [6] in an article entitled "Positioning units for commercial services using the Analytic Hierarchy Process" investigated the spatial modeling of Torghabeh and the results of his study revealed the priority areas of different sections of Torghabeh with regard to the positioning of commercial services.

Shokoouhi [7] in another article entitled "The role of fuzzy-GIS in optimal positioning of urban applications" investigated modeling and application of fuzzy-GIS in urban location finding and it was practiced and implemented in the parks of Zanjan.

IV. METHODOLOGY AND INSTRUMENTS

The general approach is deliberative. This approach is proportional to the areas and interests of applied research that requires decision making. In this study, three methods are used: 1 – the documentary method, 2- the survey method and 3 - descriptive and analytical method. In this study, the Analytic Hierarchy Process (AHP) is used for optimal positioning of cultural centers. In analytical hierarchy process, three principles of (Analysis), (comparative analysis), and (combining preferences) are used. Analysis principle needs to break down the decision problems into different elements in a hierarchy. The first step is to create a tree structure for criteria and sub-criteria. The comparative analysis refers to the binary comparison of the elements in a level of hierarchical structure by taking its origin in the higher level into consideration. Thus, elements of each level are compared with the elements of the same level in a binary format and their relative importance is calculated. These weights can be calculated on an individual basis or through applying expert judgments. GIS in the Arc Map environment is used to combine information of location finding and providing maps.

V. SHIRAZ POPULATION IN 2011 AND THE DISTRIBUTION OF CURRENT CULTURAL CENTERS

Statistical Center of Iran has reported the city's population in 2011 based on segregated districts. According to Table (1), Shiraz is a city with a population of 1,549,453 people, 441,245 families, family dimension of 3.92 and an area of 17889.1, with 9 districts. Among these districts, district 4 with a population of 196320, 50819 families and family dimension of 3.86, has the maximum number of population and district 8 has the minimum number of population.

TABLE I
 SHIRAZ POPULATION BASED ON DISTRICT IN 2011

District	Area (Acre)	Family dimension	Number of families	Total population	Population of men	Population of women	Gender ratio	Population density
1	3085	3.66	56515	207106	103221	103885	99.4	67.13
2	401639	3.99	54691	214371	109821	104550	105	89.126
3	1803	3.85	50848	196113	99375	96738	102.7	108.77
4	2318	3.86	56095	216701	108705	107996	100.7	93.491
5	1671	4.25	36430	154802	81367	73435	110.8	92.62
6	2923	91.3	42797	167463	86446	81017	106.7	57.29
7	901478	3.99	38765	154729	78743	75985	103.6	62.104
8	50377	3.79	16079	60924	31924	29000	110.1	161.49
9	2543	1.4	29083	119242	60682	58560	110.1	161.49
Shiraz	1017889	3.92	441245	1549453	778404	771049	104	84.37

Source: Statistical Yearbook of Shiraz (2011) [8]

Based on Table II, in the current distribution of cultural centers in Shiraz, the most number of centers are located in district 8 (with 5 cultural centers) and the least is in district 9 which has no cultural center. Young and Family cultural centers have the largest area (1500 m²). The activities carried

out by these centers are similar except those that have specialized courses like Family and Book cultural centers.

TABLE II
 ACTIVE EDUCATIONAL, CULTURAL, SCIENTIFIC AND SPORTS CENTERS IN
 SHIRAZ UNDER THE SUPERVISION OF MUNICIPALITY

Name	District	Area	Capacity	Name	District	Area	Capacity
Prospect	1	480	200	Stability	5	480	300
Rain	1	250	200	Health	6	700	200
Art	1	250	50	Alavi	6	300	150
Ghadeer	2	700	300	Golestan	6	279	100
Narges	3	250	150	Technology	7	300	200
Book	3	700	300	Quran	8	1500	300
Shaghayegh	4	480	200	Family	8	300	150
Young	4	1500	400	Sibviah	8	100	200
Child	4	100	80	Mother	8	300	200
Astronomy	4	200	50	Effort	8	300	200
Motahari	5	700	300				

