

TeMA

Journal of
Land Use, Mobility and Environment

There are a number of different future-city visions being developed around the world at the moment: one of them is Smart Cities: ICT and big data availability may contribute to better understand and plan the city, improving efficiency, equity and quality of life. But these visions of utopia need an urgent reality check: this is one of the future challenges that Smart Cities have to face.

Tema is the Journal of Land use, Mobility and Environment and offers papers with a unified approach to planning and mobility. TeMA Journal has also received the Sparc Europe Seal of Open Access Journals released by Scholarly Publishing and Academic Resources Coalition (SPARC Europe) and the Directory of Open Access Journals (DOAJ).



METHODS, TOOLS AND BEST PRACTICES TO INCREASE THE CAPACITY OF URBAN SYSTEMS TO ADAPT TO NATURAL AND MAN-MADE CHANGES

METHODS, TOOLS AND BEST PRACTICES TO INCREASE THE CAPACITY OF URBAN SYSTEMS TO ADAPT TO NATURAL AND MAN-MADE CHANGES

1 (2017)

Published by

Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"

TeMA is realized by CAB - Center for Libraries at "Federico II" University of Naples using Open Journal System

Editor-in-chief: Rocco Papa
print ISSN 1970-9889 | on line ISSN 1970-9870
Licence: Cancelleria del Tribunale di Napoli, n° 6 of 29/01/2008

Editorial correspondence

Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"
Piazzale Tecchio, 80
80125 Naples
web: www.tema.unina.it
e-mail: redazione.tema@unina.it

Cover Image: Ferryland Newfoundland, Canada, Jody Martin

TeMA. Journal of Land Use, Mobility and Environment offers researches, applications and contributions with a unified approach to planning and mobility and publishes original inter-disciplinary papers on the interaction of transport, land use and environment. Domains include: engineering, planning, modeling, behavior, economics, geography, regional science, sociology, architecture and design, network science and complex systems.

The Italian *National Agency for the Evaluation of Universities and Research Institutes* (ANVUR) classified TeMA as scientific journal in the Area 08. TeMA has also received the *Sparc Europe Seal for Open Access Journals* released by *Scholarly Publishing and Academic Resources Coalition* (SPARC Europe) and the *Directory of Open Access Journals* (DOAJ). TeMA is published under a Creative Commons Attribution 3.0 License and is blind peer reviewed at least by two referees selected among high-profile scientists. TeMA has been published since 2007 and is indexed in the main bibliographical databases and it is present in the catalogues of hundreds of academic and research libraries worldwide.

EDITOR IN-CHIEF

Rocco Papa, University of Naples Federico II, Italy

EDITORIAL ADVISORY BOARD

Mir Ali, University of Illinois, USA

Luca Bertolini, University of Amsterdam, Netherlands

Luuk Boelens, Ghent University, Belgium

Dino Borri, Polytechnic University of Bari, Italy

Enrique Calderon, Polytechnic University of Madrid, Spain

Roberto Camagni, Polytechnic University of Milan, Italy

Derrick De Kerckhove, University of Toronto, Canada

Mark Deakin, Edinburgh Napier University, Scotland

Aharon Kellerman, University of Haifa, Israel

Nicos Komninos, Aristotle University of Thessaloniki, Greece

David Matthew Levinson, University of Minnesota, USA

Paolo Malanima, Magna Græcia University of Catanzaro, Italy

Agostino Nuzzolo, Tor Vergata University of Rome, Italy

Rocco Papa, University of Naples Federico II, Italy

Serge Salat, Urban Morphology and Complex Systems Institute, France

Mattheos Santamouris, National Kapodistrian University of Athens, Greece

Ali Soltani, Shiraz University, Iran

ASSOCIATE EDITORS

Rosaria Battarra, National Research Council Institute of Studies on Mediterranean Societies, Italy

Luigi dell'Olio, University of Cantabria, Spain

Romano Fistola, University of Sannio, Italy

Carmela Gargiulo, University of Naples Federico II, Italy

Thomas Hartmann, Utrecht University, Netherlands

Markus Hesse, University of Luxemburg, Luxemburg

Seda Kundak, Technical University of Istanbul, Turkey

Rosa Anna La Rocca, University of Naples Federico II, Italy

Houshmand Ebrahimpour Masoumi, Technical University of Berlin, Germany

Giuseppe Mazzeo, National Research Council Institute of Studies on Mediterranean Societies, Italy

Nicola Morelli, Aalborg University, Denmark

Enrica Papa, University of Westminster, United Kingdom

Dorina Pojani, University of Queensland, Australia

Floriana Zucaro, University of Naples Federico II, Italy

EDITORIAL STAFF

Gennaro Angiello, PhD student at University of Naples Federico II, Italy

Gerardo Carpentieri, PhD student at University of Naples Federico II, Italy

Stefano Franco, PhD student at Luiss University Rome, Italy

Marco Raimondo, Engineer, University of Sannio, Italy

Laura Russo, PhD student at University of Naples Federico II, Italy

Maria Rosa Tremitera, PhD student at University of Naples Federico II, Italy

Andrea Tulisi, PhD at Second University of Naples, Italy

METHODS, TOOLS AND BEST PRACTICES TO INCREASE THE CAPACITY OF URBAN SYSTEMS TO ADAPT TO NATURAL AND MAN-MADE CHANGES

1 (2017)

Contents

- 3** EDITORIAL PREFACE
Rocco Papa

FOCUS

- 5** **Conurbations and resilience. When growth makes us fragile**
Valerio Cutini

- 25** **The water sensitive future of Lahijan. Public spaces as integrated components of stormwater management infrastructure**
Masoumeh Mirsafa

LAND USE, MOBILITY AND ENVIRONMENT

- 41** **The effectiveness of urban green spaces and socio-cultural facilities**
Mehmet Faruk Altunkasa, Süha Berberoğlu, Cengiz Uslu, Halil Duymuş

- 57** **Planning assignments of the Italian metropolitan cities. Early trends**
Giuseppe Mazzeo

- 77** **Shortcomings to smart city planning and development. Exploring patterns and relationships**
Margarita Angelidou

95 **Active transport to school and children's body weight. A systematic review**
Houshmand E. Masoumi

111 **REVIEW PAGES**
Gennaro Angiello, Gerardo Carpentieri,
Maria Rosa Tremiterra, Laura Russo, Andrea Tulisi

TeMA

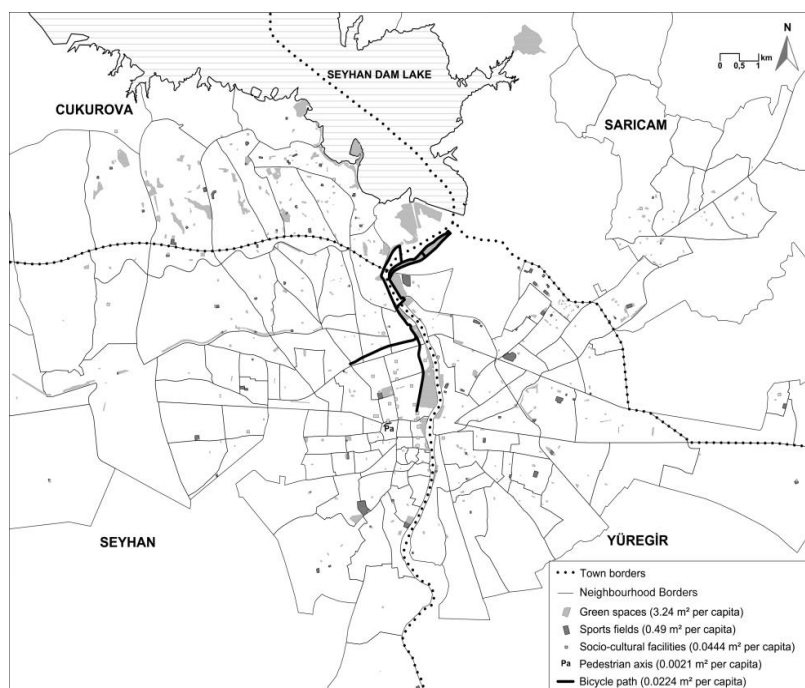
Journal of
Land Use, Mobility and Environment

TeMA 1 (2017) 41-56
print ISSN 1970-9889, e- ISSN 1970-9870
doi: 10.6092/1970-9870/4087

review paper received 01 February 2017, accepted 20 March 2017
Licensed under the Creative Commons Attribution – Non Commercial License 3.0
www.tema.unina.it

