The Contribution of Accessible Urban Greenspace in the Quality of Residents' Life in the Attica Basin - A Spatial Analysis

Koliotsis P. Ts. [1,*] And Papadopoulou M.P.[1]

[1]Laboratory of Physical Geography and Environmental Impacts, School of Rural and Surveying Engineering, National Technical Univesity of Athens (NTUA), 9 Iroon Polytechniou, University Campus, Zografou 15780 GR

*corresponding author

e-mail: panagiotis.koliotsis@gmail.com

Abstract: The current study focuses on the investigation and determination of the accessible urban green spaces in a particular region by exploiting methods of processing and analysis in Geographic Information Systems (GIS) environment. The aim of this study was the analysis of people's access into urban green spaces, using the Accessible Natural Greenspace Standards (ANGSt) Model, assessing the role and the contribution of these areas to the adaptation of climate change, at local level (Attica basin). According to the obtained results, the accessibility of urban green areas is sufficient, covering the largest percentage of Attica basin indicating that the majority of residents have access to urban green spaces.

An adequate existence of green area is as important as the accessibility and the combination of these two indices, among others, can create a more efficient way to evaluate the quality of urban environment for its residents. Finally, ANGSt model allows the comparison of green areas accessibility, within different urban pattern, among different cities and countries. Indicating that the accessibility and the existence of green areas are two independent but complementary indices the combination of which may lead to more accurate results.

Keywords: Accessible Natural Greenspace Standards, Climate Change, Urban Green Area, Geographic Information System, City Resilience

1. Introduction

The intensive urbanization of the 20th century was the major cause of a significant reduction of urban green space (Aravantinos, 1997). The existing green areas are fragmented without creating any urban network. The urban green areas contribute to the improvement of residents' quality of life, particularly when it comes to densely populated cities. The multiple benefits that arise from the green areas' existence in cities are observed to area's microclimate, temperature's adjustment, upgrade of neighborhood's social relations, absorption and filtering of solar radiation, etc. In order to positively contribute to the city's sustainability, an urban green space has to be properly designed. In other words, accessibility of these areas to the city's residents should be provided (Wooley, 2003).

The quality of public urban green space is directly related to the living standards of a resident in a city. Citizens' right to improve the quality of their daily life in the city requires the development of public green spaces. Generally, in Greek Cities, the urban green spaces arise as the surplus of the reconstruction and not as the result of urban planning interventions. Fact that explains the low rates of green per capita, in comparison with other european metropolitan cities.

The term "urban green space" has prevailed to be referred to characterize an area, which is designed during the development process of a city or has evolved to remain free of buildings by hosting any form of vegetation. The urban and suburban green space is a sustainability index of the urban fabric. The contribution of urban green areas to the improvement of residents' quality of life is utterly important, especially in the case of densely populated cities.

Understanding the interdependency of urban space and human life requires a uninterrupted observation and analysis. Nowadays, Geographic Information Systems (GIS) have many applications related to engineering and planning, due to the spatial connection with the descriptive information. With geographic information systems technology, researchers are able to monitor at nature's dynamic changes, using satellite data, in near - real time. GIS are designed to capture, analyze and present spatial data, as well as climate conditions and weather occurrences that take place on the earth's surface (Goodchild, 1985). GIS could easily create updating maps, by updated data that can simply be added to the existing database or map. A GIS database often contains a large variety of data, that do not appear, allowing users to access and analyze this information. Furthermore, the ability of a further spatial analysis and processing of data from different users at different times could be obtained by GIS methods.

2. Climate Change

Nowadays, more and more involvement and awareness of local communities is observed, due to the fact that Climate

Change is considered one of the major problems that threaten people's daily life. According to the United Nations Framework Convention on Climate Change (UNFCCC), Climate Change is defined as the change in climate that is caused directly or indirectly by human activities (United Nations, 1992). The causes of climate change are divided into two main categories: a) the external causes and b) the internal causes. In regard to the external causes, the most important ones are the Milankovitch variations and the solar radiation. As far as the internal causes, the most important are the greenhouse gases emission (GHGs), the changes on earth's surface and land uses - factors directly related to human activities.

The European regions that appear particularly vulnerable to Climate Change are the Southern and the Nothern Europe and the Arctic region. It is therefore required an adaptation plan to increase cities' resilience to Climate Change by taking appropriate measures. The appropriate strategies and measures that are necessary, have to be considered at local, national and european level.

