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Distributing Green Spaces Based on Qualitative Criteria in Tehran

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Abstract: The aim of this study is to distribute green spaces based on qualitative factors in Tehran. Base on the 7 qualitative criteria and Fuzzy AHP, the distribution of green spaces has been performed. These criteria were introduced: sustainability, aesthetic, safety, connectivity and accessibility, legibility, desirability, dependency, adaptability and biodiversity. In the research process, firstly the criteria are compared together and given suitable weight to them based on experts' opinions. The fuzzy evaluation results of the factors in each site showed that out of the 9 factors evaluated, site2 was superior to site 3 on 5 factors. The biggest difference among these was "Biodiversity" with a difference of approximately 0.20. Site 2 was superior to site1 on 6 factors as well with the biggest difference being "Biodiversity" with a difference of 0.123. Site 3 was superior to site 1 in 5 factors with the biggest difference being "Safety" where the difference was 0.112.

Key words: Green spaces, qualitative factors, Fuzzy AHP, Tehran

INTRODUCTION

There is no doubt that green spaces have significant environmental values in our cities. Places with less dense settlements and more open space and abundant vegetation are usually more comfortable environments especially in the summertime. One of the current problems in cities such as Tehran is heat islands which are created when natural ventilation system are replaced by heat absorbing surfaces such as building's roofs and walls, parking lots and streets. Creating green areas and effectively micro climates can be an important determinant in coping out of these heat islands of Tehran. They can increase wind and ventilation and also shade urban surfaces.

This becomes more tangible in the urban context where dominating the wind direction is not so reliable, as inner city areas have their own micro climates. Urban vegetation such as street trees, lawns, parks, urban forests, cultivated land and wetlands can have considerable role in making an urban micro climate. Developing green spaces has both short and long-term economic values. A well designed public space can raise property values, enhance economic vitality and increase the tax base. It also can have long-term values through health benefits as well as attracting commercial land-use. A study in Scotland shows reducing the level of inactive people by %1 in the next 5 year benefits £85.2 million. By dealing with the issues that prevent people from becoming ill, £30 billion a year could be shaved off the NHS budget by 2030. The aesthetics of green spaces is another effect of them on quality of urban life. The urban landscape designers are now provided that greater opportunities than ever to get better the spaces we already have.

Creating sustainable communities rely on taking equivalent account of the design of buildings, their location and the quality of the outside space at strategic, local and site scales. Today, landscape designers can do this duty. Landscape design is an independent profession and a design and art tradition, practiced by Landscape designers, combining nature and culture. In contemporary practice, Landscape design bridges between landscape architecture and garden design. Having daily contact with green spaces creates different social effects and reducing the crime and vandalism. In a study conducted in Chicago, researchers found that the residents of the buildings with surrounding green spaces had a stronger sense of community, better relationships with their neighbors and reported using less violent ways of dealing with domestic conflicts. On the other hand, the importance of green space to our quality of life is enormous and there is much evidence to back this up.

Green spaces break down social barriers and help pull communities and people together. They are free of charge and reasonably accessible-neighborhoods are better places because of this Green spaces are probably the best form of community facility any city has. Main goal is to identify and analyze urban green spaces of Tehran in order to promote urban environmental quality. In this paper a new methodological approach to the distribution of green spaces in Tehran has been prepared and the

combination of qualitative factors with quantitative factors to determination of model has been done. Moreover a model offered by using of the AHP Fuzzy method to choose between options helped to increase the confidence of design decisions develops and implements.

Theatrical background

Urban green space: According to The evaluation definitions, two parts for green space can be considered. First, the complex of green coverage including trees, shrubs, flowers, herbs and grass induce meaning of green space. Second, the expectations and duties including to improve the environmental quality of human, esthetic and ecological needs as a target is hidden in the construction of green space. The most comprehensive definition for urban green space can be defined (Heckler , 2009).

Urban green space is part of urban open spaces that in the natural or synthetic fields under the trees, shrubs, flowers, grass and other plants which preserve ore are built under the supervision and management of people with regard to rules, regulations and related specialties To improve the living conditions, habitat and welfare of citizens and non-rural population centers.

Patterns of urban green space: Generally, Green spaces can be divided into two groups based on the ecological view: Suburban green spaces and urban green spaces. Green spaces of city around as suburban green spaces have uncontrolled growth inhibitors in the city and the other hand, their ecological-environmental efficiency includes the entire urban environment. Public green spaces constitute only a small part of all urban vegetation. The more green spaces within urban are built as a park and add to the beauty of the urban environment. Moreover urban parks, squares, sports complexes, children amusement parks and vegetable gardens should be considered among this group. Suburban green space is divided into several categories; surrounding green belts Green arcs, green axes, national parks, forest parks and botanical parks.

Surrounding green belts are used for renewal of the city, the control of city spread, prevention of uncontrolled growth and city morphology structure coordination. These belts may lose their primary role in the dynamic process of city but their potential role as urban green space of the balance of urban resort and their secondary role as living landmark for the diagnosis of the city remain. Green arcs are wide green belt which used for the uncontrolled growth of cities and guided them in the desired direction, linking the city core to satellite towns on one hand and separating the main urban space of the suburban space.

Green axes include urban green axes-green space along the urban streets and suburban green axes -roads green space accedes urban directly or through the belt. reen Belt is the belt of trees and shrubs that can be created around the city and has multiple functions. Green Belt is used for filtering dust, protection of city against pollution, determination of the city limited, the outer expansion of the city and separating the inner parts of the city from the lands around.