How to cite item in APA format:

Altunkasa M. F., Berberoğlu, S., Uslu, C., Duymuş, H. (2017). The effectiveness of urban green spaces and socio-cultural facilities. *Tema. Journal of Land Use, Mobility and Environment*, 10 (1), 41-56. doi: <http://dx.doi.org/10.6092/1970-9870/4087>



THE EFFECTIVENESS OF URBAN GREEN SPACES AND SOCIO-CULTURAL FACILITIES

MEHMET FARUK ALTUNKASA^a, SÜHA BERBEROĞLU^b,
CENGİZ USLU^c, HALİL DUYMUŞ^d

^{a, c, d} Çukurova University, Department of Landscape Architecture
e-mail: ^afaltun@cu.edu.tr, ^ccuslu@cu.edu.tr, ^dhduymus@cu.edu.tr

^b Çukurova University, Department of Remote Sensing and
Geographic Information System
e-mail: ^bsuha@cu.edu.tr

ABSTRACT

This paper aims to develop a theoretical approach for mapping and determining the effectiveness of green spaces and socio-cultural facilities as providers of urban ecosystem services and urban services in the case of Adana, Turkey. Firstly, green spaces and socio-cultural facilities per capita have been determined and indexed for the neighbourhoods in the city. Then, a distance-based method for estimating the effectiveness of these facilities was used. The distances between the various neighbourhoods and between a given facility and the farthest threshold have been measured and these values have been used to determine the facility effectiveness change value for each neighbourhood. Then, effective values have been calculated and indexed by incorporating the green space and socio-cultural facility values and the effectiveness change values for the neighbourhoods. Finally, point-based effective green spaces and socio-cultural facilities index values have been converted to continuous surface values in a GIS (geographic information system) environment in order to utilize as a base map for urban physical planning purposes. According to the outcomes of this study, the distribution of green spaces and socio-cultural facilities of the neighbourhoods are imbalanced and index values of these facilities range in between 45 and 84 out of 100.

KEYWORDS:

Effectiveness Change Value; GIS; Index Map; Index Value; Socio-Cultural Facilities; Urban Green Spaces

TeMA

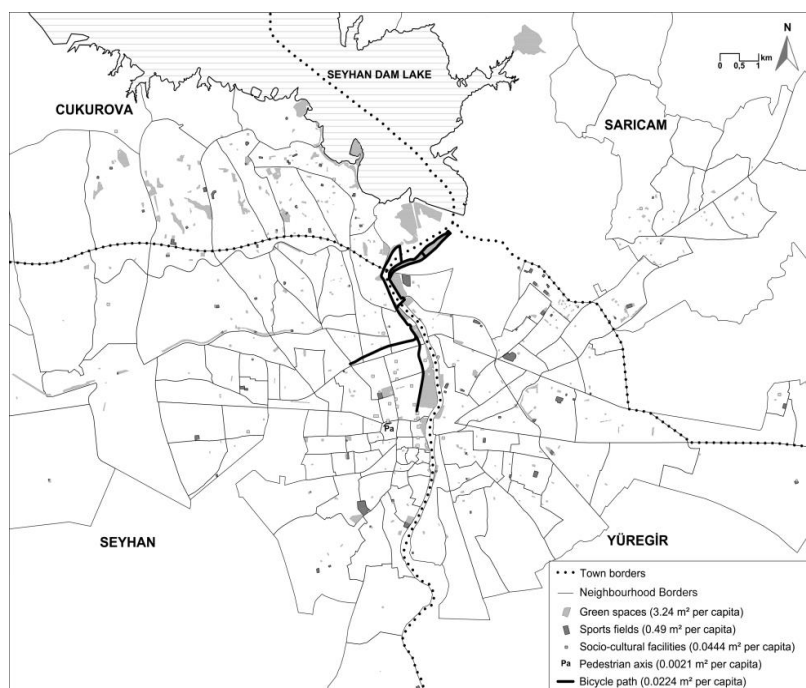
有关土地使用、交通和环境的杂志

TeMA 1 (2017) 41-56
print ISSN 1970-9889, e- ISSN 1970-9870
doi: 10.6092/1970-9870/4087

review paper received 01 February 2017, accepted 20 March 2017
Licensed under the Creative Commons Attribution – Non Commercial License 3.0
www.tema.unina.it

How to cite item in APA format:

Altunkasa M. F., Berberoğlu, S., Uslu, C., Duymuş, H. (2017). The effectiveness of urban green spaces and socio-cultural facilities. *Tema. Journal of Land Use, Mobility and Environment*, 10 (1), 41-56. doi: <http://dx.doi.org/10.6092/1970-9870/4087>



城市绿色空间与社会文化设施的效益

MEHMET FARUK ALTUNKASA^a, SÜHA BERBEROĞLU^b,
CENGİZ USLU^c, HALİL DUYMUŞ^d

^{a, c, d} Çukurova University, Department of Landscape Architecture
e-mail: ^a faltun@cu.edu.tr, ^c cuslu@cu.edu.tr, ^d hduymus@cu.edu.tr

^b Çukurova University, Department of Remote Sensing and
Geographic Information System
e-mail: ^b suha@cu.edu.tr

摘要

本文旨在建立一种理论方法，帮助土耳其阿达纳的城市生态系统服务和城市服务提供商设计并确定绿色空间与社会文化设施的效益。首先，为城市社区确定了人均绿色空间和社会文化设施并进行了指数化处理。然后，采用基于距离的方法对这些设施的效益进行了评估。对不同社区之间的距离和给定设施之间的距离以及最远的阈值进行了测量，这些测量值已被用来确定各个社区的设施效益变化值。然后，通过合并绿色空间和社会文化设施的价值以及社区的效益变化值计算出了有效值，并进行了指数化处理。最后，基于分数的有效绿色空间和社会文化设施的指数值被转换为GIS（地理信息系统）环境中连续的表面值，以使用作城市实体规划的基图。根据本研究的结果，社区的绿色空间和社会文化设施的分布并不平衡，这些设施的指数值范围介于45和84之间（满分100）。

关键词：

效益变化值；GIS；指数图；指数值；社会文化设施；城市绿色空间。

1 INTRODUCTION

Quality of urban life is quantified by the physical, social and economic characteristics of the urban environment and its inhabitants. Social and economic characteristics are excluded from this research, which focuses on green spaces and socio-cultural facilities although physical characteristics do include components of urban systems.

Urban systems are traditionally able to deliver services for the fulfilment of human needs via the provision of urban services, which are defined as public services and facilities that are historically and typically provided in cities. Urban services are provided by society, generally without the direct use of ecosystems, and include basic provisions such as sanitary sewer systems, Storm drainage systems, domestic water systems, fire and police protection services, public transit services, road construction services, sidewalks, street and road lighting systems, parks and recreational facilities, schools, social and cultural facilities, public health and environmental protection, and so on (Antognelli & Vizzari, 2016). These areas, particularly urban green spaces as providers of urban ecosystem services (e.g., air purification, groundwater recharge, erosion prevention, crop or biomass production), are of great importance for urban aesthetics, culture and recreation as well as, for harmonizing green areas, urban structure and urban ecosystems (Baycan-Levent & Nijkamp 2009; Gomez et al. 2011; Haq 2011; Coolen & Meesters, 2012). The diversity and richness of these areas and spaces contribute to the physical and mental health of urban inhabitants. Additionally, it improves social networks, solidarity, spatial identity and urban culture by enabling various social activities of urban inhabitants (Cohen 1996; Gangloff 1995; Kotler et al. 1997; Bolund & Hunhammar 1999; Madanipour 1999; Willis et al. 2001; Jim 2004; Kabisch & Haase 2013).

The presence of green spaces and socio-cultural facilities in a city can be expressed either qualitatively (e.g., high, medium, low or sufficient, medium sufficient, insufficient) or quantitatively (e.g., total and per capita amount). However, urban life has many components (income and education, housing type and quality, urban green space etc.) and the description of these components with a single criterion is an important constraint. Therefore, creating a common single unit is essential in order to compare and combine all these components and to obtain a life quality value. The index value, as a measurement unit, defines a system both as a whole and by pieces and is an important tool to solve this constraint. The Human Development Index (HDI), Index of Sustainable Economic Welfare (ISEW), Recreation Opportunity Index (ROI), Perceived Quality Index (PQI), Green Index, and Open Space Index (OSI) are some of the indices that define social, economic or physical life quality of the public.