3. Case Study

The wider area of Athens constitutes a self-contained region Attica Basin, where Athens the capital and the most densely populated city of Greece, is located.

During the last century, the urban core of Athens has been developed in Attica Basin, between Penteli, Parnitha, Ymittos, Aigaleo mountains and Saronikos Gulf in the south. In particular, the study area coincides with the Spatial Unity of Athens – Piraeus and it is divided into 5 spatial subsections of:

- Central Athens,
- South Athens,
- North Athens,
- West Athens and
- Piraeus.

The value of urban green space sustainability index is quite low in Attica, due to the fact of the compact urban fabric in relation to the high population density. The urban green areas differ between the Spatial Subsections, and especially between municipalities. Both the network and rate of green area per resident are different, a fact that indicates a different level of life quality standards within the city.

By analyzing the financial profile between the spatial subsections, the higher the financial capacity is, the higher the rate of green space per capita. This is due to the fact that the marital or personal financial status leads to change in the residence within the city, at areas where a better quality of life is provided. In the case of Athens, this fact led to the relocation of the population to the suburbs (Asimakopoulos *et al*, 2011).

4. Methodological Approach

4.1. The Accessible Natural Greenspace Standards Model

Nowadays, the urban planning connects the existence of natural areas, as an integral part of the daily life in urban areas with the term of quality of life. In addition, an introduction of the term accessibility in urban greenspaces, as well as the benefits and contribution in a balanced emotional health of urban residents takes place.

The accessibility to the green space varies from country to country and from city to city. The model Accessible Natural Greenspace Standards (ANGSt) was developed in the early 1990 on the basis of the ability to access natural areas near the urban fabric. The model defines the minimum distance that a resident has to walk towards an urban green space.

The ANGSt model is a tool which has been mainly designed in order to estimate the accessibility to an urban space (Buell, 2009). In this approach, based on an urban greenspace network, ANGSt was classified into following classes where:

- there should be at least one accessible 2ha area within 300m distance,
- there should be at least one accessible 20ha area within 2km distance,
- there should be accessible 100ha area within 5km distance,
- there should be one accessible 500ha area within 10km distance.

Referring to the greenspaces, natural urban green areas and greenways, involve in regions as public parks.

4.2. Methodology Analysis

The analysis was based on reliable and relevant data sources. Their cartographic visualization is obtained, using GIS techniques. In addition, the analysis was based on the spatial location and the peak area, which fuction under the characterization of green public area.

Primiraly, a spatial database in GIS environment has been developed. More specifically, concerning accessibility, the area of accessible urban greenspace, was defined based on an influence zone created around green areas (buffer), which represents the distance of service or access. For example, around an, at least 2 hectares, urban green area a buffer with radius of 300 meters was created. Respectively, around an, at least 20 hectares, green area a buffer with radius of 2 kilometers was created and around an at least 100 hectares, green area, a buffer with radius of 5 kilometers (Figure 1). In order to estimate the residents, who have access to urban green areas, the appropriate data from the Hellenic Statistical Authority and more specifically from population and housing census of 2011, in which the population is related to the postcodes, was analyzed (Hellenic Statistics Authority, 2016). By joining population data and postcodes, a spatial visualization and analysis of the residents, who have the appropriate access to greenspace through the corresponding influence zones, was obtained. Also around an at least 20ha area, for instance, a buffer with radius of 300 meters was also created. This influence zone was created in order to define the population, who is served by these, specific areas, regardless of their extent, by providing access across the whole region within its limits.