Source: Statistical Yearbook of Shiraz (2011)

Programs that are usually offered in these cultural centers include classes such as sewing, embroidery, carpet weaving, painting, computer, sports, counseling classes, exhibitions, etc. which are quite similar in all centers. The position of these centers is not defined by population and area of the district; for instance, comparing district 1 with district 8, district 1 has more population and area in comparison to district 8, but it is district 8 which has the most number of centers. A number of cultural centers have architectural and physical problems such as Golestan center which in terms of educational environment is faced with the problem of lack of space. About 70 percent of the clients of these cultural centers are women and they are mostly housewives. In some centers like astral cultural center, 50 percent of clients are women and 50% are men and they are from all age groups. Below, four maps of the current distribution of cultural centers as well as population distribution, density and family size are given.

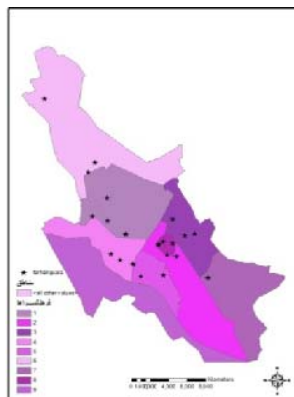


Fig. 1 The distribution of current cultural centers in Shiraz

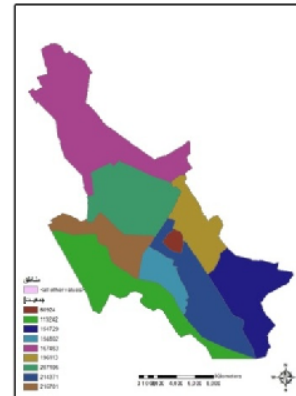


Fig. 2 Population distribution

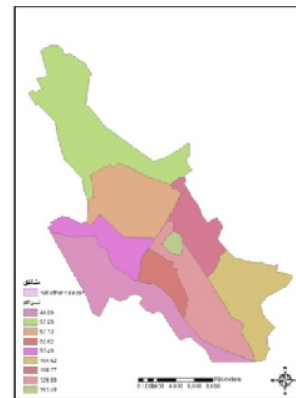


Fig. 3 Family density

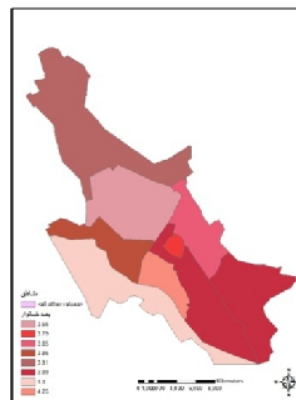


Fig. 4 Family dimension

(Source: Department of Planning and Information Technology of Shiraz Municipality in 2011)

VI. THE STAGES OF LOCATING CULTURAL CENTERS USING GIS AND AHP

- The AHP Model

In decision-making approach which deals with choosing a solution from among a number of existing solutions or ranking them, Multi-Attribute Decision Making (or MADM) has become more prevalent. Among these methods, the method of Analytic Hierarchy Process (AHP) has been more applied in management science. AHP model is one of the famous MADM techniques that reflects the natural behavior and human thinking. This technique examines complex issues based on their mutual effects and makes them simple to solve.

AHP can be used in the operations and decision making processes that involve multiple criteria and options for making decision. The proposed criteria can be qualitative or quantitative. The decision-making process is based on paired comparisons. The decision-maker begins by providing a hierarchical decision tree. Hierarchical decision tree shows the compared factors and evaluated competing alternatives in decision making. Then, a series of paired comparisons is carried out. These comparisons show the weight of each factor in order to evaluate competing alternatives in decision. Ultimately, the logic of AHP combines matrices of paired comparisons such that the optimized decision is achieved [9].

