Int. J. Hum. Capital Urban Manage., 4(1): 23-32, Winter 2019

International Journal of Human Capital in Urban Management
(IJHCUM)

Homepage: http://www.ijhcum.net/

ORIGINAL RESEARCH PAPER

Spatial distribution of urban green spaces using entropy model and coefficient of dispersion

A.R. Sadeghi[1], M. Khakzand[2,*], M.A. Dehghani[1]

[1] Department of Urban Planning and Design, Faculty of Art and Architecture, Shiraz University, Shiraz, Iran

[2] School of Architecture and Environmental Design, Iran University of Science and Technology, Tehran, Iran

ARTICLE INFO

Article History:
Received 01 October 2018
Revised 11 November 2018
Accepted 22 December 2018

Keywords:
Green Space
Population distribution
Shiraz City
Spatial distribution
Sustainable urban development

ABSTRACT

In the present era, the importance and role of green space in the life and development of cities are to the extent that it is mentioned as one of the indicators of sustainable development. In sustainable urban development, proportional distribution of green space according to balanced distribution of population is one of the principles of establishing geographical justice. The purpose of the present study is also to determine the status of green space per capita in ten districts of Shiraz city. The research type is applied-developmental and the research method is descriptive-analytical. The data has been collected from urban plans, and to investigate the spatial distribution of the share of green space in 10 districts of Shiraz city, Dispersion coefficient model was utilized. Shannon entropy also has been implemented for analyzing Population distribution during 2007, 2012 and 2016 in urban districts of Shiraz. The research results show that the highest per capita of urban green space is related to districts 9, 3, 6, 1, respectively, and the lowest per capita of green space is related to districts 8 and 7, respectively. The coefficient of dispersion was obtained as equal to 0.20, which, unlike the previous studies, indicates realization of principle of justice in spatial planning of green space index in 2016. The results of entropy coefficient showed that distribution of population in ten districts of Shiraz in 2007 has been balanced, in 2012 has moved toward unequal distribution of population, and then in 2016 again has moved toward balanced distribution.

DOI:10.22034/IJHCUM.2019.01.03

INTRODUCTION

Shiraz, despite being a fertile and watery city and having many gardens and streets full of trees since Safavid era, its population has increased from 170659 in 1947 to 1460665 in 2012 due to natural growth of population and immigration. It has become a pollutant metropolis of the country which is in need of green space development. Being fertile and watery, Shiraz had caused many species of plants be grown there. There have been many gardens in different eras throughout the history. In Safavid era, Esfahan had many streets full of trees, just like Shiraz. The most important of which began from Allah Akbar street till Esfahan gate. According to Tavreniyeh and Sharden, there were fountains and two great ponds at the center of Shiraz`s streets, one of which was located in front of the Shrine of Ali-ibn-Hamzeh. Rokn-Abad district of this city was irrigated with

*Corresponding Author:
Email: *mkhakzand@iust.ac.ir*
Phone: +9821 77240467
Fax: +9821 77240468