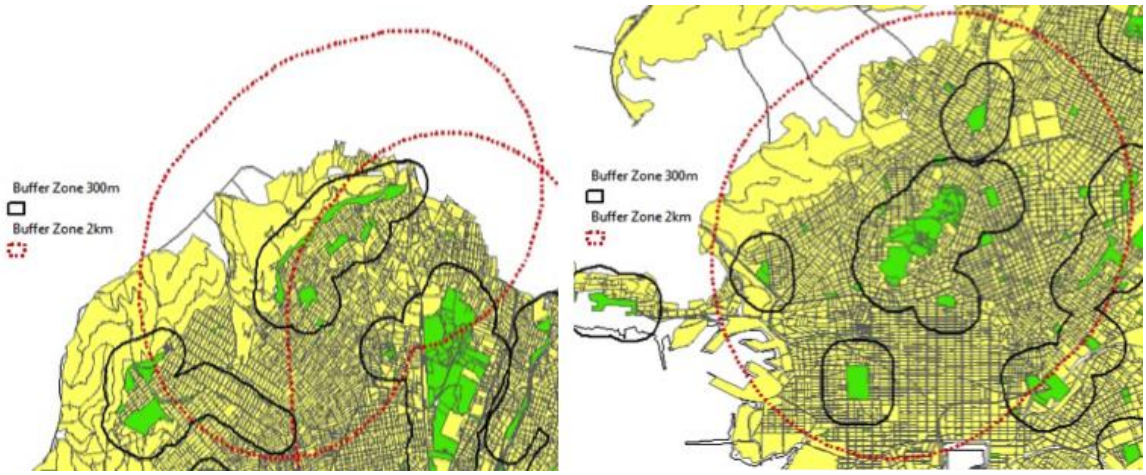

Figure 1. Buffer Zone of 300m within a Buffer Zone of 2km

Table 1. The Accessibility of Urban Green Space in Attica Basin

Spatial Subsections	Population (Census 2011)	Population (based on model)	Population Coverage (%)	Urban Green Space per capita (sqm/ capta)
North Athens	592.490	523.698	88,4	8,30
West Athens	489.675	397.825	81,2	5,48
Central Athens	1.029.520	1.029.520	100	8,25
South Athens	529.826	205.792	38,9	2,93
Piraeus	448.997	342.928	76,4	3,24
Total	**3.090.508**	**2.499.763**	**80,9**	**5,64**

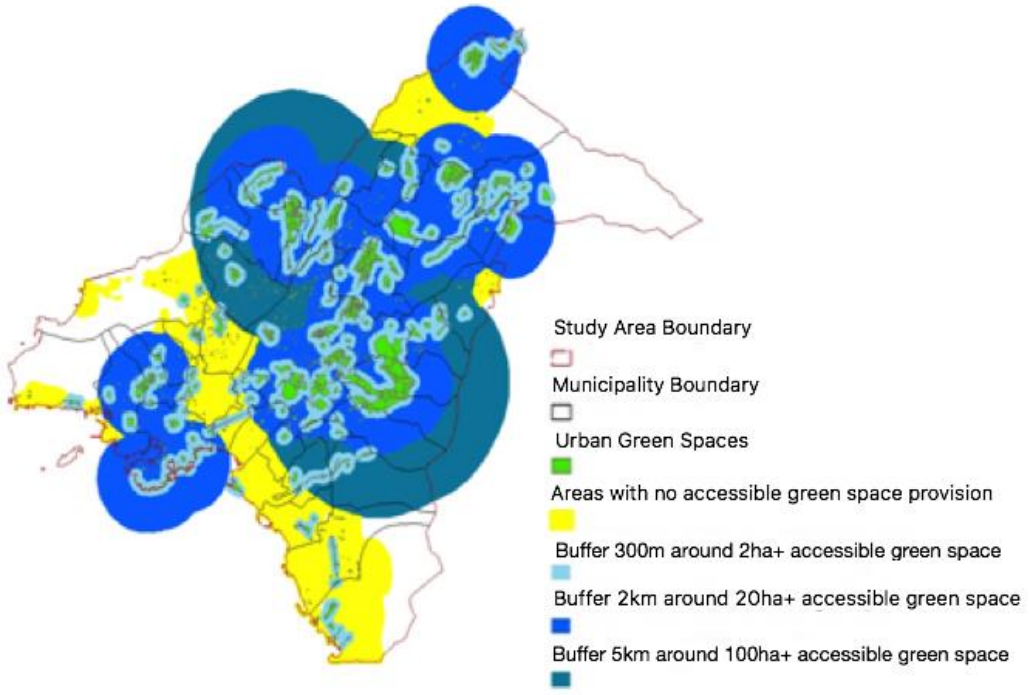

Figure 2. Attica Basin green space accessibility based on ANGSt analysis and classification

Table 2. Summary of the key findings

Spatial Subsections	% of households		
	within 300m of 2ha	within 2km of 20 ha	within 5km of 100 ha
North Athens	33	75	73
West Athens	33	52	73
Central Athens	49	80	100
South Athens	16	2	32
Piraeus	44	58	0
Total	**35**	**53**	**56**

5. Results

In this section the overall accessibility of urban green spaces, which consists of the union of three mentioned categories (2ha, 20ha, 100ha) is presented. In Attica basin, green space with an area of 500 hectares or more is not considered and as a result, in the analysis it was not taken into account. İn Table 1 the total population (Census 2011); the population which is covered by the accessible green space; the percentage population coverage and the index of urban green space per capita, at the spatial subsections are summarised.