VII. MAKING A HIERARCHICAL GRAPH

The first step in AHP is making a graphic display of the problem in which the goal, criteria, sub-criteria and alternatives are shown [10]. Transforming issue or problem into a hierarchical structure is the most important part of AHP [11]. Since in this section by analyzing complex and difficult issues, AHP transforms them into simple forms which match the human mind and nature [12]. In the current study, this hierarchy is made in three levels of goal, criteria and alternatives. Fig. 1 shows the hierarchical structure.

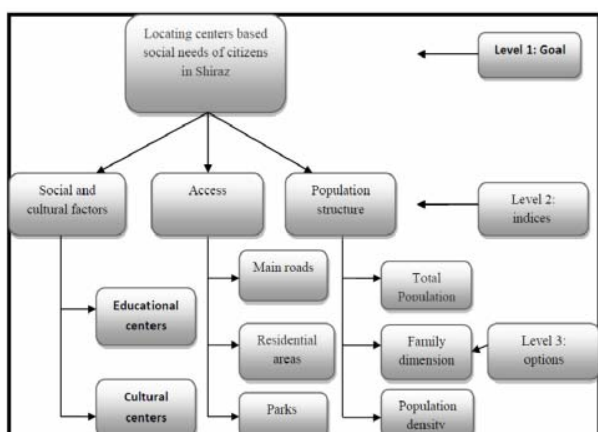


Fig. 5 The hierarchical structure of indices and locating cultural centers of Shiraz (Source: Authors)

The paired comparison method involve three stages which are making matrix of paired comparisons, calculating factors and estimating consistency index.

Making comparisons between different options based on each index and judging the importance of each decision index having paired comparisons: after designing the hierarchy of decision problem, the decision-maker should make the matrices that are numerically important or find the relative preference indices. This is done by the pairwise comparisons of the decision elements (paired comparison) and by assigning a numerical score that shows the importance or preference between the two decision elements.

TABLE III
 RELATIVE IMPORTANCE OF FACTORS

Verbal judgment	Numerical value
Quite more important	9
More important or strong preference	7
Important or preference	5
Slightly important or preference	3
Equal importance or preference	1
Intermediate preferences	2, 4, 6, 8

Source: Authors' Calculation

Making paired matrix: After analyzing the problem to a hierarchy, elements of different levels are compared in a binary fashion, and then based on the priority of two criteria, valuation is done. In AHP, elements of each row are compared together and are weighted. For valuation, usually a 1 to 9 scale based on preferences and importance is used. Paired comparison matrix is an inverse matrix, in that if the comparative value of the element in row A is equivalent to nine times of the element in column B, the comparative value of the element in row B will be equivalent to 1/9 times of the element in column A. This matrix involves the relative importance of elements from 9 to the inverse of the number 9, which is the least important among the elements in paired comparisons (Table III).

TABLE IV
 DETERMINING WEIGHT WITH PAIRED METHOD

Factors	Compatibility	Main roads	Residential	Cultural centers	Parks	Educational centers	Family dimension	Population density	Total population
Compatibility	1	7	5	3	7	5	6	9	9
Main roads	0.14	1	7	6	5	7	8	9	8
Residential	0.2	0.14	1	5	6	7	8	9	8
Cultural centers	0.33	0.5	0.5	1	3	3	5	8	9
Parks	0.14	0.2	0.33	0.33	1	2	2	9	7
Educational centers	0.14	0.2	0.14	0.33	0.5	1	5	3	5
Family dimension	0.16	0.12	0.12	0.2	0.5	0.2	1	5	7
Population density	0.11	0.11	0.11	0.12	0.11	0.33	0.11	1	3
Total population	0.11	0.12	0.12	0.11	0.14	0.2	0.2	0.33	1

Source: Authors' Calculation

Measuring the weight of factors: This method follows a three-stage process. The first stage involves adding the numbers of each column of paired comparison matrix. The second stage deals with dividing each element of the weight matrix into the

sum of each column that yields normalized values. And the third stage involves the average of each row. The value obtained in the third stage is the weight of each factor. Table IV shows determining each weight through paired method.