water. Like many of the Iranian cities, there were large and little gardens in Shiraz`s houses, some of which vastness was really big. According to Herbert, most of the houses in Shiraz have a garden. These gardens are in fact jungles of plane trees and tall cypresses. Gasr-oldasht district`s gardens of Shiraz are also among valuable districts for the production of oxygen which are still remaining and provide beautiful landscapes in different seasons. To this end, it becomes necessary to investigate and identify the way theses green spaces have been distributed along ten districts of Shiraz to recognize the deficits and considering justice principle. Therefore, the current study has tried to answer the following questions: Which pattern (balanced or unbalanced) was followed when distributing green space between urban districts of Shiraz in 2007, 2012 and 2016? How was the population distribution process in the ten districts of Shiraz in 2007, 2012 and 2014? The importance on urban green space is to an extent that it is considered as one of the societies` developing indexes (Mohammadi Saran, 2014). Green space is a part of urban physical development, which can have specific functions. Green space can have a decorative role (embellishment of the urban appearance), or entertaining and recreational role. Having developed urban areas in recent years, and transcending urbanization over urban development, which has itself increased difficulties regarding irregular population spike, non-targeted developing of cities` structures and increasing environmental pollutions, urban green space has gained an importance toward maintaining and balancing urban environment and reducing air pollution (Ajilian Momtaz *et al*., 2014). Urban green space exists in and surrounds urban areas. The idea of urban green space is understood to refer to all publicly owned and publicly accessible open spaces with a high degree of cover by vegetation, such as parks, woodlands, nature areas and other green spaces in urban areas (Schipperijn *et al.,* 2010). As 'the green lungs of cities', urban green spaces contribute to people's physical and mental health by providing breathing space to take time out from the stresses of modern life (Nicol and Blake, 2000). Horwood (2011) has pointed out that urban green space is a broad subject of interest to diverse fields, with links to policy issues such as healthy living, ecology, climate change mitigation, property value uplift and community cohesion. Sustainable development is seriously influenced by green and open spaces within those urban areas that are planned and managed (Horwood, 2011). Thus urban green spaces play a key role in maintaining sustainable development and the liveability of an area (Levent and Nijkamp, 2004). It recognizes the environmentally beneficial role that green spaces may offer, as well as the social and economic (Sutton, 2006). Social benefits of green spaces are related to leisure and recreation, access to and experience of nature, the facilitation of social contact and communication, issues influencing human physical and psychological health and well-being and overall sustainability (Stiles, 2006; Cilliers and Timmermans, 2014). Green spaces contributes to enhanced community cohesion (Kuo, 2003; Kazmierczak and James, 2008; Cilliers *et al.,* 2012), social interaction, less aggressive behavior, lowers levels of fear, and better neighbor relationships (Ulrich, 2002). Human health and mental health are also part of the social benefits of green-spaces (Kuo, 2003; Ulrich, 2002; Van den Berg *et al.,* 2007). Research proofed the restorative effects of green spaces in terms of stress relief (Hansmann *et al.,* 2007), happiness versus aggression (Kuo and Sullivan, 2001; Chiesura, 2004) and especially the positive social impact on children (Taylor *et al.,* 2002). Environmental benefits provided by green spaces include ecosystem services (Stiles, 2006) and ecological systems that provide a myriad of services to human societies (Cilliers *et al.,* 2013). Green spaces contributes to noise reduction (Bolund and Hunhammar, 1999), microclimate and heat island effects (Akbari *et al.,* 2001; Alexandri and Jones, 2008) and reducing pollution and enhancing air quality (Bolund and Hunhammar, 1999). The greatest environmental benefit of green spaces is the impact on biodiversity and providing refuge to species that are disappearing from urban areas (Hodgkison and Hero, 2007; Green space Scotland, 2008). The economic benefits of green spaces including aspects such as a favorable image for a place, the boost retail sales, increased tourism (Swanwick *et al.,* 2003), encouraged employment, enhance inward investment in the area (Cabe, 2005), positive impact on property values (Luttik, 2000) and the value of open spaces and proximity of neighborhoods to natural areas (Lutzenhisher and Netusil, 2001; Shultz and King, 2001; Smith *et al.,* 2002). Fig. 1 illustrates the conceptual relationship between urban green

areas and sustainable community.

Nowadays, it is observed that there is no balance in terms of green space and open spaces among urban networks and natural patterns of earth and urban networks are dominating over ecologic networks (Thaiutsa *et al.,* 2008). Meanwhile, green space has a determinant role in supporting social and ecological systems of cities (Barbosa *et al.,* 2007). Therefore, the physical and natural effects of these spaces in urban systems and its various ecological, social and economic restitutions are undeniable in societies` structures. Its importance is to the extent that the subject of green space uses in cities and their shares is one of the fundamental discussions in urban planning and management (Mohammadi *et al.,* 2012). A sustainable city is the one which considers the citizen`s health conditions in terms of natural environment (Hosseini *et al.,* 2013) and the process of developing urban green space for having sustainability should be pointed based on local ecological characteristics and local peoples' thoughts (Kiani and Khalilnezhad, 2010). Planners now recognize sustainable development as development that is profitable, green, and fair (Bartelmus, 1994; Campbell, 1996). The World Commission on the Environment and Development (WCED) defined sustainable development as development "that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). The definition

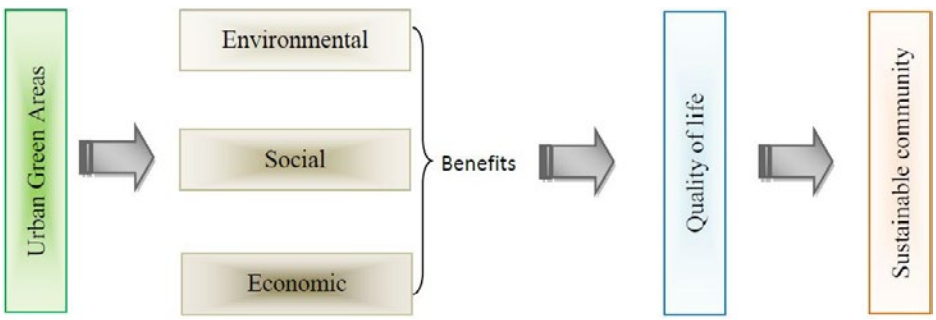

Fig. 1: The conceptual relationship between urban green areas and sustainable community(Elgizawy, 2014).

