Service Areas of Local Urban Green Spaces:
A Explorative Approach in Arroios, Lisbon

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Abstract

The identification of service areas and lacking areas of urban green spaces is increasingly necessary within the planning and management of these spaces, as it translates into important indicators of the quality of life in the urban context. In this setting, it is important to assess the attractiveness and accessibility dynamics through a set of attributes, taking into account the local reality of the territory under study.

This work presents an operational methodology associated with these dynamics in local urban green spaces and subsequently assists in the planning and management of this type of urban spaces. This methodology is supported in the first phase on questionnaire surveys and faces a second phase in a geographical information system (GIS). For the application of this methodology, two local green spaces in Lisbon (Jardim Constantino and Campo Mártires da Pátria) were selected, on a local perspective explorative approach. Through the field data, it was possible to identify service areas for both spaces, and compare the results with references in the literature. It was also possible to recognise areas with lack of these spaces. The difficulty to evaluate the dynamics of real individuals in their choices of urban green spaces and the respective route is a major challenge to the application of the methodology. In this sense it becomes imperative to develop different instruments and adapt them to other types of urban green spaces.

Keywords: Service area; local urban green spaces; attractiveness; accessibility; GIS

1 Introduction

The existence of urban green spaces is reflected in indicators of the quality of life. As such, it is imperative to assess the respective attractiveness and accessibility dynamics to enhance their use, improve access and enhance their role and overall benefits in the urban environment. The evaluation of accessible and attractive green spaces is an integral part of urban quality of life (Herzele & Wiedemann, 2003), as the quantity, distribution and easy access can be major contributions to the social and ecological functioning in urban environments (Barbosa et al., 2007). The importance of having green spaces nearby the residential places and the positive association between short distance and increased use are mentioned in various health policies and urban planning guidelines, becoming a contemporary issue (Schipperijn et al., 2010).

2 Public Urban Green Spaces

2.1 History

The concept of *public space* has always existed, specially in ancient Greece, where the development of democracy led to new urban elements leads to a more people's participation in

community affairs (Goitia, 2008). According to Telles (p. 55, 1997) “the public urban green space, as it is understood today, appears primarily from the eighteenth century”, when it is created the *Passeio Público* in Lisbon and the Louvre-Étoile axis in Paris based on geometric composition from French rationalist baroque. At the same time the first urban parks appeared, delivering to the community large spaces in the context of the emergence of suburban middle classes and the growth of industrialized cities. With the Industrial Revolution comes the need to correcting the bad health conditions which makes born the idea of improving the environment by integrating green spaces in the city. On the other hand, Magalhães (1992) believes that the urban green space concept emerged after the post-industrial era, like a space that intents to create the nature presence and rural component in the urban environment. In this perspective this spaces beyond their ecologic and health component, were already seen as a means of social integration, which reach to integrate urban planning.

Later, Frederick Olmsted (the author of Central Park, New York) proposed the primitive concept of “green lung” and developed it with the parks’ continuous system idea as a way to structure, improve the urban tissue, control the urban growth and also proposing for the first time, the separation of pedestrian and car traffic. This American model reflects on the middle of the nineteenth century the Romantic Movement that invades Europe, including Lisbon, by creating park systems on the consolidated or expanding urban fabric.

In the early twentieth century, the previous concepts have been developed, enabling the rise of the “continuum natural” theory (Magalhães, 1992), towards the Green Structure transformation to a network more continuous, liking the city centre to its surroundings and holding a circulation urban function (Telles, 1997). With this more integrated vision, not only new spaces were built but also requalification efforts of previous green areas were conducted. Corridors along main traffic routes had been afforested to connect the main green spots, from small parks to forest parks located on city periphery, also applying the concept of “green lung” that supports the city. The emergence of rationalist theories presented on the Athens Charter (1933) has fundamentally changed the concept of urban green space, (Telles, 1997). This document, which defines the modern and functional urbanism paradigm, saw the green spaces as free large areas that high buildings should release and defined them as indispensable to urban quality of life.