TABLE V
 DETERMINING WEIGHT THROUGH PAIRED METHOD

	Compatibility	Parks	Cultural centers	Residential	Main roads	Population density	Family dimension	Total population	Educational centers	Determining weight
Compatibility	0.15	0.16	0.16	0.16	0.34	0.33	0.27	0.53	0.35	0.27
Parks	0.14	0.16	0.22	0.27	0.24	0.22	0.40	0.17	0.111	0.21
Cultural centers	0.14	0.16	0.22	0.27	0.14	0.22	0.13	0.05	0.17	0.17
Residential	0.15	0.15	0.14	0.11	0.14	0.11	0.06	0.08	0.11	0.11
Main roads	0.14	0.16	0.22	0.27	0.14	0.22	0.1	0.05	0.17	0.16
Population density	0.08	0.05	0.14	0.03	0.02	0.03	0.01	0.03	0.04	0.04
Family dimension	0.1	0.06	0.02	0.007	0.02	0.02	0.01	0.02	0.02	0.03
Total population	0.05	0.01	0.003	0.01	0.005	0.01	0.01	0.01	0.03	0.01
Educational centers	0.01	0.006	0.05	0.007	0.006	0.01	0.01	0.02	0.03	0.01

Source: Authors' Calculation

Determining compatibility proportion: This value indicates the probability of random correspondence degrees. Values less than 0.1 show a good compatibility. When this value is greater than 0.1, the matrix's weight should be revised.

Estimation of the compatibility proportion is done in three steps:

First step: Measuring the value of compatibility vector

The initial weight of each factor is multiplied by its corresponding paired score, this operation is done from the first row, and then the total results of multiplication will be added together and will divide by the weight assigned to each factor. This is done for all factors and their average is calculated. Table VI shows the calculation of the value of compatibility vector.

TABLE VI
 MEASURING THE VALUE OF COMPATIBILITY VECTOR

Factors	First stage									Second stage
Compatibility	0.15	0.17	0.14	0.12	0.32	0.28	0.26	0.44	0.33	7.44
Parks	0.14	0.17	0.19	0.29	0.32	0.18	0.38	0.21	0.10	14.71
Cultural centers	0.14	0.17	0.19	0.21	0.13	0.18	0.21	0.06	0.16	10.25
Residential	0.15	0.16	0.12	0.08	0.13	0.13	0.09	0.10	0.10	9.44
Main roads	0.14	0.17	0.19	0.21	0.14	0.18	0.16	0.06	0.16	9.38
Population density	0.08	0.05	0.14	0.01	0.02	0.01	0.009	0.03	0.03	12.51
Family dimension	0.12	0.6	0.01	0.05	0.01	0.01	0.009	0.01	0.02	8.52
Total population	0.12	0.10	0.002	0.008	0.004	0.008	0.009	0.01	0.02	12.65
Educational centers	0.10	0.06	0.004	0.005	0.005	0.008	0.009	0.02	0.02	7.23

Source: Authors' Calculation

Then, the mean vector of compatibility (y) is calculated.

$$y = \frac{7.44 + 11.71 + 12.25 + 9.44 + 9.38 + 12.51 + 8.52 + 12.65 + 7.23}{9} = 9.87$$

Second stage: calculating the compatibility index

The compatibility index is obtained from the following formula:

$$CI = \frac{y - n}{n - 1} = \frac{0.87}{8} = 0.10$$

compatibility index = **CI**

Number of assessment factors = **n**

Third stage: the compatibility ratio is obtained from the following formula

$$CR = \frac{CI}{RI} = \frac{0.10}{1.45} = 0.07$$

compatibility proportion = **CP**

compatibility index = **CI**

Random incompatibility index = RI

The proportion of 0.1 or lower than 0.1 shows compatibility in calculations [13]. Based on the compatibility calculations and the obtained number which is 0.07 (lower than 0.1), there is a compatibility in calculations.