Urban green space typology: The placement of a recreational area is done in an area suitable for the neighborhood or residents of a given environment in terms of accessibility and location. The appropriate site placements can attract users to use the facilities constantly. Among the importance of site planning guidelines are maximizing the advantages such as natural water bodies, hills, greenery and natural environment. Space is also used in accordance with the function of an adequate site and can accommodate the needs of the site in the future. The functions of the park's types are as follows:

Neighborhood golf: Neighborhood Golf features are sports activities and passive recreation as well as sport fields and courts for badminton and other related games with also a picnic and aesthetic surroundings. The location should be within the pedestrian distance of approximately 1.5 km (0.9 miles); the facilities should accommodate 3,000-12,000 inhabitants. It should be in the neighborhood service center or outskirts with natural and man-made sites. Area of 2.0 ha to 8 ha (5.0-20 acres) of land is required.

Local parks: Local Parks must include physical activities, social and cultural interests of local residents, multi-purpose sports activities and open space viewer (open air theater). Here, passive recreation and sport activities are arranged for the entire local community. There are events for sports and other physical activities as centers that can create social and cultural interaction each time. Its location should be near the service center or neighborhood center that is easily accessible either by walking, cycling, public transport and private vehicles. It is designed to accommodate between 12.000-50.000 populations and within a distance of 3.0 km (1.8 miles) from residential users. Land area is 8.0 hectares to 40 ha (20 and 100 acres). Recreational facilities are football field, tennis courts, rugby, badminton, hockey, volleyball, netball and others. Swimming pool, gardens and children's playground, picnic area, adventure ground, indoor hall and parking.

Town park: City park serves as a sporting and active structure. It is the focus of recreational activities for city residents and seasonal sports center which provide facilities and opportunities to enjoy natural beauty and high value. Location should be within an area which is easily accessible within a half an hour. It should also be within the range of 5-10 km (3-6 miles) and required a population of over 50,000 people and 40.0 hectares of land to 100 ha (100-250 acres). Facilities should include fields for organized sport activities, game courts, sport halls or buildings, complex, tennis, badminton and others, swimming pool, golf practice range, children's playground, picnic area and camping, facilities for water sports such as boating and others. Forest soap opera, flower garden and other facilities such as parking lots and bus must be held.

Regional park: Regional park is a center for urban residents, rural, regional and other competition for sporting events, seasonal sports or enjoyment of the natural environment. Position is usually on the edge or outside urban density; the site features are mainly natural and have a visitor's attraction. It is not within an hour distance and vehicle facilities are other requirements for the entire population of the city to visit there. Area of 100 ha (250 acres and above) of land is required for this type of park. Recreational facilities such as a picnic place, camping, fishing, boating, hiking, jogging, jungle tracking, drive scene and others are required. Sports complex or stadium open or closed should also be present. For the limited facilities and seasonal sports such as golf course tracing circuit and other natural areas such as waterfalls, beaches, lakes, hills and others with natural material for passive recreation such as forest soap opera, jungle tracking, camping, picnics and scientific research purposes to maintain the wild life, ecology and others (Larson and Forman, 2007).

National park: Location of a National park must be in a unique area in terms of landscape beauty, the existence of wild life and materials for research in science and geology. There is no limited distance from residents. The area has no facilities and there is a need to have every material or equipment necessary to maintain appropriate nature. Accommodation, transport does not affect the ecological environment or wild life existence (Koksalan *et al*., 2011).

Gardens and forest parks: One of the common and favorite pastimes for citizens of Tehran is spending time in open spaces, green spaces, gardens and forest parks. Located on the southern face of the Albourz mountain and enjoying suitable weather, Tehran offers excellent opportunities for such recreational activities. In spite of rapid expansion of the city in every direction, Tehran has kept its green spaces during the last few decades. The total green spaces, including public places, city parks, forest parks, gardens and farming lands, measure about 11 ha. The forest parks are approximately 2700 ha and include Chitgar, Pardisan and Lavizan. Public green spaces include orchards and farmlands scattered throughout the city. This is a valuable heritage, covering an area of over 536 ha. The greatest number of orchards and farm lands are situated in districts 18 and 20. The main orchards of Tehran include Bagh Ferdows in district 1; Bagh Negarestan, North of Baharestan Sq. and Bagh Kamraneyeh. Green and open spaces include river-valleys (1005 ha, 2% of the total area of Tehran) and special open and green spaces (3790 ha, 6% of the total area of Tehran). Green rivervalleys, cool mountain weather and beautiful scenery on the southern slopes of the Alborz Mountains make districts 1, 2, 5 and 22 particularly attractive. There are 13 river-valleys with an approximate length of 10 km. They include Garmdareh, Vardavard, Solaghan (Kan), Farahzad, Evin (Darakeh), Darband, Golabdareh, Hesarak (Jamshideieh), Darabad, Lavizan (Sohanak) and Sorkheh Hessar. The most important green urban parks in Tehran are the following: Mellat Park, Laleh Park, Neyavaran Park, Shahr Park, Pardisan Park and Bes'at Park.

Standards of green spaces: Based on studies of ministry of Housing and Urban urbanism, normal and acceptable green spaces per capita in the Iran cities is between 7-12 m^2 per person compared with the determinate criteria of the United Nations environmental (20-25 m^2 for each person) is less. However, the number of this per capita in various cities of country, according to distinct geographical and climatic features has differences associated with the approved plans of cities.

Totally, urban green space per capita is important In view of the social environment associated with urban green space as it doesn't blocked for public transport or in other words, social green space (Vigo, 1990). Thus, the per capita of green space can be used for that type of green space is provided for leisure, gaming and entertainment. The important point about the green space is location.