Another question is to decide which values to index for the studied characteristics. Green spaces and socio-cultural facilities are defined by the area (m²) per capita. For example, per capita standards in Turkey are as follows: total 2.5 m² for libraries, museums, theatres and concert halls, cinemas and exhibition places; total 2 m² for pedestrian and bicycle path widths total 20 m² for picnic areas, arboretums, woodland; 20 m² for urban parks; 10 m² for community parks; 8 m² for neighbourhood parks; 6 m² for playgrounds; 8 m² for sports fields; and 0.075 m² for swimming pools (Gurbuz 2012).

This figure is inadequate in evaluating the effectiveness of these areas, the spatial distribution of which may be unbalanced. Some parts of the city may have facilities with high levels of opportunities and diversity, whereas other parts may have poor levels of the same. In such a case, the inhabitants living in areas with poor facilities will tend to use facilities at adjacent neighbourhoods, in which case the use of such facilities will be overloaded by the other users from outside of the neighbourhood. As a result of this over-use, the effectiveness of these facilities will be diminished. The distances of facilities to people's homes should be incorporated with indices calculated on per capita values to create employable indices within urban plans. Integrated index values calculated for each neighbourhood will define the effective supply of green spaces and socio-cultural facilities in a city (English & Cordell 1993; Marcouiller et al. 2009).

Integrated index values indicate urban areas and effective facility levels of the neighbourhoods included in the study. These indices need to be mapped in order to be integrated into the planning process properly. Thus the effectiveness of the facilities in each part of the city will be determined easily through this map. The most important function of these maps are their ability to facilitate a decision support system for the planning and application process of green spaces and socio-cultural facilities which are well balanced with the needs of urban areas.

This study aims to test the application of a theoretical approach for mapping and determination of the effective supply of green spaces and socio-cultural facilities in the example of Adana City, the 5th largest city in Turkey. In the first phase of the study, 16 facility types have been indexed and the average per capita has been calculated for city and neighbourhood scales. These values have been combined with effectiveness change values as a result of the calculated distances to homes and re-indexed to determine the effective supply of the 16 facilities (urban park, community park, neighbourhood park, playground, sports field, swimming pool, picnic area, arboretum, woodland, pedestrian axis, bicycle path, library, museum, theatre and concert hall, cinema, exhibition place). In the second phase, index values have been interpolated within a GIS environment to create contours. As a result of this work a baseline map was created for urban planning.

It can be concluded that the distribution of green spaces and socio-cultural facilities are unbalanced, which diminishes the effectiveness of facilities in the neighbourhoods studied.

2 MATERIALS AND METHODS

2.1 STUDY AREA

Adana, as the 5th largest city in Turkey, is also the centre of the Çukurova Metropolitan area. Agriculture and agricultural industry is developed within the region as it is largely covered with the most fertile soils in the country. This development creates a large employment capacity which results in migration from the countryside to the city. Thus, the population increased from 500,000 to 1,700,000 in between 1980 and 2015. Housing needs of this population were prioritized in the urban development plans of 1990-2010. However, green spaces, recreational and socio-cultural facilities were not developed sufficiently and green area per capita decreased inversely with the population increase. On the other hand, the ecological potential of the city offers great opportunities for the establishment of these facilities. When compared with the other parts of the country, the cities inhabitants spend longer periods doing outdoor activities due to the location of the city in the Mediterranean region, which is characterised by mild and rainy winters and hot summers. The city has a mostly flat topography. Seyhan River, which crosses the city, and Seyhan Dam Lake, located in the northern area of the city, offer great potential for recreational activities. The utilization of all of this potential in the development of green spaces and socio-cultural facilities will increase the quality of urban life in many ways (Berberoğlu et al. 2000; Altunkasa & Uslu 2004; Uslu et al. 2012; Adana Urban Council, 2015).

A new law in Turkey was introduced in 2008 to share the authorization and responsibilities of the municipalities with town administrations. As a result of this, urban development plans are approved by representatives of town municipalities together with the city council, thus authorization and responsibilities are shared amongst municipalities. In this respect, Adana city has been divided into four towns, namely Çukurova, Sarıçam, Seyhan and Yüreğir by the borders of the Seyhan River and the main irrigation channel. These towns include 146 neighbourhoods (Çukurova: 14; Sarıçam: 19; Seyhan: 74; Yüreğir: 39). The populations in 2014 were 330,000, 110,000, 840,000 and 420,000, respectively, for Çukurova, Sarıçam, Seyhan and Yüreğir (Uslu et al. 2012; Adana Urban Council 2015).

2.2 METHODS

Socio-cultural facilities are well developed in Seyhan, which covers the old city centre and surrounding urban development area, and in Çukurova which is a new urban development area. Rural and agricultural life style is still dominant in Sarıçam and Yüreğir where the population consists of immigrants from other parts of Turkey.

The study is implemented in four stages:

I Calculating green spaces and socio-cultural facilities index (*GSSF*)

In this phase, 16 facilities within the four towns and 146 neighbourhoods have been converted to area per capita by using city and town municipality inventory reports, aerial photos and ground truth. Herein, different populations have been used for each facility according to its service characteristics: city population for urban parks, arboretums and museums; town population for community parks, picnic areas, woodlands, libraries, theatres and concert halls, cinemas, exhibition places, pedestrian and bicycle paths; and neighbourhood population for other facilities have been used to calculate area per capita. The highest possible value is assumed to be 100 for each facility and other values have been calculated relative to this value. Thus, unweighted index values (*UIV*) for each facility have been derived from the neighbourhoods of the four towns. The priority level of each facility is a crucial question. Gold (1980), English & Cordell (1993), Dunnett et al. (2002) and Gilliland et al. (2006) emphasized that considering all planning units equally may cause misleading results. Thus, the *UIVs* for each facility have been weighted. Gold (1980) points out that a planning process without the contribution of decision makers, planners and users will not progress well. Having considered this fact, weights ranging between 1 and 10 have been assigned by 20 decision makers, 20 planners and 600 randomly selected users. Planners consist of city planners, architects and landscape architects employed in Çukurova University, each having a PhD degree. The total number of these staff was 20 during the implementation period of this research. Decision makers are composed of four members from each metropolitan municipality and four town administrations. This composition enabled a good balance between the two groups. The user survey was implemented using 600 people based on the sampling size recommended by Arkin and Colton (minimum 400 users for settlements with a population of over 100,000) (Pulido 1972). One hundred and fifty randomly selected users over 18 years of age from each town area (total 600 users) have been interviewed face to face, 46 of whom were discharged due to inconsistencies and protests in their answers.

It has been observed that weight values vary between 1-3, 1-5, -3-3, 1-6, 1-10, 1-100 in the literature. Gold (1980) and Giles-Corti et al. (2005) emphasise that the range of weight values may be small if the elements under evaluation are similar in terms of concept, whereas the range of weights should be large for elements with large number and diversity in order to increase discrimination. This research maintains weight values of between 1 and 10 for the 16 different facilities.

Another constraint is that the three actors in the planning progress have different aims and objectives. Gold (1980) points out that political pressures may affect the behaviour of decision makers. They are expected to make investments in the short term, using small budgets to maximum benefit as they have limited time. However, planners aim to reach maximum benefit for the public through a more systematic approach. On the other hand, users seek maximum benefit with minimum willingness to pay. As a result of these differences, the three actors should have different weights for the planning process. The average weight values of planners, users and decision makers have been multiplied by coefficients of 3, 2 and 1, respectively, as suggested by Gold (1980). Weighted scores (*WS_i*) of each facility have been calculated by averaging the weighted values. Weighted index values (*WIV*) for each facility have been calculated by multiplying the *WS_i* with the *UIV*. Values for the green spaces and socio-cultural facilities (*GSSA*) for each neighbourhood have been calculated by

averaging weighted index values and scaled between 0 and 100. Consequently, a green spaces and socio-cultural facilities index (*GSSF*) of the 16 facilities for the 146 neighbourhoods has been derived.

II Calculating effectiveness change (*EC*) values

calculating effectiveness change (*EC*) values: English & Cordell (1993), English et al. (1993), Coles & Caserio (2003), Giles-Corti et al. (2005), Stahle (2010) and Peschardt et al. (2012) point out that the effectiveness of facilities is assumed to change linearly with distance. This change in effectiveness describes the relationship between two different spatial distances (D_{xy} and TD_i) with the following definitions:

D_{xy} = the linear distance between the centres of any two neighbourhoods x and y ,

TD_i = the longest linear distance between facility i and the threshold regardless of the boundaries of neighbourhoods.