VIII. PREPARING THE CRITERIA AND SUB-CRITERIA DATA LAYERS

When effective parameters in locating cultural centers were identified and the hierarchy graph was formed, the required data layers should be extracted and prepared from the basic urban maps. In this relation, maps were prepared in the form of slope file. With regard to the sub-criteria data layers of demographic factor, the layer of population of nine districts, population density layer, family dimension layer as well as area of the districts were collected. With regard to the access layer to residential areas, main roads, access to parks and access to educational centers were prepared in a general layer. Social and cultural layers such as existing cultural centers were prepared based on hierarchy graph. Then, the above data were entered into Arc Map software to be analyzed. Preparing such layers is one of the most important parts of this study. Then, using the AHP model, data were valued and prioritized.

IX. PERFORMING SPATIAL ANALYSES AND EXTRACTION OF DATA LAYERS

In order to obtain optimal areas for prioritizing with AHP method, GIS was used. It is normal that AHP cannot find the optimal areas alone and prioritize them. Thus, GIS was used as its applicability was previously proved. After finding a number of areas and prioritizing them, a number of these areas should be prioritized using AHP based on quite quantitative criteria.

In this stage, using the AHP model in the ArcMap software through *Distance* software, access distance are extracted and using *Reclassify* function, they are classified based on the number of categories mentioned in the hierarchy graph of locating cultural centers. In classifying layers, every different pixel in a layer that were more important with regard to their optimal location, should be valued more and the group with lower pixels were valued less. Ultimately, using the AHP model in ArcMap software, the optimal layers for locating were identified.

X. LOCATING CULTURAL CENTERS IN SHIRAZ

In this section using data layers such as educational centers layer, parks, residential areas and main roads as well as the current demographics such as family size, population density and population distribution, cultural centers positioning is done in Shiraz. 13 maps are prepared for Shiraz. Figs. 6, 7 and 8 is for the distance from educational centers, in which the distance of 100 meters is appropriate and distances of higher than 250 is quite inappropriate. And Figs. 9, 10 and 11 shows the distance from parks, in which the distance of 50 meters is appropriate and distances of higher than 200 is quite inappropriate for locating cultural centers. Fig. 12 shows the distance from residential areas, in which the distance of 1000

meters is appropriate and distances of higher than 2500 is quite inappropriate for making cultural centers. The distance from current cultural centers is shown in Fig. 13, in which the distance of 1000 meters is appropriate and distances of higher than 3000 is quite inappropriate. Fig. 14 shows the optimal place for making cultural centers and Fig. 15 shows the suggested areas.