Distribution of urban green space and its per capita: Green space coverage differs enormously among cities, yet little is known about the correlates or geography of this variation. This is important because urbanization is accelerating and the consequences for green space are

unclear. Here, we use standardized major axis regression to explore the relationships between urban green space coverage, city area and population size across 386 European cities. We show that green space coverage increases more rapidly than city area, yet declines only weakly as human population density increases.

Thus, green space provision within a city is primarily related to city area rather than the number of inhabitants that it serves or a simple space-filling effect. Thus, compact cities (small size and high density) show very low per capita green space allocation. However, at high levels of urban city, the green space network is robust to further city compaction. As cities grow, interactions between people and nature depend increasingly on landscape quality outside formal green space networks such as street plantings or the size, composition and management of backyards and gardens.

Research background: The recent years, some researchers have done in subjects related with this research-Location of land use by GIS-case study: Golestan City green space.

- Multipurpose Evaluation of parks vegetation
- GIS in location of green spaces-case study: Ghods town
- Location of public parking by OWA method method-case study: Tehran, district 1
- Geographic Information Systems in location of urban green spaces in Tabriz region
- Implementation of hierarchical analysis to location of optimum urban public space

It is due to emphasize that in the mentioned researches aren't any models to locate green spaces with approach to quality and quantity factors and only referred to quantity factors emphasis on GIS. Therefore, we intend to show that some Policies should return an understanding of how green spaces are integrated with the built environment; of the wide range of types of green space and the suitability model for various uses. Local policy should take account of the quality of green space as same as the quantity. So, the qualitative factors are combined with the quantitative factors, the result for location of urban green spaces is more effective and suitable. In the paper are used references derived from Iranian reality and international parallel studies, specially the research based on site selection and analysis with AHP fuzzy. For historical geographic studies, the paper bases on "Tehran: Geography, History and Culture", "Glance to Tehran", "Tehran's cultural-social History: from beginning to Naseri's caliphate home". For periodization well enough used the references from Iranian historic such as "The Arts of Persia" (Ferrier, 1989), "The Persian Garden" (Khansari *et al*., 2004). For landscape architect, studies bases on "The Essex Landscape: A Study of its Form and History" (Hunter, 1999), "Ideas of landscape: An Introduction" (Johnson, 2007), "Landscape, Process and Power: Re-evaluating Traditional Environmental Knowledge" (Heckler, 2009).

MATERIALS AND METHODS

Survey of texts: One of the data collection methods is to refer to the research and scientific Resources. Such documents include reading books, articles and texts of computer networks.

Survey of field: In order to achieve the required information and reference to the city maps and making it consistent with the current status we need to survey field. At this stage, in according to the current urban plans and survey field, some quantitative factors and qualitative factors is examined. Dates analysis method: we want to use AHP method to obtain suite analysis for esoteric and inconsistent in related to research object and if it's necessary, we use some optimize methods like neurotic algorithm for more literal affects which can obtain a suitability method for analysis.

Constructing a hierarchy typically involves significant discussion, research and discovery by those involved. Even after its initial construction, it can be changed to accommodate newly-thought-of criteria or criteria not originally considered to be important; alternatives can also be added, deleted or changed (Saaty, 1988). To better understand AHP hierarchies, consider a decision problem with a goal to be reached, three alternative ways of reaching the goal and four criteria against which the alternatives need to be measured. A simple AHP hierarchy: There are three Alternatives for reaching the goal and four criteria to be used in deciding among them (Fig. 1).

Priorities defined and explained are numbers associated with the nodes of an AHP hierarchy. They represent the relative weights of the nodes in any group. Like probabilities, priorities are absolute numbers between zero and one without units or dimensions. A node with priority 0.200 has twice the weight in reaching the goal as one with priority 0.100, 10 times the weight of one with priority 0.020 and so forth. Depending on the problem at hand, "weight" can refer to importance, or preference, or likelihood, or whatever factor is being considered by the decision makers (Jayaswal *et al*., 2007). Priorities are

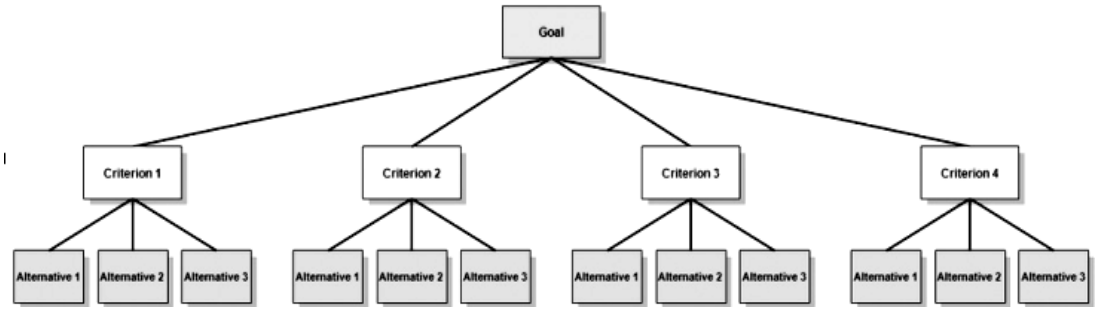

Fig. 1: The simple AHP hierarchy (Jayaswal *et al*., 2007)

distributed over a hierarchy according to its architecture and their values depend on the information entered by users of the process.