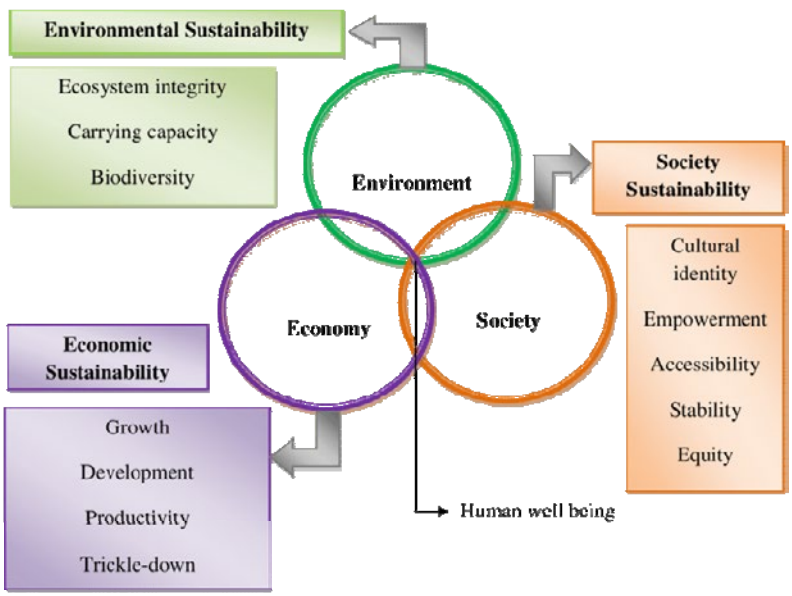

Fig. 2: The Sustainability Aspects (Elgizawy, 2014)

of sustainable development has three following dimensions: Economic sustainability (economic use), environmental sustainability (ecologic stability), and Social sustainability (distributed social justice and fairness) (Shurcheh, 2012). Fig. 2 illustrates the sustainability aspects.

In this context, Zarrabi and Ranjbar (2014) conducted a study entitled "Evaluating the use of urban green space through urban planning techniques in a GIS environment; A case study of Shiraz, district 4". They had used descriptive-analytical approach and concluded that the highest urban green space share belonged to districts 3, 8 and 9. Moreover, the distribution of green space area and population parameters, as well as the least amount of share associated with district 4 among city districts of Shiraz, according to Gini coefficient was 0.16. These two parameters indicate that the distribution of urban green space and the population of urban districts was relatively balanced. Hosseini *et al.* (2013), conducted a research entitled "Investigating and analyzing Shiraz's urban green space" through analytical-comparative studies based on statistics available at Shiraz municipality of green spaces in 2010. They concluded that there was a lack of green space in Shiraz and green spaces has not been fairly distributed in its districts. Azani and Abbasi (2013) in an article entitled "An analysis of position of green space in sustainable development approach using entropy Coefficient and Williamson model, a case study: Shiraz city" through descriptive- case approach concluded that there was no balance of urban green space related to irregular population growth in different districts of Shiraz city. Momtaz *et al.* (2014), developed a research entitled "investigating the importance of urban green spaces when approaching sustainability development target". Using descriptive- analytical method, they concluded that the effects of developing urban green spaces caused improvements in citizen's lives and all in all developed urban environmental sustainability when proving the targets of sustainable development. Mohammadi *et al.* (2012) investigated a research entitled "analyzing and evaluating the distribution and sustainable development of urban green spaces; a case study of Miandoab city" through descriptive-analytical method in 2002 and 2012. They indicated that despite national and international standards toward using urban green spaces and high environmental capability, this city has fundamental deficiencies and there exists discrepancies between districts in terms of using green spaces. Chiesura (2004) in an article entitled "The role of urban green space in having a sustainable city", meanwhile pointing to the importance of urban green spaces, he emphasized on the importance of city's nature for citizen's convenience and city's sustainability. His results indicated that the nature's experience was the source of positive feelings and beneficial services in an urban environment which provides worthy incorporeal and spiritual needs. Milward and Sabir (2011) in an article named "Advantages of having an urban forest park", provided various valuable social, economic and environmental services which were also measurable for cities. They tried to show the advantages of having such a park in cities quantitatively, so that its` importance could be understood. Table 1, shows the suggested share of using urban green space suggested by related individuals, organizations and organs. This study has been carried out in Shiraz in 2018.

MATERIALS AND METHODS

The current research was conducted in an applied-developmental way through descriptive-analytical method. Data collection procedure was done through documentary and library methods. Moreover, the needed statistical data were received from Shiraz

Table 1: Proposed green space per capita in urban areas (Mohammadi *et al.*, 2012)

Related individuals, organs and organizations	Suggested share (m^2)*	Related individuals, organs and organizations	Suggested share (m^2)
United Nations	20-25	Municipality of Tehran	15-20
National entertainment institution of America	14	Comprehensive design of Tehran	10
Public health center committee and housing department of America	18	Russian Poulad-Shahr planners	20-30
Center of urban studying and planning of the country	10	Bahram Soltani	30-40
Housing department	7-12	Majid Makhdum	1-50

*Square miter

municipality organization of green spaces and parks as well as the population statistics of Fars government and also from the related site to Shiraz municipality researches. They were, then analyzed by comparing the shares of Shiraz city's districts with standards and common shares both quantitatively and qualitatively. Ultimately, quantitative methods are mathematical and statistical analyses techniques were utilized.