D_{xy} and TD_i values were derived using digital aerial photos of the city within a GIS environment. Measured TD_i values for each of the 16 facilities have been weighted through multiplying by the WS_i and a weighted average of the obtained values have been used to form the integrated threshold distance (*ITD*) values.

EC_{xy} value for green spaces and socio-cultural facilities of any two interacting neighbourhoods (x and y) have been calculated using a modified version of the method of English and Cordell (1993) described below:

$$EC_{xy} = 1 - (D_{xy}/ITD) \text{ if } D_{xy} < ITD$$

$$EC_{xy} = 0 \text{ if } D_{xy} > ITD$$

III Calculating effective green spaces and socio-cultural facilities index (*EGSSF*) values

The *EGSSF_x* value for any neighbourhood x depends on the *GSSF_y* value of neighbourhood y and the relation between the EC_{xy} values of two neighbourhoods and this relationship is described as (English & Cordell 1993; English et al. 1993):

$$EGSSF_x = \frac{\sum_{y=1}^n (GSSF_y * EC_{xy})}{\sum_{y=1}^n EC_{xy}}$$

$n = 146$ neighbourhoods.

For any neighbourhood, the most important determinants of the *EGSSF* value are green spaces and socio-cultural facilities available in that neighbourhood. Proximity to a neighbourhood with good opportunities may greatly augment the effective supply. Similarly, proximity to other neighbourhoods with large population concentrations and few opportunities will reduce the effective green spaces and socio-cultural facilities when these competing populations are taken into account. Small neighbourhoods have larger adjustments due to surrounding ones because of the greater effectiveness changes associated with the surrounding neighbourhoods (English & Cordell 1993; Van Herzele & Wiedemann 2003; Germann-Chiari & Seeland 2004; Schipperijn et al. 2010; Stahle 2010; Yildiz et al. 2011; Kabisch & Haase 2014).

A flowchart summarizing all of the steps described above, as well as each of the acronyms, is provided in Figure 1.

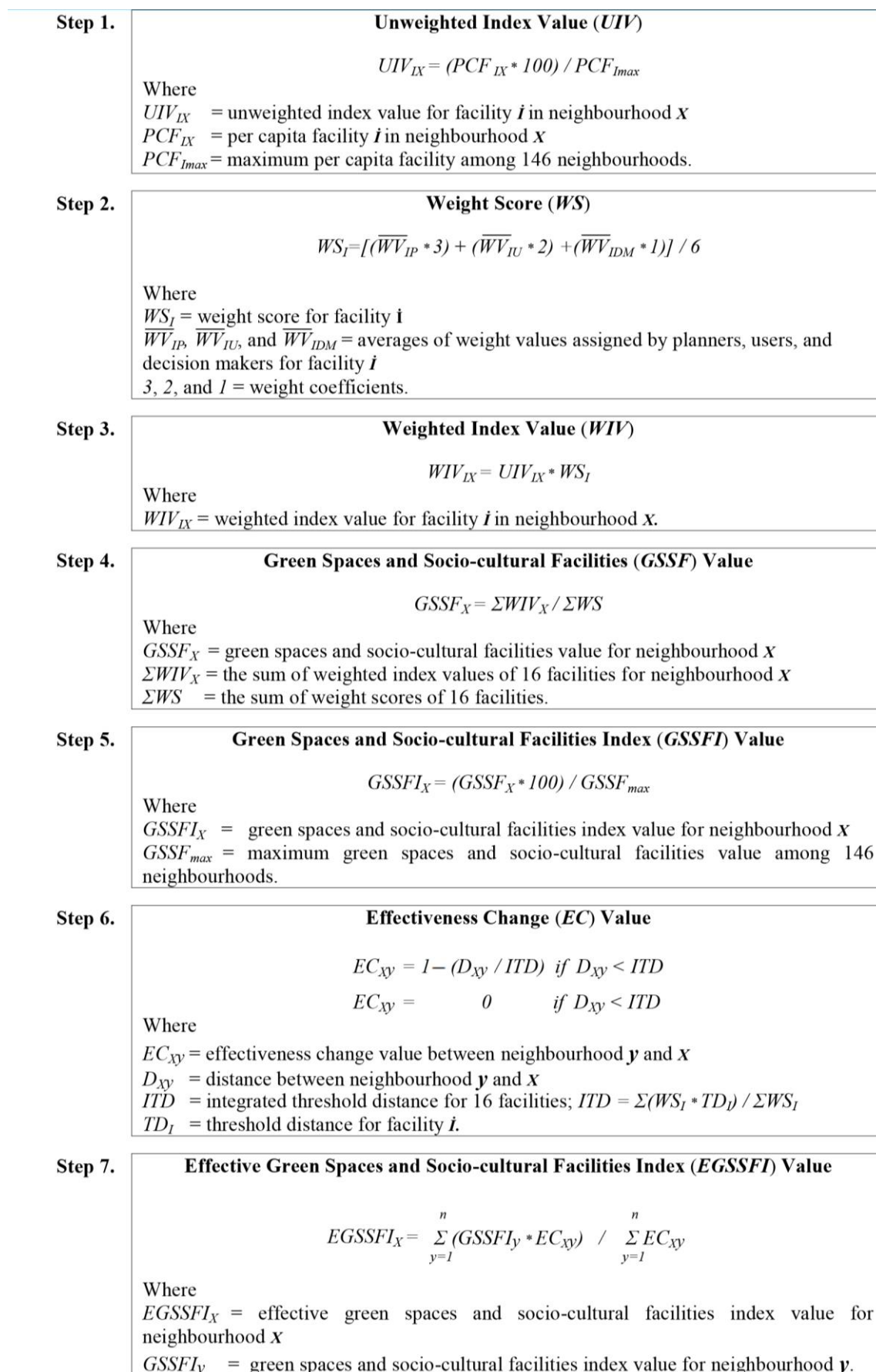


Fig. 1 Flowchart for calculating EGSSFI values.

IV Mapping *EGSSFI* values

mapping *EGSSFI* values: The *EGSSFI* values of the 146 neighbourhoods describe the effectiveness of green spaces and socio-cultural facilities, however, these values are not spatial. In other words, the *EGSSFI* value of a neighbourhood represents the whole neighbourhood. However, the *EGSSFI* values may vary with distance over the area. In such a situation, determining *EGSSFI* values over the city regardless of neighbourhood boundaries would be a more appropriate approach. Converting *EGSSFI* values to contours on a map will enable planners to evaluate the spatial distribution of this index. This approach is implemented in a GIS environment by interpolating point values of *EGSSFI* onto contours. To that end, digital aerial photographs are used as raw data, with a requirement for georeferencing with ground coordinates. This process has been performed by resampling the photographs into a Universal Transverse Mercator (UTM) projection system using ERDAS Imagine 9.1 software. Following the geometric registration, the central pixels of each neighbourhood have been determined and *EGSSFI* values have been assigned. In the final stage, these values have been interpolated using inverse distance weighting (*IDW*) to produce the effective green spaces and socio-cultural facilities index map. The distribution of *EGSSFI* values occurred in a large range (45-85), thus creation of contours for each value might cause difficulties in interpretation, which decreases the practical use in the physical planning process. For this reason, *EGSSFI* values were grouped into 8 classes (45.0-50.0; 50.1-55.0; 55.1-60.0; 60.1-65.0; 65.1-70.0; 70.1-75.0; 75.1-80.0; 80.1-85.0) and these classes were integrated into the map. *EGSSFI* values can be considered to be an important tool in the making of development plans for a particular location in terms of the levels of green spaces and socio-cultural facilities across the city.

3 RESULTS

The spatial distribution of green spaces and socio-cultural facilities which have been derived from Adana metropolitan and town municipalities' inventory reports, development plans and digital air photographs is shown in Figure 2.