According to literature relating to urban landscape evaluation and visual simulation factors (Farenc, 2001; Bishop and Rohrmann, 2003; Fukahori and Kubota, 2000), affecting qualitative factors in locating of appropriate urban green space are drawn up. Layer 1 contained 9 items: Sustainability, aesthetic, safety, connectivity and accessibility, legibility, desirability, dependency, adaptability, Biodiversity. In the next step, 30 questionnaires are distributed among experts to collect their ideas. In the questionnaire, the comparisons between the sites as for the considered factors have been proposed

Then, according to MCDM theory, the pair comparison between sites is done and optimum site is suggested. In complex systems, the experiences and judgments of humans are represented by linguistic and vague patterns. Therefore, a much better representation of this linguistics can be developed as quantitative data; this type of data set is then refined by the evaluation methods of fuzzy set theory. On the other hand, the AHP method is mainly used in nearly crisp (non-fuzzy) decision applications and creates and deals with a very unbalanced scale of judgment. Therefore, the AHP method does not take into account the uncertainty associated with the mapping. The AHP's subjective judgment, selection and preference of decision-makers have great influence on the success of the method. The conventional AHP still cannot reflect the human thinking style. Avoiding these risks on performance, the fuzzy AHP, a fuzzy extension of AHP was developed to solve the hierarchical fuzzy problems.

District of study: Growing of population and the wide range of developments in the economy has created an extensive reflection on Tehran physical transformation that the formation of district 22 of Tehran Municipality is one of the consequences. Undoubtedly, this district is the largest and broadest development of the city connected to Tehran. This district was established in Tehran with the aim of eliminating of the deficiencies in services of the West of Tehran and movement of the population living in timeworn context of central Tehran and the settlement of the part of Tehran population. District 22 of Tehran Municipality is located between the East longitude 51 5' 10-51 20' 40" and the north latitude 35 32' 16-35 57' 19" in the North West of Tehran and in the downstream river basin and Vardij. The degree angle of sunshine in highest annual status according to location of district 22 is 78 and in lowest annual status is 32°. This area is surrounded with central Alborz Mountains in North, Kan River in East, Tehran Freeway in South and the range of planted forests-Vardavard in West.

This area is contiguous with district 5 and 21 of Tehran Municipality. The extent of this district is 54,000 ha approximately and its length and width are 26 and 17 km. District 22 has 4.8% of a total area of Tehran compared to other regions. This shows that district 22 has important position in the future of Tehran physical structure especially in the West. Distance of the west of this area to Karaj is about 11 km. The Ken River which flows from North to South stretches across the East of the area. Also Vardavard River flows along the North-South and parallel with the Kan River and extends down the middle in the North West region. The average distance between the two rivers is about 10 km (Caves, 2005). District 22 of Tehran Municipality has 4 regions. Generally, dominant wind during the day or night blows from the west. The total amount of annual rainfall in this region is 281 mm .its maximum is 43% in winter and 36% in spring. Approximate amount of district population, according to 1385 census report is 138,970 people.

Introduction of alternatives layout: After the introduction of District 22 as a case study to locate urban green space, six sites (alternative) are specified. According to the

views of experts in the municipality and university randomly 6 vacant spaces for implementation of the optimal model was selected. These sites, regardless of location, proximity and access have been allocated in the comprehensive plan of Tehran as a green space to them. In fact, vacant space as first option to start the process of choice of superior alternative is considered. Then six sites and their proximity are determined:

- Address of site 1: Olympic Dene, the end of Varzesh St (5800 m^2) (Pl 24. Fig. 1)
- Address of site 2: Kaj Blvd, Sixth sarvestan St (6300 m^2) (Pl 25. Fig. 1)
- Address of Site 3: Hashem Zadeh Blvd, Sharestan St (7400 m^2) (Pl 26. Fig. 1)
- Address of Site 4: Golha Blvd, Amir Kabir Blvd (6100 m^2) (Pl 27. Fig. 1)
- Address of Site 5: Golfam Blvd, Eighth Banafshe (5200 m^2) (Pl 28. Fig. 1)
- Address of Site 6: Havanirooz Blvd, East Shayan St (6700 m^2) (Pl 29. Fig. 1)

After identify of alternatives for the location, the qualitative factors affecting the location will be introduced. The number of qualitative factors according to the frequency of their usage in researches and books of researchers in recent years has been extracted and their details will be introduced.

Determination of quality and quantity effective criteria in locating of urban green space: Sustainable communities are areas that people like to live in the neighborhood with a sense of place. In these successful spaces, green spaces must be designed like that people want. Today, importance of experiences both inside and outside the country-according to economic-social developments is evident to improve people's lives spaces (Swanwick *et al*., 2003).

Consideration of green space and a balance between outside space and the building blocks of space density has not been considered in many high-rise buildings in the past. Many performance spaces have been proposed for sale to non locals. Good design and the product design is the process of formation of green space on a path that many opportunities in the region consider the discussion. A good design, green space converts into a negative space for public use - according to their needs. This cause that the space is formed with varied and diversified activities. Because, the character to an unused space and make it a useful and efficient space, provides tranquility, vitality for the people of the area. Also a good design for green space, create space for growing plants to change and optimize the regional ecosystem. The best locating is possible with the appropriate urban management and effective intervention and a high level of professional skills. Management is required to solve the conflict between the issues and draws achievable vision of the area in the future. Effective public involvement in the design process is essential in order to achieve the appropriate response. This involved not only to ensure that the spaces created to reflect the values and behavior patterns may be accompanied gainer but with a sense of ownership, success will result in designing the green space.