Coefficient of dispersion

To investigate the spatial distribution of the share of green space in 10 districts of Shiraz city, Dispersion coefficient model was utilized. This model is one of the fundamental methods when getting access to the inequality of the districts. Using this method, the extent to which an index is distributed unequally becomes well evident. The overall structure as Eq. 1.

$$Dv = \frac{\frac{-b \pm \sqrt{\sum_{i=1}^{n}(x_i - \bar{x})2}}{n}}{\frac{\sum_{i=1}^{n} x_i}{n}} \quad (1)$$

Where,

x_i= the amount of variable in each district= x_i
n= number of districts
D_v= dispersion coefficient
D_v= 4.49/(22.1)
D_v= 0.20

Entropy model

Entropy is a measure of the level of uncertainty in the probability distribution of random variables. This notion first appeared in thermodynamics, but has since found application in many fields of science. It was introduced to information theory by Shannon (1948). In defining and measuring entropy, use has been made of many forms of mathematical functions (Haynes *et al.,* 1980). In this study, Shannon entropy has been implemented for analyzing Population distribution during 2007–2016 in urban districts of Shiraz. Shannon entropy, as a scientific method determine the city is sprawled or not, based on a variety of researches like (Sudhira *et al.,* 2004; Bhatta, 2009; Li and Yeh, 2004). The Shannon's entropy is considered in Eq. 2.

$$H_i = -\sum_{j=1}^{m} p_j \log_e (pj) \quad (2)$$

Where,

i = temporal span
j = target zone
p_j = proportion of the variable in the j-th target by: built-up growth in j-th zone/sum of built-up growth rates for all zones and m = number of zones.

The Shannon entropy values ranges from 0 to loge(n), values closer to 0 (smaller values) indicates very compact distribution and the value closer to loge(n) (larger values) indicates that the distribution is much dispersed (Bhatta, 2009).

Study area

Shiraz is the most important urban point of Shiraz county and it is the capital of Fars province (Fig. 3). It is located in the distance of 919 kilometers from south of Tehran. Shiraz located on a long plain having the geographical length of 120 kilometer and width of 15 kilometers, having the geographical length of 30 and 52 degrees in east and having the geographical width of 30 and 29 in north, it is located in the distance of 919 kilometers from south of Tehran (annual statistics of Fars province, 2007). The area of Shiraz is 10479 square kilometers, 8.54 of the total area of province, whose 60.4 percent is consisted of plain. Mountains of this county are stretched from north to east south following general direction of Zagros mountain hierarchy. There are disparate plains based on general directions of mentioned heights.

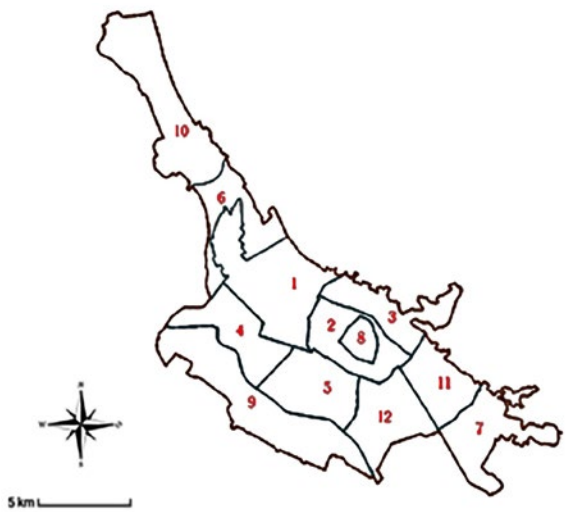

Fig. 3: Shiraz zoning

The most important of which is Shiraz plain, Kovar plain, Sarvestan plains and Siyakh Darneghoun. The highest point of this county is Mishowan Mountain having the height of 3097 meters and the lowest point is Maharlou Lake with the height of 1046 meter from the sea. This city is located at the height of 1484 meters from the sea in a mountainous district of Zagros which has moderate weather. Shiraz is limited from the west to Dorak Mountain and from north to Bamu, Sabzpooshan, Chehel magham and Babakuhi mountains (from Zagros ranges). There a seasonal river passing from the center of the city which is known as Dry River. This river has water only in winter and spring. This river goes to Maharlou Lake in the east south of Shiraz.

According to conducted studies and investigations of Housing Department, defined and acceptable share of urban green spaces in Iranian cities is between 7 to 12 m^2 for each individual. This is a low value when compared to determined index of natural environment of United Nations (20 to 25 m^2 for each individual). However, in different cities of the country, this value is different regarding various geographical and climatic characteristics. The amount of which is determined in every city's approved design (Mo`tamedi *et al.* 2013). The following Table shows the status of green space in every 10 districts of Shiraz (Table 2).