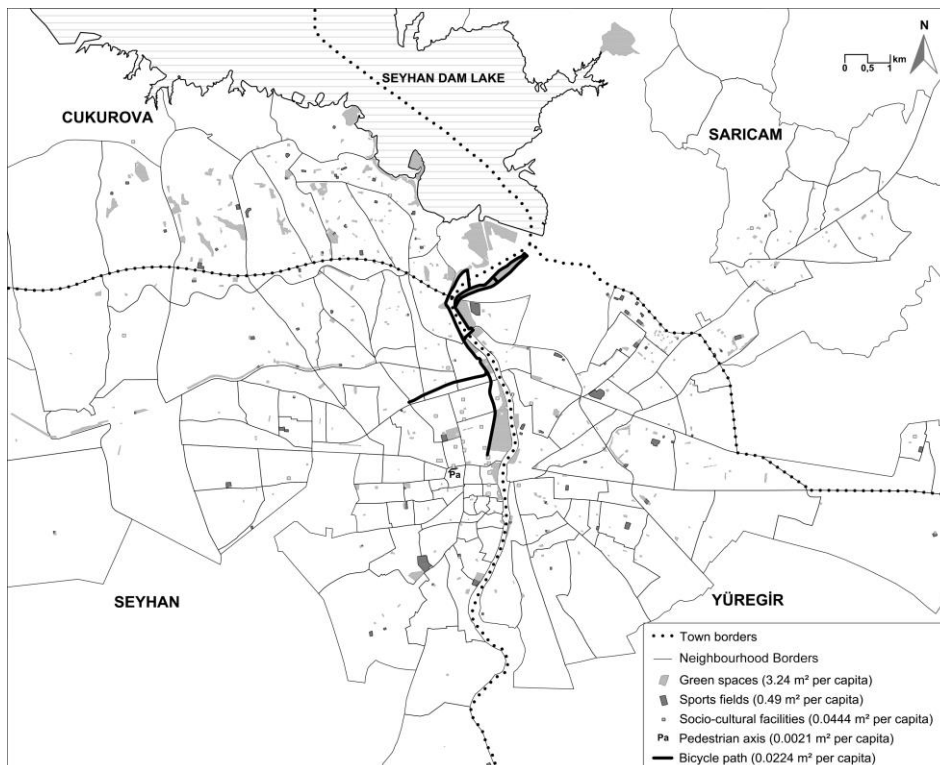


Fig. 2 The spatial distribution of green spaces and socio-cultural facilities.

The amount of green space and socio-cultural facility area per capita for the four towns is given in Table 1. Additionally, the WS_i , TD_i and ITD values which were used to calculate the $GSSF$ and EC , are also shown in Table 1.

Facilities	Per capita green space and socio-cultural facility (m2)										Average value for city	Weight score (WS_i)	TD_i (m)
	Çukurova		Sarıçam		Seyhan		Yüreğir						
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)					
Urban park	0.25		0.25		0.25		0.25		0.025	8.942	13124		
Community park	0.29		0		0		0		0.06	8.770	13825		
Neighbourhood park	1.44	33.76	1.45	3.45	0.80	54.40	0.69	13.01	0.93	8.785	5080		
Playground	2.19	23.64	0.30	2.92	0.88	13.67	1.42	7.92	1.22	8.912	5162		
Sports field	0.35	13.35	0.52	3.88	0.26	3.70	0.71	7.45	0.42	8.758	6291		
Swimming pool	0.01	0.41	0.03	0.17	0.01	0.16	0.01	0.14	0.01	7.960	5576		
Picnic area	3.04		0		0		0.06		0.58	8.202	10347		
Arboretum	0.22		0.22		0.22		0.22		0.22	7.889	16829		
Woodland	0.68		0		0.16		0		0.21	7.177	12175		
Pedestrian axis	0		0		0.0032		0		0.0021	8.396	13778		
Bicycle path	0		0		0.0301		0.0308		0.0224	7.907	11601		
Library	0.0012		0.0026		0.0014		0.0015		0.0015	7.509	8069		
Museum	0.0021		0.0021		0.0021		0.0021		0.0021	7.460	12457		
Theatre and concert hall	0.0124		0		0.0282		0		0.0162	8.545	11824		
Cinema hall	0.0064		0		0.0212		0.0062		0.0132	8.449	12720		
Exhibition place	0.0512		0		0.0021		0		0.0114	7.353	12639		

(1) Average value for town, (2) The highest value measured between neighbourhoods in each town.

Tab. 1 Distribution of green space and socio-cultural facility area per capita in the towns of Adana City, weight values of 16 facilities (WS_i) and threshold distances (TD_i).

Table 2 includes the lowest and highest $EGSSFI$ values in the 146 neighbourhoods within the four towns together with UIV , $GSSF$, $GSSFI$ and ΣEC values. $EGSSFI$ values of other neighbourhoods ranged between the highest and lowest values.

	Unweighted Index Values (UIV)														$GSSF$	$GSSFI$	ΣEC	$EGSSFI$		
	Up	Cp	Np	Pg	Sf	Sp	Pia	Arb	Wdl	Pa	Bp	Lib	Mus	Tch					Ch	Ep
Çukurova																				
1	100	100	7.5	16.5	0.2	0	100	100	100	0	0	46.2	100	44.3	28.6	100	51.6	80.9	64.3	67.7
13	100	100	0	0	100	100	100	100	100	0	0	46.2	100	44.3	28.6	100	62.7	98.3	1.8	84.3
Sarıçam																				
19	100	0	0	0	0	0	100	0	0	0	100	100	0	0	0	24.3	38.1	13.3	70.3	
21	100	0	0	0.00	0	0	100	0	0	0	100	100	0	0	0	24.3	38.1	16.8	45.0	
Seyhan																				
62	100	0	0	1.6	0	0	100	2.1	100	100	53.8	100	100	100	3.9	47.5	74.4	16.8	45.1	
99	100	0	85.6	0	0	0	100	2.1	100	100	53.8	100	100	100	3.9	53.1	83.2	27.4	76.9	
Yüreğir																				
119	100	0	0.8	10.0	41.1	0	1.9	100	0	0	100	57.7	100	0	28.6	0	33.3	52.2	72.2	65.5
146	100	0	0	32.3	0	0	1.9	100	0	0	100	57.7	100	0	28.6	0	32.0	50.2	28.8	48.6

Tab. 2 The lowest and highest $EGSSFI$ values and UIV , $GSSF$, $GSSFI$ and ΣEC values of 16 facilities within the 146 neighbourhoods of the four towns.

Analytical example of calculating GSSF and EGSSFI values for neighbourhood number 146:

$$GSSF = (100 * 8.942 + 0 * 8.770 + 0 * 8.785 + 32.3 * 8.912 + 0 * 8.758 + 0 * 7.960 + 1.9 * 8.202 + 100 * 7.889 + 0 * 7.177 + 0 * 8.396 + 100 * 7.907 + 57.7 * 7.509 + 100 * 7.460 + 0 * 8.545 + 28.6 * 8.449 + 0 * 7.353) / 131.014 = 32$$

$$EGSSFI_{146} = (GSSFI_{146} * EC_{146} + GSSFI_1 * EC_{146, 1} + GSSFI_2 * EC_{146, 2} + GSSFI_3 * EC_{146, 3} + \dots + GSSFI_{143} * EC_{146, 143} + GSSFI_{144} * EC_{146, 144} + GSSFI_{145} * EC_{146, 145}) / \sum EC_{146}$$

An effective green spaces and socio-cultural facilities index (EGSSFI) map is shown in Figure 3.