Over time, the concepts associated with these spaces have been broader. There was discussion on the physical and psychological contributions of these spaces for human health, where there is an increased attention and proof on the positive relationship (e.g. Vries et al, 2003; Maas et al, 2006, Mitchell & Popham, 2007, Takano et al, 2002 *in* Tzoulas et al., 2007). Recent studies focus on issues of usefulness, attractiveness and accessibility, where the theme of "walkability", the compatibility of the urban environment with pedestrian habits as defined by Abley and Turner (2011), has increasingly being present, due to the contemporary need to search for sustainability and healthy life (Cambra, 2012).

2.2 Local Urban Green Spaces

There is not a universal concept that can be conferred to local urban green spaces, at the neighbourhood scale, but from the literature it is possible to have some knowledge of their characteristics and their respective specificities. According to Gupta et al. (p. 326, 2012), the neighbourhood is synonymous with proximity and can be defined as an area of homogeneous characteristics, and the scale is indicated for the application of green strategies.

This type of small green space generally located in consolidated urban centres may have a strong connection with the local lifestyle and thus holds one component of social action (Herzele & Wiedemann, 2003). There is a long tradition in research that explores the relationship between characteristics of proximity (or neighbourhood) and individual well-being (Macintyre & Ellaway, 2000 *in* Tzoulas et al., 2007). In fact there was been proved that the level of proximity, the availability of green space affects the quality of the environment, helps in restoring stress, increases the feeling of safety (Maas et al., 2009), social interaction, the value of the property (Jim & Chen, 2012 *in* Gupta et al., 2012) and also provides a recreational space for the physical and mental development of children (Jacobs, 1961 *in* Gupta et al., 2012).

There are already standardized parameters for the maximum distance from the residence and minimum dimensions for the various types of urban green spaces (MIRA-S, 2000), so in this setting this work uses values collected from the literature for the accessibility time and distance to this type of spaces. Values on Table 1 are maximum standards stated as acceptable, denoting how much is perceived as affordable. They are proposed by authors and recommended by European and National government entities. In general, it appears that the maximum acceptable distance for access to urban green space proximity is 400 meters from housing, thus corresponding to 5 a minutes walking. These values are merely general recommendations which is imperative to have account the local territory characteristics and also very important for defining service areas and spatial analysis.

Table 1. Maximum accessibility distance and time standards of local green spaces and their authors

Accessibility distance and time	Author(s)
400 m – 5 min	Boone et al., 2009; Wendel et al., 2012
400 m	Magalhães, 1992
400 m – 5 min	Herzele & Wiedemann, 2003
400 m	Hart, 1979; Matthews, 1987; Hillman et al., 1990)
400 m	MIRA-S, 2000
300-400 m	Coles & Bussey, 2000; Giles-Corti et al., 2005; Grahn & Stigsdotter, 2003; Nielsen & Hansen, 2007
900-1000 m – 15 min	European Environment Agency, 2007; Stanners & Bourdeau, 1995
<300 m	English Nature, 2005; Harrison et al., 1995; Barker, 1997; Handley et al., 2003; Wray et al., 2005
400 m	Hart, 1979; Matthews, 1987; Hillman et al., 1990

On the Portuguese bibliography, this type of urban green spaces appears as *areas which are adjacent to residential areas and near housing areas* (GEPAT, 1990). With this reference document, although not upgraded, comes the need to establish and adopt minimum standards for the planning and design of these spaces, including their minimum areas and maximum distance (Magalhães, 1992). These spaces are located between 100 and 400 meters

from home, covering all the residents in the neighbourhood, and can be playgrounds or other children or youngsters-oriented facilities, or having social or meeting purposes. What differentiates these spaces, beyond the smaller dimension, is the daily use and casual stay.

3 Attractiveness and Accessibility of Urban Green Spaces

3.1 Concept

The attractiveness concept is associated with specific characteristics several urban green space categories which differ from the context of the surrounding area and defines its use. Giles-Corti et al. (2005 *in* Wendel et al., 2012) consider that there are "*a set of factors that influence the use of public green spaces including: the quality and quantity of spaces, the sociodemographic characteristics of potential users, access to facilities, ability to meet the needs of users, maintenance and the perception of safety*". In this sense, the choices of the space does not fall only on physical factors associated with them, but this choice may also be influenced by individual preferences (Hillier & Lida, 2005 *in* Koohsari et al., 2013), even though it is expected to visit the parks closest to the residence or work or those which have higher levels of attractiveness associated with quality. Therefore, a set of formal and informal, physical and psychological, objective and subjective factors weigh in the choice of a green space. The attractiveness is associated with accessibility, in the way as this may be a determinant attribute for the use of certain urban areas (Corti et al., 1996), respectively related to physical and / or psychological barriers encountered by the individual on your route.