RESULTS AND DISCUSSION

Investigations and data analysis of the results obtained from Table 2 indicated that district 2, having the population of 142.96 individuals per hectare, is the most populous district after districts 3 and 4. However, the share of its green space is 12.39, which has too less share of green space in relation to

Table 2: Area and share of green space (m^2) as divided by each district in Shiraz (Authors)

Districts	Area of green space including highlands in 2014 (m^2)	Population in 2014 (people)	Per capita green space per District in 2014	Surplus and shortage
1	2.682.403	160.963	16.66	25536699
2	2.423.485	195.651	12.39	858257
3	9.202.442	205.775	44.72	7556242
4	3.634.769	241.360	15.06	1703889
5	2.200.458	159.561	13.79	923970
6	2.743.201	115.361	23.78	1820313
7	1.749.560	195.635	8.97	186640
8	204.667	47.530	4.31	-175573
9	5.067874	116.909	43.35	4132602
10	4.277.673	108.385	39.47	34110593
Area and per capita green space including highlands in 2014				
year	green space Area	population	Green space per capita	
2014	34.186.532	1.547.130	22.1	

Table 3: Calculating entropy coefficient variations in 10 districts of Shiraz in 2007, 2012 and 2016

Districts	Population in 2006 (people)	2006			Population in 2011 (people)	2011			Population in 2015 (people)	2015		
-	-	Pi	Ln(pi)	Pi × Ln (pi)	-	Pi	Ln(pi)	Pi × Ln (pi)	-	Pi	Ln(pi)	Pi × Ln (pi)
1	197127	0.1496	-1.899	-0.28	201613	0.138	-1.980	-0.27	160.963	0.15	-1.89	-0.28
2	204042	0.1548	-1.865	-0.28	208316	0.142	-1.951	-0.27	195.651	0.09	-2.40	-0.21
3	186663	0.1416	-1.954	-0.27	204842	0.140	-1.966	-0.27	205.775	0.09	-2.40	-0.21
4	206259	0.1565	-1.854	-0.29	210952	0.144	-1.937	-0.27	241.360	0.14	-1.96	-0.27
5	147344	0.1118	-2.191	-0.24	150697	0/103	-2.273	-0.23	159.561	0.08	-0.22	-0.01
6	159393	0.1209	-2.112	-0.25	154828	0.105	-2.253	-0.23	115.361	0.02	-3.91	-0.07
7	147273	0.1117	-2.191	-0.24	170705	0.116	-2.154	-0.24	195.635	0.12	-2.12	-0.25
8	57988	0.044	-3.123	-0.13	59308	0.040	-3.218	-0.12	47.530	0.01	-4.60	-0.04
9	113496	0.0861	-2.452	-0.21	99405	0.068	-2.688	-0.18	116.209	0.12	-2.12	-0.25
10	-	-	-	-	-	-	-	-	108.385	0.12	-2.12	-0.25
Total	1317485	-	-	2.19	1460666	-	-	2.08	1547130	-	-	1.84

G1394=0.98; G1390=0.94; G=1385=1; Ln10=2.30

district 9 whose population is lower and about 42.48 individuals per hectare. Moreover, district 9 having the populous of 116.909 has expanded physically when comparing to previous years, since its share is more than other districts (42.66 m^2). Later on, district 3 has the most area of 4640155 and green space share of 44.72 m^2. District 8 despite having a population density of 146.21 individuals per hectare, has the smallest area (204.667 m^2) and the smallest per capita green space (4.14 m^2), compare to Shiraz with population density of 75.53 individuals per hectare. Additionally, district 7 of Shiraz, having the area of 1.749.560 m^2 is ranked 4th regarding its population, but its share of green space is about 8.97 which is needed to be included in green space planning after district 2 (Fig. 4).

The first hypothesis of the research stated that "It seems that spatial distribution of the share of green space in Shiraz doesn`t follow an equilibrant model". To investigate the spatial distribution of the share of green space in 10 districts of Shiraz city, Dispersion coefficient model was utilized. The obtained percentile amount from the dispersion coefficient of Eq. 1 showed that the dispersion index of green space in Shiraz city was 0.20%. Considering that the more obtained index coefficient approaches to zero, the more balanced distribution of the intended index would happen. Moreover, the more it converges to number 1, the less balanced spatial distribution of indexes becomes evident. According to dispersion coefficient calculations, since the obtained amount (0.20%) is closer to number 1, the spatial distribution of green space in 10 districts of Shiraz has relatively balanced distribution. Thus, the research hypothesis is rejected. The main reasons of this issue is prioritizing and special considering of municipality and urban managing toward green space problem in deprived districts, their paying attention to the lack of share for green space in 10 districts and relative expansion of abandoned lands within the city to become a green space, these days. The cause of which was justice has been achieved in the spatial planning of the share of urban green space in its 10 districts. Second hypothesis of the research stated that "the process of population distribution in 10 districts of Shiraz city was done equally in 2007, 2012 and 2016". To test the second hypothesis, Entropy model was used. The overall structure of the model is shown in Eq. 2. The following table shows the calculations about Entropy coefficient variations in 10 districts of Shiraz regarding the population distribution in 2007, 2012 and 2016 (Table 3).