Location of a park or green space for its desirability and efficiency is important. Different types of green space for different situations - from the rural fringe to urban core are appropriate. The hierarchy of spaces causes some green spaces Provide services to a neighborhood and others to a district. Large green spaces are responsible to provide services in the central city in a region. Green space strategy in a determined framework, defines that each model of green space for what a place is an appropriate (Catanese, 2005). A successful design is rarely influenced standard rigid quantity (per capita) and the space required will result with emphasis placed on qualitative factors. This issue depends on the extent to which a range of considerations have understood and creative solutions to problems and issues facing potential have been discovered. A good design requires inspiration, innovation and experience.

The qualities factors of suitable green space, the main reason for creating these spaces is leisure time and creating a fun and exciting spaces. Although the educational aspects of these spaces should be essential in order to balance between demands (considering the definition of green space (Hargrove, 2003). Also, a successful design space is affected to understand the specific demands of the space. Finding answers to the following questions can be instrumental in this issue. In many urban areas, unused spaces or remaining parts of the spaces surrounding the buildings dedicated to green space that is used without a just society bear the maintenance cost has been imposed. Because there doesn't exist enough knowledge of the local people needs and effective quality factors for considering to the appropriate spaces.

According to literature relating to urban landscape evaluation and visual simulation factors, affecting qualitative factors in locating of appropriate urban green space are drawn up. Layer 1 contained 9 items: Sustainability, Aestatic, Safety, Connectivity and Accessibility, Legibility, Desirability, Dependency, Adaptability, Biodiversity

RESULTS AND DISCUSSION

AHP fuzzy analysis: AHP is a method for ranking decision alternatives and selecting the best one when the decision maker has multiple criteria. It answers the

question, "Which one?". With AHP, the decision maker selects the alternative that best meets his or her decision criteria developing a numerical score to rank each decision alternative based on how well each alternative meets them. These applications are performed with many different perspectives and proposed methods for AHP Fuzzy. In this study, Chang (1996)'s extent analysis (EA method) on AHP Fuzzy is formulated for a selection problem. In fuzzy logic approach, for each comparison the intersection point is found and then the membership values of the point correspond to the weight of that point. This membership value can also be defined as the degree of possibility of the value. For a particular criterion, the minimum degree of possibility of the situations where the value is greater than the others, is also the weight of this criterion before normalization. After obtaining the weights for each criterion, they are normalized and called the final importance degrees or weights for the hierarchy level.

To apply the process depending on this hierarchy, according to the method of Chang (1996)'s extent analysis (EA method), each criterion is taken and extent analysis for each criterion, gi is performed on, respectively. Therefore, m extent analysis values for each criterion can be obtained by using following notation:

$$M_{gi}^{1}; M_{gi}^{2}; M_{gi}^{3}; M_{gi}^{4}; M_{gi}^{5}.....M_{gi}^{m}$$

Where:

gi = The goal set (i = 1, 2, 3, …., n)
M_{gi}^{j} (j-1, 2…..m) = Triangular Fuzzy Numbers (TFNs)

The steps of Chang's analysis can be given as in the flowing:

Step 1: The fuzzy synthetic extent value (Si) with respect to the it h criterion is defined as Eq. 1:

$$S_i = \sum_{j=1}^{m} M_{gi}^{j} \otimes \left[\sum_{j=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} \quad (1)$$

To obtain Eq. 2:

$$\sum_{j=1}^{m} M_{gi}^{j} \quad (2)$$

Perform the "fuzzy addition operation" of m extent analysis values for a particular matrix given in Eq. 3, at the end step of calculation, new (l, m and u) set is obtained and used for the next:

$$\sum_{j=1}^{m} M_{gi}^{j} = (\sum_{j=1}^{m} l_j; \sum_{j=1}^{m} m_j; \sum_{j=1}^{m} u_j) \quad (3)$$

Where:

l = The lower limit value
m = The most promising value
u = The upper limit value

And to obtain Eq. 4:

$$\left[\sum_{j=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} \quad (4)$$

Perform the "fuzzy addition operation M_{gi}^{j} (j = 1; 2; 3, ..., m). Values give as Eq. 5:

$$\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j} = (\sum_{j=1}^{m} l_j; \sum_{j=1}^{m} m_j; \sum_{j=1}^{m} u_j) \quad (5)$$

And then compute the inverse of the vector in the Eq. 5 and 6 is then obtained such that:

$$\left[\sum_{j=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} = \{\frac{1}{\sum_{j=1}^{m} u_j}; \frac{1}{\sum_{j=1}^{m} m_j}; \frac{1}{\sum_{j=1}^{m} l_j}\} \quad (6)$$

Step 2: The degree of possibility of:

$$M_2 = (l_2; m_2; u_2) \geq M_1 = (l_1; m_1; u_1)$$

is defined as Eq. 7:

$$V(M_2 \geq M_1) = SUP_{y \geq x}[\min(\mu_{M1}(x); \min(\mu_{M2}(y)] \quad (7)$$

And x and y are the values on the axis of membership function of each criterion. This expression can be equivalently written as given in Eq. 8: where d is the highest intersection point μ_{M1} and μ_{M21}

$$V(M_2 {}^{3} M_1) = \begin{cases} 1 & \text{if } m_2 \geq m_1 \\ \dfrac{l_1 - u_2}{(l_1 - u_2) + (u_1 - l_2)} & \text{otherwise} \end{cases} \quad (8)$$

To compare M1 and M2 we need both the values of V (M2≥M1) and V (M1 ≥M2):