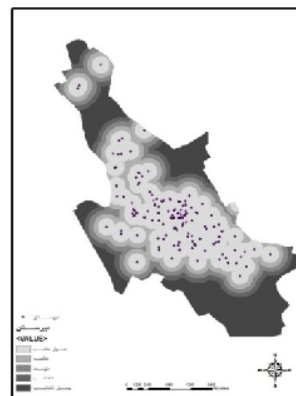


Fig. 6 The distance from primary school

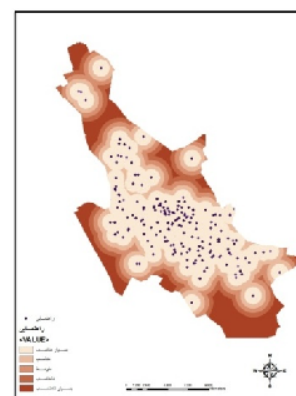


Fig. 7 The distance from secondary school

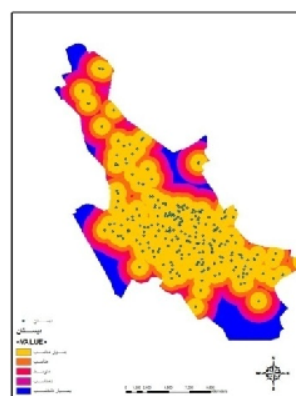


Fig. 8 The distance from high school

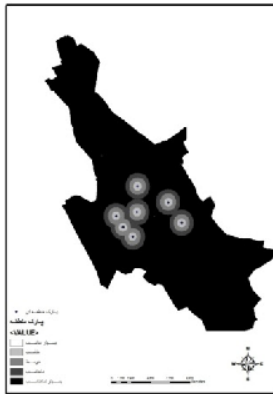


Fig. 9 The distance from Regional Park

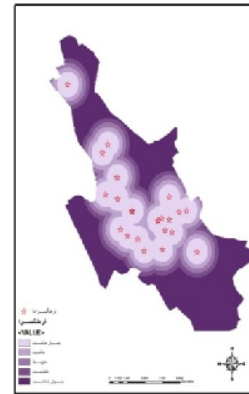


Fig. 13 The distance from existing cultural centers

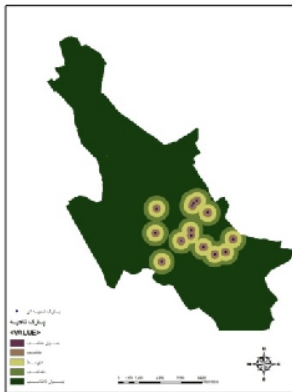


Fig. 10 The distance from zonal park

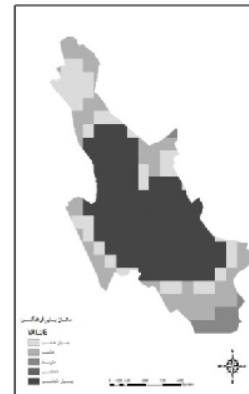


Fig. 14 The optimal place for locating cultural center

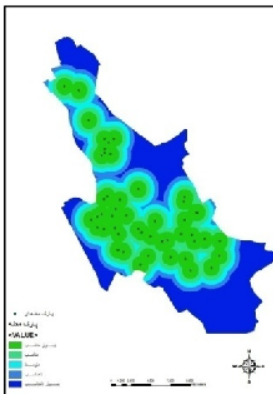


Fig. 11 The distance from Local Park



Fig. 15 The suggested areas for locating cultural center

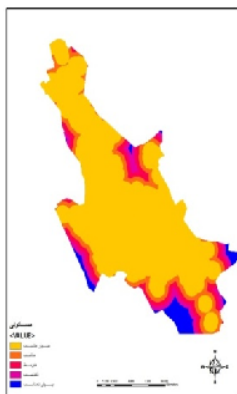


Fig. 12 The distance from residential areas

XI. CONCLUSION

In the current attempt, the current distribution of cultural centers and the population of Shiraz were investigated. With the largest number of centers in district 8 and the least is in district 9 which has no cultural center. Young and Family cultural centers have the largest area (1500 m²) and Child and Sibviah cultural centers have the smallest area (100 m²). The activities carried out by these centers are similar except those that have specialized courses like Family and Book cultural centers. In addition, the table of current distribution of cultural centers was provided with their maps.

- The problems of cultural centers and solutions to solve these problems are provided. Among them, problems such as lack of classroom space, architecture and building physical problems, lack of energy and lack of resources to address these problems as well as recruiting employers, enhancing the quality of cultural center environment, increasing advertisement and educating citizens can be mentioned.
- The current positioning of cultural centers in Shiraz is not appropriate since they have some problems such as staying away from residential places, distance from having access and as they are not responsive to some needs of population. Thus, based on the current studies, optimal and suggested areas for cultural centers should be within the parks and places that have access to educational centers and main roads and residential areas. Using the AHP model in the ArcMap software through Distance software, access distance were extracted and using Reclassify function, they were classified based on the number of categories mentioned in the hierarchy graph of locating cultural centers.

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