The accessibility can be defined as "*the ability of the environment to provide all people an equal opportunity to use in a direct, immediate, permanent and as autonomous way as possible*" (p.21., CML, 2013). It is an important component of any urban public space since proximity to these areas encourages positive physical, mental and social order, ranging from the quality of life (Coombes et al., 2010 *in* Koohsari et al., 2013) to the improvement of air quality and community cohesion (Davies et al., 2011 in Koohsari et al., 2013).

Accessibility to green spaces can be evaluated through the service area analysis for a base measure indicating the green spaces available for residents with a specific distance, in general to evaluate the distribution and potential gaps (Boone et al., 2009 *in* Wendel et al., 2012). The access conditions influence the use of such spaces so this dictates the extent of use and the profile of the main users, since a green accessible space may be used for a diverse group of persons, including the elderly, children and individuals with mobility impairments. Indeed, in recent years a growing body of evidence indicates that a range of perceived environments and objectively measured attributes (including access) are associated with patterns or pedestrian walk (Owen et al., 2004; Giles-Corti et al., 2005 *in* Sugiyama et al., 2013). On the other hand, Koohsari et al. (p. 92, 2013) indicates that "*different aspects of public open spaces can influence the walk*", getting the idea that not only the conditions of the surrounding area of the space and its access influence the choice of route and pedestrian behaviour but also what is inherent in space itself can be determined in the manner of how individuals move to this.

3.2 Attributes of Attractiveness and Accessibility

To prepare the questionnaire surveys, knowing the users' attractiveness and accessibility dynamics and for the spatial analysis it was necessary review the existing literature to support the group's choice of attributes associated with the two earlier referred concepts and also local urban green spaces. What it matters in here is not assess formally the green spaces under study or their quality, but to understand the main preferences or motivations for their use and their access. Some attributes required bibliographic support compared with others, specially the more informal and hardly measurable, where some were chosen for purely empirical reasons. Given the content similarities the attributes were grouped in a way to be used on both accessibility and attractiveness themes. In the following table (table 2) are present the attributes and indicators chosen with the respective authors.

Table 2. Attributes respective author(s)

Attribute	Author(s)
distance and proximity to space	Herzele & Wiedemann, 2003; Bjork et al., 2008; Coles & Bussey, 2000; Giles-Corti et al., 2005; Grahn & Stigsdotter, 2003; Jensen & Koch, 2004; Nielsen & Hanson, 2007; Roovers et al., 2002; Schipperijn et al., 2010; Choumert, 2010; Humpel et al., 2004; Owen et al., 2004; Hillier & Lida, 2005; Koohsari et al, 2013
easiness of getting to space and physical effort	Handy, 1996; Sisiopiku & Akin, 2003; Brown et al., 2007
aesthetic and space's environment	Deconinck, 1982; Coeterier, 2000; Herzele & Wiedemann, 2003; Harrison and Burgess, 1988; Grahn, 1991
friends, family and neighbourhood individuals	Bertera, 2003; Schipperijn, 2010
supporting facilities	Giles-Corti et al., 2005; Burgess et al., 1988; Berggren-Barring & Grahn, 1995; Holm, 1998; Herzele & Wiedemann, 2003; Coles & Bussey, 2000; Kaczynski et al., 2009; Maruthaveeran & Bosch, 2014; Reyes & Figueroa, 2010; Wendel et al., 2012
cleaning, maintenance and treatment	Giles-Corti et al., 2012; Shaffer & Anderson, 1985; Maruthaveeran & Bosch, 2014
personal meaning	Berggren-Barring & Grahn, 1990
exclusivity of space	Herzele & Wiedemann, 2003
security	Jansson et al., 2013; Maruthaveeran & Bosch, 2014; Madge, 1997; Hovell et al.,1989; Wendel et al., 2012
slope	Miller & Lida, 2005; Penn, 2003
time	Owen et al., 2004; Deconinck, 1982; Grahn, 1994; Bussey, 1996; Holm, 1998
pedestrian crossings	Owen et al., 2004; CML, 2013
abusive parking	CML, 2013
conditions and width of pedestrian crossings	CML, 2013
obstacles	CML, 2013
services, trade and public facilities	Owen et al., 2004
traffic, pollution and noise	Giles-Corti & Donovan, 2002; Owen et al., 2004; & Thompson, 2008; Koohsari et al., 2013
trees and shadow	Lamas, 2011; Sugiyama & Thompson, 2003; Giles-Corti & Donovan, 2003
street furniture	Owen et al., 2004
environment/aesthetic and associated feelings	Sallis & Owen, 1999; Australian Bureau of Statistics; 2000; Bargh & Ferguson, 2000; Ball et al., 2001; Bauman et al., 2002; Craig et al., 2002; Giles-Corti & Donovan, 2002; Trost et al., 2002; Owen et al., 2004; Humpel et al., 2004; Gobster, 2005; Sugiyama & Thompson, 2008; Sugiyama et al., 2013
walking pleasure	Giles-Corti & Donovan, 2002; Humpel et al., 2004; Owen et al., 2004