Step 3: The degree possibility for a convex fuzzy number to be greater than k convex fuzzy numbers Mi (i = 1, 2, 3, 4, 5, ..., k) can be defined by V (M≥M1, M2, M3, M4, M5, M6, ..., Mk) = V [(M≥M1) and (M≥M2) and (M≥M3) and (M≥M4) and ... and (M≥Mk)] = Min V (M≥Mi), i = 1, 2, 3, 4, 5, ..., k. Assume that Eq. 9 is:

Table 1: Fuzzy number values (Chang, 1996)

Statements	Values
Absolute	7/2,4,9/2
Very strong	5/2,3,7/2
Equal	1,1,1
Weak	3/2,2,5/2
Very weak	2/3,1,3/2

$$d(Ai) = \min V(Si \geq Sk) \quad (9)$$

For k = 1, 2, 3, 4, 5, ..., n; k≠ i. Then the weight vector is given by Eq. 10: where, Ai (i = 1, 2, 3,..., n) are n elements.

Step 4: Via normalization, the normalized weight vectors are given in Eq. 11:

$$W = (d^T(A1), d^T(A2), d^T(A3), d^T(A4), d^T(A5), d^T(A6),....., d^T(An))^T \quad (10)$$

where, W is non-fuzzy numbers. After the criteria have been determined, a question form has been prepared to determine the importance levels of these criteria. To evaluate the questions, people only select the related linguistic variable, then for calculations they are converted into the following scale including triangular fuzzy numbers developed by Chang and generalized for such analysis (Table 1). In this study, a decision making process is handled in fuzzy analyses, about analyzing the selective criteria for suitability location. Firstly 30 questionnaires were obtained to determine a suitable site for locating of urban green space. These questionnaires were distributed among experts. In this questionnaire, the first, photographs of the studied sites and their proximity was given. Then paired comparisons between sites on each of the factors will be done emphasis on the qualitative factors. These comparisons with Fuzzy scale are done based on above table. The sample question is given as follows:

- Question 1: What importance is "factor 1" to compare with "factor 2"?
- Question 2: What priority is "Site 1" to compare with "Site 2" With respect to Factor 1?

The presented questions are arranged in a table and given to experts. These questions are asked for both classical and fuzzy AHP methods but the calculation of the importance weights are handled according to the methodology given for each process. For example, compared between site 1 and site 2 on connectivity and accessibility is written very weak. According to Table 1, score has been assigned (2/3, 1, 3/2). This means that comparison between sites in terms of accessibility, site 2 is more appropriate to location than site 1. Similarly, results from all 30 questionnaires has been surveyed and assessment with using the formulas of AHP Fuzzy. Collection of questionnaires data has been estimated a week in order to visit the sites by experts. Subsequently data were analyzed by the AHP method. The results are shown in below Tables. In appropriate with the AHP Fuzzy method, selective criteria have been determined and compared in the sub levels. Then the criteria have been arranged by the calculation of the process according to the given hierarchy structure.

Following calculations are performed to reach the importance values of the first level as a sample fuzzy evaluation matrix is obtained in the Table 1: (Pl 35. Table 1).

Step 1:

$$\left(\sum_{j=1}^{m} l_j; \sum_{j=1}^{m} m_j; \sum_{j=1}^{m} u_j;\right) = (79.36, 98.75, 123.05)$$

$$\left[\sum_{j=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} = (0.01, 0.01, 0.013)$$

$$S1 = M_{gi}^{j} \otimes \left[\sum_{j=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} = (10.17, 13, 15.5)\,(0.0.01, 0.0.01, 0.013) = (0.083, 0.132, 0.195)$$

$$S2 = M_{gi}^{j} \otimes \left[\sum_{j=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} = (14, 17, 20.5)\,(0.0.01, 0.0.01, 0.013) = (0.114, 0.172, 0.258)$$

$$S3 = M_{gi}^{j} \otimes \left[\sum_{j=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} = (14.07, 17.5, 21.17)\,(0.0.01, 0.0.01, 0.013) = (0.114, 0.175, 0.267)$$

$$S4 = M_{gi}^{j} \otimes \left[\sum_{j=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} = (7.34, 9.58, 12.69)\,(0.0.01, 0.0.01, 0.013) = (0.60, 0.97, 0.160)$$

$$S5 = M_{gi}^{j} \otimes \left[\sum_{j=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} = (8.19, 9.83, 12.07)\,(0.0.01, 0.0.01, 0.013) = (0.67, 0.100, 0.152)$$

$$S6 = M_{gi}^{j} \otimes \left[\sum_{j=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} = (7.40, 9.17, 11.97)\,(0.0.01, 0.0.01, 0.013) = (0.60, 0.93, 0.151)$$

$$S7 = M^{j}_{gi} \otimes \left[\sum_{j=1}^{n}\sum_{j=1}^{m} M^{j}_{gi}\right]^{-1} = (5.64, 7.17, 9.47)\ (0.0.01, 0.0.01, 0.013) = (0.46, 0.73, 0.119)$$

$$S8 = M^{j}_{gi} \otimes \left[\sum_{j=1}^{n}\sum_{j=1}^{m} M^{j}_{gi}\right]^{-1} = (6.80, 8.17, 9.97)\ (0.0.01, 0.0.01, 0.013) = (0.55, 0.83, 0.126)$$

$$S9 = M^{j}_{gi} \otimes \left[\sum_{j=1}^{n}\sum_{j=1}^{m} M^{j}_{gi}\right]^{-1} = (5.75, 7.33, 9.73)\ (0.0.01, 0.0.01, 0.013) = (0.47, 0.74, 0.123)$$

Step 2: Using these vectors: V(S1>S2) = 0.67; V (S1>S3) = .064; V (S1>S4) = 1; V (S1>S5) = 1; V (S1>S6) = 1; V (S1>S7) = 1; V (S1>S8) = 1; V (S1>S9) = 1... V (S9>S1) = 0.41; V (S9>S2) = 0.08 ;V (S9>S3) = 0.007; V (S9>S4) = 0.73; V (S9>S5) = 0.69; V (S9>S6) = 0.77; V (S9>S7) = 1; V (S9>S8) = 0.89.