According to the calculations of Entropy model from Table 3, it can be concluded that the second research hypothesis regarding the process of balance distribution of population in Shiraz's districts, was confirmed. Since the Entropy coefficient had decreased from number 1 in 2007 to 0.94 in 2012 and then the Entropy coefficient had increased in 2016 to 0.98 thus had converged to number 1. The more convergence of the Entropy coefficient to number 1, the more equality of the population distribution becomes evident. The main reasons for this can be seen in the implementation of the designed plans by green space and parks organizations of Shiraz city. They mostly include: implementing the project of forestation of 13000 hectares in lands and heights around the city of Shiraz, cultivating everlasting plants

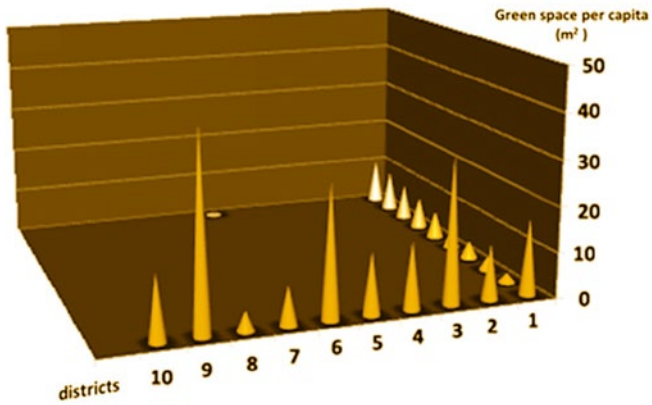

Fig. 4: The difference between shares of green space in 10 districts of Shiraz (authors)

having less need to water, comprehensive system of electronic observation of green space contractors` performance, observing energy consumption through far distance controlling, lightening the parks of Shiraz, producing compost out of plants` residuals in parks and green spaces, designing and implementing the green height of Shiraz, non-chemically solve the problem of calamities and plant disease and weeds, taking preventive actions against the effects of destructive drought in parks, green spaces and gardens of Shiraz and trying to increase the share of green space in Shiraz. Comparing the findings of this study with the previous studies, it is revealed that this study prevailed new results with those of the past. According to statistics available in Shiraz municipality of green space and parks in 2012, Hosseini *et al.* (2013), concluded that not only there was a lack of green space in Shiraz, but also the distribution of green space in 8 districts of it was not balanced. The results of the current study were not in line with them. According to the results of the first hypothesis, after a while and in 2016, the spatial distribution of the share of green space in 10 districts of Shiraz was relatively balanced. The findings of this study were not also in line with those of the Azani and Abbasi (2013). They had concluded that according to Williamson index, there was a strong inequality in green space distribution and population distribution of Shiraz in 1987-2007. While the finding of this study indicated a balance distribution of green space and population based on dispersion and Entropy coefficients during 2007, 2012 and 2016.

CONCLUSION

Green space is one of the dimensions forming the pattern of sustainable development. Besides considering the quality and quantity of its use in cities, its distribution and dispersion is of utmost importance. Since considering this issue, is directly related to social justice and equality in generations. The current research investigated and analyzed the use of green space through urban planning and recognized the way of distribution, lack of green space regarding population and area of each 10 districts in Shiraz. According to the results, the share of green space of these districts in 2016 was averagely 22.1 m^2. So, this amount was more than the standard of housing department and urban development which was among 7-12. It was approximately near and equivalent to the global standard of urban green space which was 20 to 25 m^2 for each individual. The highest urban green space was attributed to districts 9, 3 and 6, respectively. The lowest share of green space, which was even lower than the housing department, was associated to district 8 of Shiraz. Likewise, conducting the Entropy coefficient in 2007, 2012 and 2016 it was revealed that population distribution in districts of Shiraz was balanced in 2007, this amount was a little far from number 1 in 2012 and had converged to number 1 in 2016 which had made it more balanced. All in all, the result of the current research indicated a relative improvement regarding the status of urban green space and balanced distribution of population in Shiraz's different districts, as well as growth planning and its beneficial development by urban managing organizations in time. Moreover, the results showed a considerable lack of share in green space in districts 7 and 8 of Shiraz. Hence, it is suggested to pay attention to the development of green space in these districts in future planning, and urban managers of organizations consider this issue significantly. Furthermore, based on the results of this study, it is recommended to use unutilized and left lands inside the city to expand urban green space and beneficially use them. So, the lack of share of green space in districts is compensated. On the other hand, the results of this research indicated the closeness of the share of green space in Shiraz to the share of global standards. Thus, it is recommended that Shiraz municipality of green space and parks take preventive actions against the destructive effects of draughts in parks and gardens to maintain and improve this condition. According to the results of this research, it is suggested to use mountainous spaces of the north and west-north of Shiraz as mountainous parks. Moreover, preventive legal actions can be considered seriously to prevent the change in the use of green spaces. At the end, it is highlighted that to completely apply the principle of justice, the construction and texture of urban green spaces and parks should be considered and redefined by authorities regarding peoples' gender, nationality, language and general culture.

ACKNOWLEDGMENT

The authors would like to thank all the experts who involved in collecting the data of this research and helped the authors to carry out the manuscript.

CONFLICT OF INTEREST

The author declares that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy have been completely observed by the authors.

REFERENCES

Ajilian Momtaz, Sh.; Naemi, F.; Ghadamghahi, N., (2014). Investigating the importance of green space to reach sustainable development goals. Architecture, urban development and sustainable development conference, Mashhad, Iran. (In Persian).