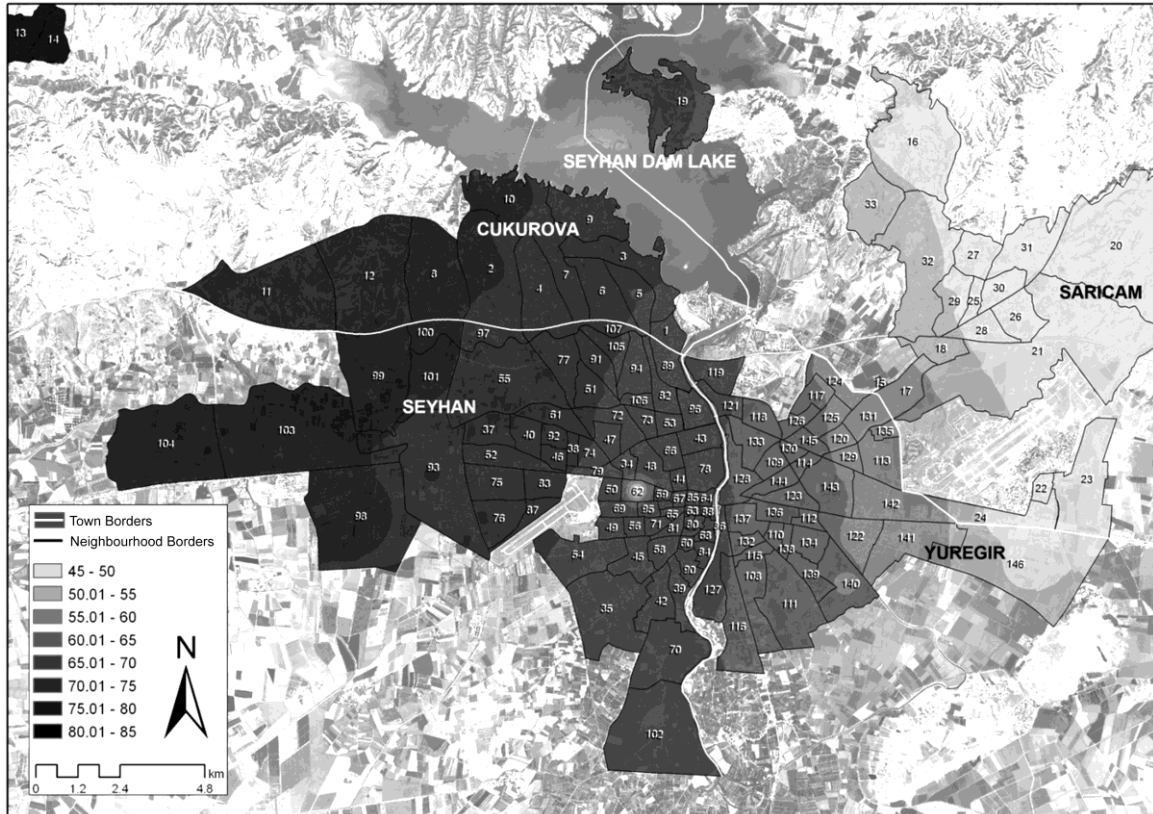


Fig. 3 Effective green spaces and socio-cultural facilities Index (EGSSFI) map.

The interpretation of Tables 1 and 2 and Figures 2 and 3 can be summarised as follows:

- the green spaces and socio-cultural facilities of Adana are below the standards introduced in Turkey. The amount of green space and socio-cultural facilities per capita suggested by national urban planning law and the ratio of the current amount to the suggested amount are given in parentheses as follows: 2.50 m² for libraries, museums, theatres and concert halls, cinemas, exhibition places (0.2%-2.9%); 2 m² for pedestrian and bicycle paths (0%-1.7%); 20 m² for picnic areas, arboretums, woodland (1.1%-19.7%); 20 m² for urban parks (1.3%); 10 m² for community parks (0%-2.9%); 8 m² for neighborhood parks (8.6%-18.1%); 6 m² for playgrounds (5%-36.5%); 8 m² for sports fields (3.3%-8.9%); and 0.075 m² for swimming pools (13.3%-40%);
- the spatial distribution of green spaces and socio-cultural facilities in the neighbourhoods are unbalanced. Çukurova and Seyhan have more facilities than the others. Seyhan includes more cultural places and historic parks than any other place in the city as it is located centrally and forms the current shape of the city, particularly from the 14th to 20th century. Çukurova is located next to the Dam Lake of Seyhan on an undulating terrain, this environmental structure, including valleys and the coast of the lake, enables

- an increase in the number of parks and woodlands. Development of green spaces and socio-cultural facilities is poor in Sarıçam and Yüreğir, where the rural life style is still the norm. Priority has been given to residential development in these towns, particularly in the neighbourhoods away from the city centre;
- the effectiveness of facilities in a given neighbourhood varies according to the distance to other neighbourhoods having better or poorer facilities due to the unbalanced distribution of green spaces and socio-cultural facilities amongst the neighbourhoods. For example, the *GSSFI* value of neighbourhood number 9 decreases from 100 to 73, whereas the *GSSFI* value of neighbourhood number 19 increases from 38.1 to 70.3. It can clearly be seen that people in poorly facilitated neighbourhoods tend to use the higher level of facilities in adjacent neighbourhoods depending on their distance. As a result of this, the effectiveness of the facilities decreases in the neighbourhoods with a high level of facility due to the increasing population, whereas poorly facilitated neighbourhoods have an increase due to the population tending towards use of facilities in the other neighbourhoods;
 - the spatial distribution of green spaces and socio-cultural facilities can be clearly seen on the maps (Figure 2). Index values decrease from west to east. Urban growth in the west and northwest part of the city took place during the planning revisions in the 1990s. House construction started in the same period, which created opportunities for the growth of green spaces and socio-cultural facilities. There was not such an opportunity on the eastern side due to a long period of unplanned and illegal urban development. Urban transformation projects for the eastern part were introduced in the early 2000s. These projects are expected to speed up the planned development and, consequently, green spaces and socio-cultural facilities shall reach an acceptable level.

4 DISCUSSION

Quantity of green spaces and socio-cultural facilities within a city can be determined with two criteria: quantity per capita and accessibility. Service diversity within a facility is the third criterion which defines quality and quantity together. Service diversity may vary according to social, cultural and economic characteristics, tendencies and demands of the users. It is difficult to set the norms or standards for service diversity as the necessity and sufficiency levels are subjective. Size of the area per capita and accessibility (or distance to homes) can be calculated mathematically and objectively (Gold 1980; Santerre 1985; Phillips 1996; Georgi & Dimitriou 2010; Haq 2011; Higgs et al. 2012; Peschardt et al. 2012). In this respect, the green spaces and socio-cultural facility level of Adana was derived using two criteria, including size of the area per capita and distance to homes.

Coles & Caserio (2003) indicated that the most intensively used open and green spaces are a maximum of 500 m walking distance in their research which was conducted in 15 European cities to determine the effects of accessibility and facility diversity of urban green spaces on usage. Insufficiency of these areas in terms of facility diversity particularly affects the level of short-term usage (maximum 2 hours). For long-term usage, it has been observed that users preferred green spaces to be closer and with highly diverse facilities, however, they should be further than 500 m away. Findings of Giles-Corti et al. (2005) in Perth in Australia showed that accessibility to the green spaces is closely related to the level of usage whereas area and attractiveness have less of an effect. Threshold distance may reach up to 5-6 km for daily use facilities such as neighbourhood parks, playgrounds and sports fields in Adana as a result of insufficiency and uneven distribution of green spaces and socio-cultural facilities. It can be concluded that most of the users are either unable to use these facilities or usage efficiency is poor due to intensive usage of many visitors who come from far away.

The effectiveness method used in this research was proposed by English & Cordell (1993). Similar to this study, there is a clear trend that effectiveness of the facilities decreases in the neighbourhoods with a high

level of facilities due to population pressure from outside, whereas poorly facilitated neighbourhoods have an increase due to lower population use.

English & Cordell (1993) use weights in the range of 1-3 to calculate a weighted opportunity set index (*WOSI*) which is identical to the *GSSFI*. The Adana study is based on stakeholder participation in the planning process. In the first stage, planning experts, decision makers and NGOs determine weights ranging between 1 and 10 for the 16 facilities covered. Average weights of the coefficients assigned by planners, NGOs and decision makers were multiplied by weights of 3, 2 and 1, respectively. Differences in the objectives of stakeholders may result in a large divergence in the values for the 16 facilities so these coefficients have a balancing effect on the values calculated for 16 facilities. These values can be attributed to an adjustment factor to reflect the views of the different stakeholders to the green spaces and socio-cultural facilities.

There are studies mapping some social, economic and physical components of urban life quality in the form of unweighted values or indices. Schyns & Boelhouwer (2002) map the unemployment rate in Amsterdam for example. Point data are interpolated and converted to surface data in the same way as for Adana City. Gilliland et al. (2006) map the playground facilities and demands in the neighbourhoods of London (Canada). Playground facilities and demands are categorised into 5 levels from low to high within the maps and a single value is assigned to whole neighbourhood areas. Li & Weng (2007), map the environmental and economic characteristics of urban life quality in Indianapolis (USA) by converting these characteristics to indices. Present facilities are not associated with distance to homes due to the nature of this study.

These studies show that converting the green spaces and socio-cultural facilities to indices and mapping in the form of contours for the expression of spatial distribution is uncommon in the literature. For that reason, the Adana case study is unique in its mapping approach, which has the potential to bridge the gap in the literature. The effective green spaces and socio-cultural facilities index (*EGSSFI*) map can be used by local administrations as a baseline map in the planning process.