Step 3: Thus, the weight vector from step 2 is found as: = (0.64, 0.97, 1, 0.36, 0.33, 0.30, 0.05, 0.11, 0.07).

Step 4: With normalize, (0.167, 0.253, 0.262, 0.095, 0.086, 0.079, 0.012, 0.028, 0.020). With similar calculate for each of items related with 9 factors. In result gained following conclusions: district 22 is surrounded with central Alborz Mountains in North, Kan River in East, Tehran Freeway in south and the range of planted forests Vardavard in west This area is contiguous with district 5 and 21 of Tehran Municipality. The cause of formation of District 22 is an extensive reflection on Tehran physical transformation due to grow of population and the wide range of developments in the economy. This district was formed in Tehran with the aim of eliminating of the deficiencies in services of the West of Tehran and the settlement of the part of Tehran population. Study of land use of district 22 shows that 1,265 ha of parks and green space, 62 ha of educational space, 168 ha of Higher Education, 238 hectares of services, 327 ha of sports, 355 ha of lakes and 1,162 ha of residential are determinate. Density of residential is divided to low density area (100 units per ha), medium density area (135 units per ha) and high density area (200 units per ha).

Population studies in District 22 indicate that this District has 138670 population based on 2006 census. District 22 of Tehran Municipality has 4 regions. District 22 has unique cross accessibility in Tehran and extra-urban. District 22 of Tehran's is the last hope of Tehran for preparing the best pattern of suitable urban living. This District is part of the continuous development of the city based on master plan criteria. Qualitative factors as well as required principals to locate the green space have been discussed. According to previous studies in locating and examining of the used factors, these criteria were introduced: sustainability, aesthetic, safety, connectivity and accessibility, legibility, desirability, dependency, adaptability, biodiversity. The used method to evaluate sites with respect to the mentioned factors has been introduced. This method is the subset of general method faced with qualitative factors. Presentation of questionnaire in classical and AHP Fuzzy technique is the same. But Assessment methods are different and the final result in studied technique is closer to reality. In this method, firstly the criteria are compared together and given suitable weight to them based on experts opinions. The presented result shows the degree of importance of the criteria (Table 2):

Table 2: the degree of importance of the criteria

Criteria	Result
Sustainability	0.262
Safety	0.253
Aestatic	0.167
Connectivity and accessibility legibility	0.095
Legibility	0.086
Dependency	0.079
Biodiversity	0.028
Desirability	0.012
Adaptability	0.020

Then comparisons between sites with respect to any of the criteria have been done. Analysis and study of tables show: in comparison between sites based on Sustainability criteria, site 2 has priority. In comparison between sites based on safety criteria, site 3 has priority. In comparison between sites based on connectivity and accessibility criteria, site 2 has priority. In comparison between sites based on legibility criteria, site 1 has priority. In comparison between sites based on Aestatic criteria, site 2 has priority. In comparison between sites based on dependency criteria, site 1 has priority. In comparison between sites based on Biodiversity criteria, site 2 has priority. In comparison between sites based on desirability criteria, site 3 has priority. In comparison between sites based on adaptability criteria, site 4 has priority. Afterward the obtained criterions weight (Table 1) are multiplied by the weight of each of the sites and the final weight of sites is obtained (Table 2). This table shows that in comparison between six sites based on criterions, site 2 has priority and site 3 and site are next in priority, respectively (Table 3).

The results of the calculation showed that site 2 (0.243 points) was slightly superior to site 3 (0.233 points) and also site1 (0.205 points) and superior to site 4 and site 5 and site 6. The fuzzy evaluation results of the factors in each site showed that out of the 9 factors evaluated, site 2 was superior to site 3 on 5 factors. The biggest

Table 3: The degree of priority of the alternatives

Alternatives (sites)	Result
2	20.243
3	30.233
1	10.205
4	40.159
5	50.111
6	60.049

difference among these was "biodiversity" with a difference of approximately 0.20. Site 2 was superior to site1 on 6 factors as well with the biggest difference being "biodiversity" with a difference of 0.123. Site 3 was superior to site 1 in 5 factors with the biggest difference being "safety" where the difference was 0.112. Designing of site 2 according to criteria- Environmental context and environmental visual has been done.

This design includes the following cases: special attention to green architecture and sustainable development with minimal interference in the site and observing sky line creation of equilibrium between motor and pause spaces and diversity in the visual attention to the proximity and full adaptability of design with environment observing access hierarchy with open, semi-open and closed spaces considering the different species of plant with enjoyable visual and perfect harmony.

CONCLUSION

The results based on the study have been shown as following: Creating of urban green space can't be discussed independently without a link with the needs of urban society and culture. Today, the possibility to enjoy leisure time is considered pillar of the development. Construction of urban green spaces and their location provide convenient access for people; help the possibility of achievement. Landscape urbanism is not simply a theory in discourse among academia but currently a method of practice influencing the urban form. Its success in design competitions has begun the implementation of principles which will further inform theory.