Akbari, H.; Pomerantz, M.; Taha, H., (2001). Cool surfaces and shade trees to reduce energy use and improve air quality in urban areas. Sol. Energy, 70(3): 295-310 **(16 pages)**.

Alexandri, E.; Jones, P., (2008). Temperature decreases in an urban canyon due to green walls and green roofs in diverse climates. Build. Environ. 43(4): 480-493 **(14 pages)**.

Azani, M.; Abbasi, M., (2013). Investigating the status of green space using Entropy coefficient and Williamson model in the attitude toward sustainable development: a case study of Shiraz city. Geogr. Plan. J., 16(42): 1-22 **(22 pages)**. (In Persian).

Barbosa, O.; Tratalos, J.A.; Armsworth, P.R.; Davies, R.G.; Fuller, R.A.; Johnson, P.; Gaston, K.J., (2007). Who benefits from access to green space? A case study from Sheffield, UK. Landscape Urban Plan. J., 83(2-3): 187-195 **(9 pages)**.

Bartelmus, P., (1994). Environment, growth, and development: The concepts and strategies of sustainability. New York: Routledge.

Bhatta, B., (2009). Analysis of urban growth pattern using remote sensing and GIS: A case study of Kolkata, India. Int J. Remote Sens., 30 (18): 4733–4746 **(14 pages)**.

Bolund, P.; Hunhammar, S., (1999). Ecosystem services in urban areas. Ecol. Econ., 29(2): 293-301 **(9 pages)**.

Cabe S., (2005). Paying for parks: Eight models for funding urban green space. London.

Campbell, S., (1996). Green cities, growing cities, just cities? J. Am. Plan. Assoc., 62(3): 296-312 **(17 pages)**.

Chiesura, A. (2004). The role of urban parks for the sustainable city. Landsc. Urban Plan. 68(1): 129-138 **(10 pages)**.

Cilliers, S.S.; Cilliers, E.J.; Lubbe, C.E.; Siebert, S.J., (2013). Ecosystem services of urban green spaces in African countries - perspectives and challenges. Urban Ecosyst., 16(4): 681-702 **(22 pages)**.

Cilliers, E.J.; Diemont, E.; Stobbelaar, D.J.; Timmermans, W., (2012). Sustainable green urban planning: the workbench spatial quality method. J. Place Manage. Dev., 4(2): 214-224 **(11 pages)**.

Cilliers, E.J.; Timmermans, W., (2014). The importance of creative participatory planning in the public place-making process. Environment and Planning B: Plan. Design, 41(3): 413-429 **(17pages)**.

Elgizawy, E., (2014). The Significance of Urban Green Areas for the Sustainable Community. On Al-Azhar Engineering Thirteenth International Conference, Cairo, Egypt.

Green space Scotland, (2008). Green space and quality of life: a critical literature review. Scotland.

Hansmann, R.; Hug, S.M.; Seeland, K., (2007). Restoration and stress relief through physical activities in forests and parks. Urban Urban Gree., 6(4): 213-225 **(13 pages)**.

Haynes, K.E.; Phillips, F.Y.; Mohrfeld, J.W., (1980). The entropies: Some roots of ambiguity. Socio. Econ. Plan. Sci., 14: 137–145 **(9 pages)**.

Hodgkison, S.; Hero, J.M., (2007). The efficacy of small-scale conservation efforts, as assessed on Australian golf courses. Biol. Conserv., 135(4): 576-586 **(11 pages)**.

Horwood, K., (2011). Green infrastructure: Reconciling urban green space and regional economic development: Lessons learnt from experience in England's North-West Region. Loc. Environ., 16(10): 963-975 **(13 pages)**.

Hosseini, A.; Veysi, R.; Ahmadi, S., (2013). Investigating and analyzing green space of Shiraz city. J. Urban Ecol. Res., 3(5): 51-70 **(20 pages)** (In Persian).

Kazmierczak, A.E.; James, P., (2008). The role of urban green spaces in improving social inclusion. Salford: University of Salford, School of Environment and Life Sciences.

Kiani, V.; Khalilnezhad, M., (2010). Developing urban green space based on earth preparation principles. Nat. Environ. Dev., (1): 19-22 **(4 pages).** (In Persian).

Kuo, F.E., (2003). The role of arboriculture in a healthy social ecology. J. Arboriculture, 29(3): 148-155 **(8 pages)**.

Kuo, F.E.; Sullivan, W.C., (2001). Aggression and violence in the inner city - effects of environment via mental fatigue. Environ. Behav., 33(4): 543-571 **(29 pages)**.

Levent, T. B.; Nijkamp, P., (2004). Urban green space policies: performance and success conditions in European cities. Preliminary vision: 44th European congress of the European regional science association, regions and fiscal federalism, Portugal.

Li, X.; Yeh, A.G., (2004). Analysing spatial restructuring of land use patterns in a fast growing region using remote sensing and GIS. Landsc. Urban Plan., 69: 335–354 **(20 pages)**.

Luttik, J., (2000). The value of trees, water and open space as reflected by house prices in the Netherlands. Landsc. Urban Plan., 48(3-4): 161-167 **(7 pages)**.