5 CONCLUSION

In the light of the above discussion, solutions which may contribute to an increase of green spaces and socio-cultural facilities to a sufficient level are as follows:

- restricted or limited use of public green spaces (forest, woodland, agricultural land etc.) within the cities should be implement and use not allowed for other purposes by law. Thus, the unity of green spaces will be protected and this will ensure the existence of reserved areas for new green spaces. The effectiveness of the green spaces will increase in the case of continuity of the green spaces with playgrounds and new parks will be achieved;
- seyhan Dam Lake at the north and Seyhan River divide the city on a north-south axis. Irrigation channels which border the four towns provide great potential to develop continuous open and green spaces and socio-cultural facilities. These areas should be kept away from urbanisation and reserved to increase green spaces and socio-cultural facilities;
- public and private rural-agricultural lands have been zoned for construction in Sarçam and Yüreğir towns due to migration from outside of Adana. As a result of this, the land value has increased dramatically. Land owners tended to construct multi-storey buildings to increase their profits. The number of houses within these two towns is approximately 117,000 according to Adana Urban Council (2015) data, this number is very close to the projection fir 2020, which is 136,000. Thus, there will be a more than adequate number of houses available as the number of houses grows with this trend;

- In this respect, more land will be needed to meet this demand. The lands allocated for open green spaces will decrease or become fragmented. Thus, the size, accessibility and effectiveness of open and green spaces will diminish. To prevent such a circumstance, some preventive measures can be taken:
 - first of all, improvement of green spaces and socio-cultural facilities should be made, considering the per capita need for green space within urban development plans, and including accessibility and facility diversity. Preventive decisions should be taken to protect these areas. However, the opportunity cost which will result from conversion of built-up areas to open and green spaces is the major problem for the land owners of the expropriation areas. This problem can be solved either by giving an equal amount of land from urban development areas to land owners or by clearing;
 - less profitable rural lands increase their value following the introduction of urban development plans, as a result, land owners and constructors make profits by constructing vertical structures which increases the number of homes per unit area. The parcel sizes in these areas should be enlarged and more space should be allocated for green spaces within these parcels to convert this speculative profit to public benefit. In this way, public open and green spaces can be managed and enhanced without the need for costly actions.

REFERENCES

- Adana Urban Council (2015). *Demographic, Economic and Housing Statistics for Adana City*. Retrieved December 27, 2015 from: <http://www.adana.bel.tr/istatistikler/> (in Turkish).
- Altunkasa, M. F., & Uslu, C. (2004). The effects of urban green spaces on house prices in the upper northwest urban development area of Adana (Turkey). *Turkish Journal of Agriculture and Forestry*, 28, 203-209.
- Antognelli, S., & Vizzari, M. (2016). Ecosystem and urban services for landscape liveability: A model for quantification of stakeholders' perceived importance. *Land Use Policy*, 50 (2016), 277-292. doi: <http://dx.doi.org/10.1016/j.landusepol.2015.09.023>.
- Baycan-Levent, T., & Nijkamp, P. (2009). Planning and management of urban green spaces in Europe: Comparative analysis. *Journal of Urban Planning and Development*, 135, 1-12. doi: [http://dx.doi.org/10.1061/\(ASCE\)0733-9488\(2009\)135:1\(1\)#sthash.pyjCVyhJ.dpuf](http://dx.doi.org/10.1061/(ASCE)0733-9488(2009)135:1(1)#sthash.pyjCVyhJ.dpuf).
- Berberoğlu, S., Lloyd, C. D., Atkinson, P. M., & Curran, P. J. (2000). The integration of spectral and textural information using neural networks for land cover mapping in the Mediterranean. *Computers and Geosciences*, 26, 385-396. doi: [http://dx.doi.org/10.1016/S0098-3004\(99\)00119-3](http://dx.doi.org/10.1016/S0098-3004(99)00119-3).
- Bolund, P., & Hunhammar, S. (1999). Ecosystems services in urban areas. *Ecological Economics*, 29, 293-301. doi: [http://dx.doi.org/10.1016/S0921-8009\(99\)00013-0](http://dx.doi.org/10.1016/S0921-8009(99)00013-0).
- Bonaiuto, M., Aiello, A., Perugini, M., Bonnes, M., & Ercolani, A. P. (1999). Multidimensional perception of residential environment quality and neighbourhood attachment in the urban environment. *Journal of Environmental Psychology*, 19, 331-352. doi: <https://doi.org/10.1006/jevp.1999.0138>.
- Bonaiuto, M., Fornara, F., & Bonnes, M. (2003). Indexes of perceived residential environment quality and neighbourhood attachment in urban environments: A confirmation study on the City of Rome. *Landscape and Urban Planning*, 65, 41-52. doi: [http://dx.doi.org/10.1016/S0169-2046\(02\)00236-0](http://dx.doi.org/10.1016/S0169-2046(02)00236-0).
- Cohen, M. (1996). Habitat II and the challenge of the urban environment: Bringing together the two definitions of habitat. *International Social Science Journal*, 48, 95-101. doi: 10.1111/j.1468-2451.1996.tb00060.x
- Coles, R., & Caserio, M. (2003). Understanding and facilitating the social outputs of urban green spaces (Paper presented at the International Conference 'Open Space, People Space', Edinburgh). Retrieved March 04, 2013 from: http://www.academia.edu/download/42048822/Understanding_and_Facilitating_the_Socia20160204-27525-1lo7nvh.pdf
- Coolen, H., & Meesters, J. (2012). Private and public green spaces: meaningful but different settings. *Journal of Housing and Built Environment*, 27, 49-67. doi:10.1007/s10901-011-9246-5.

Dunnett, N., Swanwick, C., & Woolley, H. (2002). Improving Urban Parks, Play Areas and Green Spaces. Department for Transport, Local Government and the Regions, London. Retrieved April 15, 2009 from: <http://publiekeruimte.info/Data/Documents/e842aqrm/53/Improving-Urban-Parks.pdf>.

English, D. B. K., Betz, C. J., Young, J. M., Bergstrom, J. C., & Cordell, H. K. (1993). Regional demand and supply projections for outdoor recreation. General Technical Report No. RM-230, U.S. Department of Agriculture, Forest Service, August 1993, Colorado. Retrieved April 15, 2009 from: http://www.fs.fed.us/rm/pubs_rm/rm_gtr230.pdf

English, D. B. K., & Cordell, H. K. (1993). Effective Recreation Opportunity Set (EROS) index: A computable measure of recreation supply. Research Paper No. SE-286, U.S. Department of Agriculture, Forest Service, Asheville, North Carolina.

Gangloff, D. (1995). The sustainable city. *American Forests*, 101, 30-36.

Georgi, J. N., & Dimitriou, D. (2010). The contribution of urban green spaces to the improvement of environment in cities: Case study of Chania, Greece. *Building and Environment*, 45, 1401-1414. doi: <http://dx.doi.org/10.1016/j.buildenv.2009.12.003>.

Germann-Chiari, C., & Seeland, K. (2004). Are urban green spaces optimally distributed to act as places for social integration? Results of a Geographical Information System (GIS) approach for urban forestry research. *Forest Policy and Economics*, 6, 3-13. doi: [http://dx.doi.org/10.1016/S1389-9341\(02\)00067-9](http://dx.doi.org/10.1016/S1389-9341(02)00067-9).

Giles-Corti, B., Broomhall, M. H., Knuiaman, M., Collins, C., Douglas, K., Ng, K., Lange, A., & Donovan, R. J. (2005). Increasing walking: How important is distance to, attractiveness and size of public open space? *American Journal of Preventive Medicine*, 28, 169-176. doi: <http://dx.doi.org/10.1016/j.amepre.2004.10.018>.

Gilliland, J., Holmes, M., Irwin, J. D., & Tucker, P. (2006). Environmental equity is child's play: mapping public provision of recreation opportunities in urban neighbourhoods. *Vulnerable Children and Youth Studies*, 1(3), 256-268. doi: <http://dx.doi.org/10.1080/17450120600914522>.

Gold, S. M. (1980). *Recreation Planning and Design*. New York: McGraw-Hill.