Tehran metropolitan is deficient conducting the following 5 benefits. Environmental benefits, health benefits, social benefits, economic benefits, aesthetics benefits the distribution of urban green spaces in the city and its regions has a direct effect on the desirable model and the function and performance of the city. Thus, the desirability of living in the city increases. Considering to routine projects as urban green space in urban land use maps of Tehran for useless pieces shows that the location of green spaces has been done without any logic and scientific planning. Studies of per capita green space in world and Tehran show that this has been determined between 20-25 m^2 per person, according to international standards. This per capita in Tehran is between 7-12 m^2. However, the per capita of green space depends on the features of urban climate. But, lack of green space is visible with comparison between the climates of similar countries and cities. So the Tehran's per capita of green space deficit is evident.

Just per capita-quantitative factor is not important as the main factors. Per capita minimum requirements are considered for spaces and lateral facilities for the person's leisure. This is based only on quantitative factors without regard to quality aspects. New policy on urban design which is based on as quantitative factors in the range of types of green spaces along with the diversity of users is involved the qualitative factors. Selection of sites based on certain appropriate criteria is necessary in green spaces location planning. The criteria and indicators for sustainable green spaces management can be considered as the common standards for green spaces location among global community because the criteria and indicators target the achievement of green spaces location as well as human oriented green spaces functions and recreational use in a sustainable way. The developing theory of landscape urbanism has touched upon many projects such as location of green spaces on system theory. Systems theory is the Trans disciplinary study of systems in general with the goal of elucidating principles that can be applied to all types of systems in all fields of research. The term does not yet have a well-established, precise meaning but systems theory can reasonably be considered a specialization of systems thinking and a generalization of systems science.

Location of urban landscape space is a fuzzy decision making question that involves making a judgment from numerous fuzzy factors. A new multiple objective decision-making method that uses fuzzy math theory and methods was shown to be feasible. Using this evaluation method, the reliability of decision-making to locate the urban landscape space was improved. In this analysis, different perspective and experts' choice are used. Due to the diversity of opinions, the analysis of prioritize of the factors should will be done in various aspects. Also, this analysis, potentially, shows the unspecified relations of use of integrated and formulated strategies in different time intervals. In fact, it operates as a determining route for the location decisions using the urban landscape designers. Also it increased ability to identify factors, priorities and ultimately it leads to a suitability choice among various alternative.

Usage of the system analysis method to investigate the relationships between influencing factors, layers and component factors in location of urban landscape space so as to establish an evaluation model is

feasible. Location of urban landscape space is an extremely detailed undertaking. To accomplish the project objectives, thorough experts and planning by using other methods to create a representation of the design can help improve efficiency and results.

REFERENCES

Bishop, I.D. and B.E.R.N.D. Rohrmann, 2003. Subjective responses to simulated and real environments: A comparison. Landscape Urban Plann., 65: 261-277.

Catanese, A., 2005. Introduction to Urban Planning. McGraw-Hil Press, New York, USA., Pages: 354.

Caves, W.R., 2005. Encyclopedia of the City. Taylor & Francis Press, New York, USA., Pages: 564.

Chang, D.Y., 1996. Fuzzy analytic hierarchy process extend analysis method. Fuzzy Sets Syst., 12: 43-51.

Farenc, N., 2001. An informed environment for inhabited city simulation. MA Thesis, Federal Institute of Technology in Lausanne, Lausanne, Switzerland. https://infoscience.epfl.ch/record/32943

Ferrier, R.W., 1989. The Arts of Persia. Yale University Press, New Haven, USA., Pages: 334.

Fukahori, K. and Y. Kubota, 2000. Consistency evaluation of landscape design by a decision support system. Comput. Aided Civil Infrastruct. Eng., 15: 342-354.

Hargrove, E., 2003. Foundations of Environmental Ethics. Prentice Hall Press, Englewood Cliffs, New Jersey, Pages: 229.

Heckler, S., 2009. Landscape, Process and Power: Re-Evaluating Traditional Environmental Knowledge. Harvard Business Publishing, Boston, Massachusetts, Pages: 289.

Hunter, J., 1999. The Essex Landscape: A Study of its Form and History. Essex Record Office Press, Chelmsford, England, ISBN:9781898529156, Pages: 210.

Jayaswal, B.K., P.C. Patton and E.H. Forman, 2007. The Analytic Hierarchy Process (AHP) in Software Development (Digital Short Cut). Pearson Education, Upper Saddle River, New Jersey,.

Johnson, M., 2007. Ideas of Landscape: An Introduction. Blackwell Press, Malden, Massachusetts, Pages: 242.

Khansari, M., M.R. Moghtader and M. Yavari, 2004. The Persian Garden: Echoes of Paradise. Mage Publishers, Tehran, Iran, ISBN-13: 9780934211758, Pages: 172.

Koksalan, M.M., J. Wallenius and S. Zionts, 2011. Multiple Criteria Decision Making: From Early History to the 21st Century. World Scientific, Trenton, New Jersey, ISBN:10-981-4335-58-4, Pages: 197.

Larson, C. and E. Forman, 2007. Application of analytic hierarchy process to select project scope for videologging and pavement condition data collection. Transp. Res. Rec. J. Transp. Res. Board, 1990: 40-47.

Saaty, T.L., 1988. Decision making for leaders: The analytical hierarchy process for decisions in a complex world. University of Pittsburg, Pittsburg.

Swanwick, C., N. Dunnett and H. Woolley, 2003. Nature role and value of green space in towns and cities: An overview. Built Environ., 29: 94-106.

Vigo, G., 1990. Place specific sense of community. MBA Thesis, Department of Landscape Architecture, Texas A & M University, Station, Texas.