Lutzenhisher, M.; Netusil, N.A., (2001). The effect of open spaces on a home's sale price. Contemp. Eco. Pol., 19(3): 291-298 **(8 pages)**.

Maleki, S.; Daman Bagh, S., (2014). Evaluation of sustainable development indexes with emphasis on physical and social indexes and urban services (a case study of Ahvaz city). J. Urban Struct. Funct. Stud., 1(3): 29-54 **(26 pages)**. (In Persian).

Millward, A.; Sabir, S., (2011). Benefits of a forested urban park: What is the value of Allan Gardens to the city of Toronto, Canada? Landsc. Urban Plan. J., 100(3): 177-188 **(12 pages)**.

Mohammadi, J.; Ahmadian, M.; Azadi Ghottar, S., (2012). Analyzing and developing distribution and development on green spaces inside the city (case study: Miandoab City). Urban managing, 10(29): 259-275 **(17 pages)**. (In Persian).

Mohammadi Saran, S., (2014). Economic evaluation of using modern irrigation system in Tabriz parks. The first conference of approaches toward developing green spaces in Tabriz metropolis, Tabriz, Iran. (In Persian)

Motamedi, M.; Shorayi, R.; Dehghanian, A.; Haddad Hassan

Abadi, M., (2013). Evaluating the status of urban green space and comparing it with standard shares (a case study: region 10 of Mashhad). The 4th conference on urban planning and managing, Mashhad, Iran. (In Persian).

Nicol, C.; Blake, R., (2000). Classification and use of open space in the context of increasing urban capacity. Plan. Pract. Res., 15(3): 193-210 **(18 pages)**.

Schipperijn, J.; Stigsdotter, U.K.; Randrup, T.B.; Troelsen, J. (2010). Influences on the Use of Urban Green Space – A Case Study in Odense, Denmark. Urban For. Urban Gree., 9(1): 25-32 **(8 pages)**.

Shannon, C.E., (1948). A mathematical theory of communication. Bell Syst. Tech. J., 27(3): 379-423 **(45 pages)**.

Shourcheh, M., (2012). The role of economic tools in strategic managing of urban sustainable transportation. City Econ., 3(10): 59-72 **(14 pages)**.

Shultz, S.D.; King, D.A., (2001). The Use of census data for hedonic price estimates of open space amenities and land use. J. Real Estate Financ. Econ., 22(2-3), 239-252 **(14 pages)**.

Smith, V.K.; Poulos, C.; Kim, H., (2002). Treating open space as an urban amenity. Resour. Energy Econ., 24(1-2): 107–129 **(23 pages)**.

Stiles, R., (2006). Urban spaces – enhancing the attractiveness and quality of the urban environment. WP3 Joint Strategy. University of Technology, Vienna.

Sudhira, H.S.; Ramachandra, T.V.; Jagadish, K.S., (2004). Urban sprawl: Metrics, dynamics and modeling using GIS. Int. J. Appl. Earth Obs. Geoinf., 5(1): 29–39 **(11 pages)**.

Sutton, C.M., (2006). Urban open space: a case study of Msunduzi Municipality, South Africa. Canada: Queens University. (Thesis – B. SC). School of Environmental Studies. **(139 pages)**.

Swanwick, C.; Dunnett, N.; Woolley, H., (2003). Nature, role and value of green space in towns and cities: an overview. Built Environ. (1978), 29(2): 94-106 **(13 pages)**.

Taylor, A.F.; Kuo, F.E.; Sullivan, W.C., (2002). Views of nature and self-discipline: Evidence from inner city children. J. Environ. Psychol., 22(1-2): 49-63 **(15 pages)**.

Thaiutsa, B.; Puangchit, L.; Kjelgren, R.; Arunpraparut, W., (2008). Urban green space, street tree and heritage large tree assessment in Bangkok, Thailand. Urban For. Urban Gree., 7(3): 219-229 **(11 pages)**.

Ulrich, R.S., (2002). Health benefits of gardens in hospitals. Plants for People International Exhibition Florida, Florida, USA.

Van den Berg, A.; Hartig, T.; Staats, H., (2007). Preference for nature in urbanized societies: stress, restoration, and the pursuit of sustainability. J. Soc. Issues, 63(1): 79-96 **(18 pages)**.

WCED, (1987). Our common future. Word Commission on Environment and Development. London and New York: Oxford University Press.

Zarrabi, A.; Ranjbar, A. (2013). Analyzing the application of urban green space through urban planning techniques in GIS environment (case study: Shiraz 4th region). Environ. Geogr. Plan., 24(4): 135-154 **(20 pages)**. (In Persian).

HOW TO CITE THIS ARTICLE

Sadeghi, A.R.; Khakzand, M.; Dehghani, M.A., (2019). Spatial distribution of urban green spaces using entropy model and coefficient of dispersion. Int. J. Hum. Capital Urban Manage., 4(1): 23-32.

DOI: 10.22034/IJHCUM.2019.01.03

url: http://www.ijhcum.net/article_34802.html