3.3 Service areas

From the design and analysis of service areas it is possible to understand the influence that a given point has to condition the users behaviour (or route), based on the characteristics of the network. Basically the service area of an urban green space covers the range of action where its potential users live and tends to bordered to the farthest user that has the availability to move to this space. This differs with the type of urban green space and the attractiveness and accessibility conditions. It is related to the measurement network depending on the attribute and criteria in question and have a more realist approach compare to buffer approach (linear distance) because have account the multiple limitations that influences the network dynamics. The concept can also be applied to a public equipment or service that has a territorial expression.

4 Methodology

The present methodology was divided in two distinct phases: first the questionnaire surveys which were applied on the two local green spaces under study, to find out the motivations and main factors that influences the choice of the green space and access to them by the respondents users. Following the key concepts of this work, the survey was incorporated into two main groups, one on the attractiveness and other accessibility. Attractiveness is important in determining the frequency of visit, trying to understand the reasons and motivations for visiting that space under study. On that sense a relevance scale was set (*very important*, *not important* and *without relevance*) with the attributes earlier referenced. Also it was asked to identify the origin points (home or work) to intersect them with the service area, enriching the spatial analysis and future conclusions.

The second phase resulted in the delineation of service areas, according to the time cost attribute (in seconds) from the ArcGIS software and the respective network analysis extension Network Analyst. The cost network created it was taken by a network which had the slope and length information of each route with one direction. As looking for the pedestrian reality it was imperative to have the two directions information, respectively about the speed and time since that the individual takes more time and effort to climb a street than come down it. To determinate the speed and time variables taking into account the slope and length and after some research was used the *Tobler's hiking function*. This exponential function determines the walking speed, taking into account the slope angle and the distance and the effect that the slope direction has on speed (Tobler *in* Magyari-Saska & Dombay, 2012). It is important to say that this function does not have into account the age or physical condition of each individual and that the cost network created also does not have considered barriers or impediment factors on territory (besides the slope obviously). After the cost network construction it was delimitated several service areas according to times breaks (2 minutes) until 16 minutes because it was the limit travel time to access the green spaces from the surveys information and it is also the maximum acceptable time to access this type of urban green spaces according to general recommendations.