The spatial subsection of Central Athens is entirely covered by urban green space areas, due to the existence of significant groves or non-built hills. The spatial subsections of North and West Athens are in the second and third place, respectively. Apart from the existence of urban green areas, the close proximity of the built fabric among these three spatial subsections, as well as the short distance of the existing urban green spaces are the main reasons that lead to these proportions of accessibility. In coastal area of Attica (e.g. South Athens), significant urban green spaces do not exist, except in spatial subsection of Piraeus, due to the long distance of the built fabric from the Attica's basin "green" core. The same trend is followed by the index of the green space per capita, index that is derived from the General Urban Plan of each municipality.

In Figure 2, the limits of accessible urban green spaces per class is shown. According to the extracted data of accessible limits, the limit of 2 hectares area within 300 meters, means that almost none of the households have m*et al*l of their ANGSt requirements. In addition, regarding to spatial subsections of Central, North and West Athens, too, most households are covered by accessible urban green spaces, with an area of 20 and 100 hectares, that are mainly located in Central Athens and not in a wider network of greenways. The same pattern is followed by the spatial subsection of Piraeus, with a lower presence of corresponding green areas. Finally, with regard to spatial subsection of South Athens only small scale green areas occured and as a result the accessibility rate is very low.

Among the key findings of the analysis are that 19% of residents in the Attica basin does not satisfy ANGSt requirements, compared to the 23% of them, that satisfies all ANGSt requirements. The Spatial Subsection of Central Athens has the better coverage among all size classes.

It is remarkable that the population coverage and the extent of urban green areas are not accordingly increasing (Table 2). This is due to the spatial allocation of urban green areas. In other words, the accessibility is independent of administrative boundaries and it only depends on the size and spatial extend of urban green areas. Fact that explains, for instance in South Athens, the significant reduction in the population coverage of 20ha areas compared to corresponding coverage of 2ha areas.

6. Conclusions

The present analysis highlighted the provision of accessible urban green space within Attica Basin, according to the Accessible Natural Greenspace Standards (ANGSt). Subsequently, based on the whole analysis and the produced data, the estimation of accessible urban green area was held, leading to the conclusion about people's ability to have daily access to a natural green network. According to the obtained results, the accessibility of urban green areas is sufficient, covering the largest percentage of Attica Basin indicating that the majority of residents have access to urban green spaces.

The term accessibility is inadequately understood and the concept should be better promoted, in order to be upport actions by local authorities to improve the accessibility and the daily interplay between residents and the green areas. In spite of the satisfied accessibility that is observed, the percentage of green area per resident of Attica is quite low compared to other European capitals. Indicating that an adequate existence of green area is as important as the accessibility and the combination of these two indices, among others, can create a more efficient way to evaluate the quality of urban environment in city level. In addition, the spatial distribution of urban green spaces not only affect the accessibility of households in the spatial subsections, where they belong in, depending on the area that are occupied, but also the neighboring ones.

In addition, the ANGSt comprise a reliable, useful and effective tool, to assess the current levels of accessibility and plan for the future. ANGSt model allows the comparison of green areas accessibility, within different urban pattern, among different cities and countries providing a standard through which accessible green areas can be evaluated and, where necessary, improved.

Finally, GIS proved to be an useful spatial analysis tool to map and visualize spatial data which is associated both with the assessment of accessibility and spatial distribution of urban green areas.

References

Aravantinos A. (1997), Urban Planning: For the Sustainable Development of Urban Space, *Symmetria*, Athens.

Asimakopoulos D., Santamouris M., Farrou I., Laskari M., Saliari M., Zanis G., Tigas K., Giannakidis G. (2011), Risks and impacts of climate change on the built environment, *Bank of Greece*, Athens.

Buell S. (2009), Analysis of Accessible Natural GreenSpace Provision for Essex, including Southend- on- Sea and Thurrock Unitary Authorities, *Essex Wildlife Trust*, England.

Hellenic Statistics Authority (2016), http://www.statistics.gr (last access 10/10/2016)

Goodchild M. F., (1985), Geographic Information Systems in Undergraduate Geography: A Contemporary Dilemma, **8**, 34-38.

Santamouris M., Papanikolaou N., Livada I., Koronakis I., Georgakis C., Argiriou A., Assimakopoulos D., (2001), On the impact of urban climate on the energy consumption of buildings, *Solar Energy*, **70**, 201-216.

Wooley H., (2003), Urban Open Spaces, *Spon Press*, London.