Gómez, F., Jabaloyes, J., Montero, L., De Vicente, V., & Valcuende, M. (2011). Green areas, the most significant indicator of the sustainability of cities: Research on their utility for urban planning. *Journal of Urban Planning and Development*, 137, 311-328. doi: [http://dx.doi.org/10.1061/\(ASCE\)UP.1943-5444.0000060](http://dx.doi.org/10.1061/(ASCE)UP.1943-5444.0000060).

Gürbüz, M. (2012). Urban technical infrastructure impact assessment. Retrieved March 17, 2014 from: <http://www.csb.gov.tr/db/altyapi/editordosya/14-%20Mehmet%20%20GURBUZ-ILBANK.pdf> (in Turkish).

Haq, S. A. (2011). Urban green spaces and an integrative approach to sustainable environment. *Journal of Environmental Protection*, 2, 601-608. doi: 10.4236/jep.2011.25069.

Hicks, D. A. (1997). The inequality-adjusted human development index: A constructive proposal. *World Development*, 25, 1283-1298. doi: [https://doi.org/10.1016/S0305-750X\(97\)00034-X](https://doi.org/10.1016/S0305-750X(97)00034-X).

Higgs, G., Fry, R., & Langford, M. (2012). Investigating the implications of using alternative GIS-based techniques to measure accessibility to green space. *Environment and Planning B*, 39, 326-343. doi: <https://doi.org/10.1068/b37130>

Jim, C. Y. (2004). Green-space preservation and allocation for sustainable greening of compact cities. *Cities*, 21, 311-320. doi: <http://dx.doi.org/10.1016/j.cities.2004.04.004>.

Kabisch, N., & Haase, D. (2013). Green spaces of European cities revisited for 1990-2006. *Landscape and Urban Planning*, 110, 113-122. doi: <http://dx.doi.org/10.1016/j.landurbplan.2012.10.017>

Kabisch, N., & Haase, D. (2014). Green justice or just green? Provision of urban green spaces in Berlin, Germany. *Landscape and Urban Planning*, 122, 129-139. doi: <http://dx.doi.org/10.1016/j.landurbplan.2013.11.016>.

Kotler, P., Jatusripitak, S., & Maesincee, S. (1997). *The Marketing of Nations: A Strategic Approach to Building National Wealth*. New York: Free Press.

Li, G., & Weng, Q. (2007). Measuring the quality of life in city of Indianapolis by integration of remote sensing and census data. *International Journal of Remote Sensing*, 28, 249-267. doi: <http://dx.doi.org/10.1080/01431160600735624>.

Madanipour, A. (1999). Why are the design and development of public spaces significant for cities? *Environment and Planning B: Planning and Design*, 26, 879-891. doi:<http://dx.doi.org/10.1068/b260879>.

Marcouiller, D. W., Prey, J., & Scott, I. (2009). The regional supply of outdoor recreation resources: Demonstrating the use of location quotients as a management tool. *Journal of Parks and Recreation Administration*, 27(4), 92-107.

Nega, T., Fu, W. H., & Vrtis, G. (2010). Open space index: A GIS-based tool for assessing human penetration of a landscape. *Local Environment*, 15, 743-759. doi: <http://dx.doi.org/10.1080/13549839.2010.509387>.

Peschardt, K. K., Schipperijn, J., & Stigsdotter, U. K. (2012). Use of Small Public Urban Green Spaces (SPUGS). *Urban Forestry and Urban Greening*, 11, 235-244. doi: <http://dx.doi.org/10.1016/j.ufug.2012.04.002>.

Phillips, L. E. (1996). *Parks: Design and Management*. New York: McGraw-Hill.

Pulido, A. (1972). *Statistics and social research techniques*. Madrid: Anaya (in Spanish).

Santerre, R. E. (1985). Spatial differences in the demands for local public goods. *Land Economics*, 61, 119-128. doi: <http://dx.doi.org/10.2307/3145804>.

Schipperijn, J., Ekholm, O., Stigsdotter, U. K., Toftager, M., Bentsen, P., Kamper-Jørgensen, F., & Randrup, T. B. (2010). Factors influencing the use of green space: Results from a Danish national representative survey. *Landscape and Urban Planning*, 95, 130-137. doi: <http://dx.doi.org/10.1016/j.landurbplan.2009.12.010>.

Schöpfer, E., Lang, S., & Blaschke, T. (2004). A green index incorporating remote sensing and citizen's perception of green space. Centre for Geoinformatics, University of Salzburg. Retrieved April 28, 2009 from <http://ispace.researchstudio.at/sites/ispace.researchstudio.at/files/145.pdf>.

Schyns, P., & Boelhouwer, J. (2002). Measuring quality of life in Amsterdam from the viewpoint of participation. The Amsterdam Bureau for Research and Statistics/Social and Cultural Planning Office. Retrieved April 28, 2009, http://www.ois.amsterdam.nl/pdf/2002_quality_of_life.pdf.

Stähle, A. (2010). More green space in a denser city: Critical relations between user experience and urban form. *Urban Design International*, 15, 47-67. <http://dx.doi.org/doi:10.1057/udi.2009.27>.

Uslu, C., Altunkasa, M. F., Boyacıgil, O., Konaklı, N., & Salıcı, A. (2012). Bicycle master plan for Adana, Turkey. *Journal of Urban Planning and Development*, 138, 62-69. doi: [http://dx.doi.org/10.1061/\(ASCE\)UP.1943-5444.0000069#sthash.DyFAiTRM.dpuf](http://dx.doi.org/10.1061/(ASCE)UP.1943-5444.0000069#sthash.DyFAiTRM.dpuf)

Van Herzele, A., & Wiedemann, T. (2003). A monitoring tool for the provision of accessible and attractive urban green spaces. *Landscape and Urban Planning*, 63, 109-126. doi: [http://dx.doi.org/10.1016/S0169-2046\(02\)00192-5](http://dx.doi.org/10.1016/S0169-2046(02)00192-5).

Willis, K. G., Turner, R. K., & Bateman, I. J. (2001). *Urban Planning and Management*. Cheltenham: Edward Elgar.

Yildiz, N. D., Demir, M., & Yılmaz, S. (2011). Determination of the efficiency of green areas in Erzurum city. *Scientific Research and Essays*, 6, 293-304. doi: <http://dx.doi.org/10.5897/SRE10.674>

IMAGE SOURCES

Fig. 1, 2, 3: author's elaboration

AUTHOR'S PROFILE

Mehmet Faruk Altunkasa

Dr. M. Faruk Altunkasa has over 30 years' experience in landscape planning and design and is the author of more than 110 scientific publications in this field, including peer reviewed articles, books, book chapters and conference papers. He received his Ph.D. in Landscape Architecture from the University of Çukurova in 1987. In 1994, he attended the advanced course on the Economics of Natural Resources held in IAMC (Spain) and received a certificate in this field. He is currently a member of the academic staff in Department of Landscape Architecture at Çukurova University. Dr. Altunkasa's research interests are urban landscape design, urban green spaces, urban design, landscape construction, planting design.

Süha Berberoğlu

Dr. Süha Berberoğlu is a lecturer in Landscape Architecture. He has 22 years of broad-based field and laboratory environmental experience required in the application of environmental monitoring and management. Dr. Berberoğlu is also involved in various national and international projects such as biodiversity mapping, change detection, hydrological modelling and biomass estimates. His current field of research is GIS and satellite remote sensing for driving ecosystem models and

conservation in the Mediterranean region. Dr. Berberođlu is the founder of the CU Remote Sensing and GIS Lab which is dedicated to providing innovative, state-of-the-art monitoring of environment using geospatial technologies. He is also head of RS and GIS department in Institute of Basic and Applied Sciences.

Cengiz Uslu

Dr. Cengiz Uslu has over 20 years' experience in landscape planning and design and is the author of more than 60 scientific publications in this field, including peerreviewed articles, book chapters and conference papers. He received his Ph.D. in Landscape Architecture from the University of ukurova in 2002. He is currently a member of the academic staff in Department of Landscape Architecture at ukurova University. Dr. Uslu's research interests are urban landscape design, urban green spaces, recreation planning and design, computer aided design, planting design.

Halil Duymuř

Halil Duymuř is a research assistant in Department of Landscape Architecture at ukurova University. He received his M.Sc. in Landscape Architecture from the University of ukurova in 2011. Currently she is pursuing her Ph.D. in Urban Design in the University of ukurova. Mr. Duymuř' research interests are urban landscape design, urban green spaces, open public spaces, computer aided design, planting design.