5 Case Study

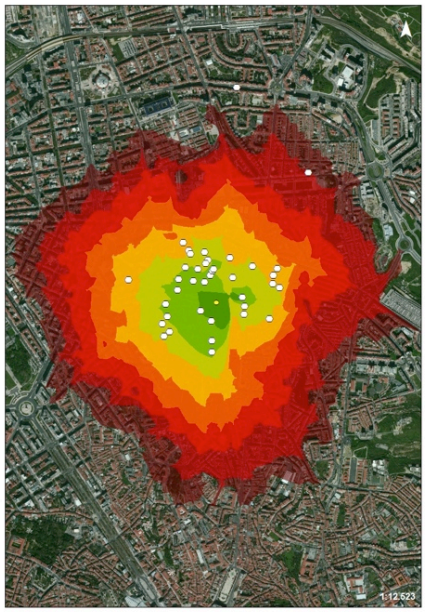
5.1 Description

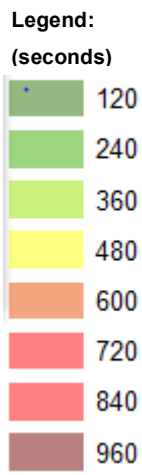
The Arroios parish in Lisbon was selected to be the case study of the present work; the reasons to select Arroios, one of the most densely populated and urbanized areas of Lisbon and located in the consolidated urban centre, are related with the existence of local urban green spaces and a low green spaces capitation index, which means that there is a small value of green area per inhabitant, eventually denoting the lack of these facilities. Two green spaces were selected based on their characteristics and territorial impact: Jardim Constantino and Campo Mártires da Pátria.

5.2 Service area delimitation

From the surveys information it was evidently that proximity to the space, easiness to achieve it, support facilities and security were the most important attractiveness attributes (98,6% of total respondents), in which personal meaning and space's exclusivity were the attributes without relevance for choosing some urban green space (91,9%). The other major motivations for using urban green spaces were leaving home or casualty (37,8%), spending free time (33,8%) and walking or walking the dog (32,4%). It was noted that almost half (41,6%) of the respondents only use the urban green space under study, which is not a surprise since the majority it was elderly population who lives nearby and with mobility limitations. The main transportation mode it was walking (98,7%) and the average time spent it was 6 to 10 minutes (54,5%). It was observed that in Jardim Constantino the time between 0 to 5 minutes gains more expression probably because of residential surroundings and the fact of the nearby neighbourhood is located in that break time. The majority (89,6%) does the same route, because of being the most directly and fastest route (87%) according to the individual perception. Regarding to the accessibility attributes the most valued were distance (100%), security (100%), trees and shadow (100%), following by time (98,7%) and slope (94,8%). The most ignored attributes for choosing the access route were the walking pleasure (90,9%), environment/aesthetic and associated feelings (89,6%), street furniture (53,2%) and friends or family's home or work (50,6%).

According to spatial analysis the majority of Jardim Constantino respondents users (in other words their origins) are within 4 (36,84%) and 6 minutes (31,58%) range. On the other hand in Campo Mártires da Pátria the preponderance is between 6 and 8 minutes range (35,9%). In this space the lower percentage of respondents users is within 4 minutes range (2,56%).This observations (supported by cartography – fig. 1 and 2) tell us that the Campo Mártires da Pátria service area (12 minutes) it is bigger than that of Jardim Constantino (8 minutes). This fact can be explained by the space's characteristics, historic centre proximity, nearby public facilities, architectural and municipal interest's heritage which can achieve various segments of the population, as tourists or young people from different parts of the city. On the other hand, Jardim Constantino seems more directed to local residents and daily use.





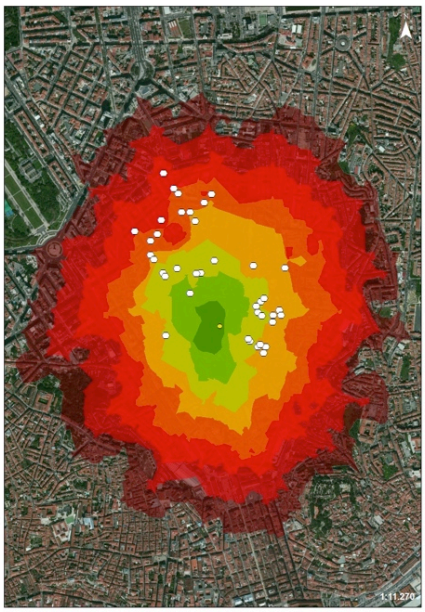


Fig. 1. Jardim Constantino service area with respective origins' users

Fig. 2. Campo Mártires da Pátria service area with respective origins' users

This kind of information it is different from the surveys time information because of the limited and reducer criteria used to create the cost network, which was not considered the age or physical performance of each individual, just like was said earlier. The function used is more targeted to active adult individuals, instead of the elderly population that translates the majority of ours respondents and will naturally have some height on route's time. It was also possible to see that the majority of respondents are conforming to the general recommendations (10 minutes). This value appears from the recommended values by most institutions and researches (5-15 minutes) and the surveys' results (6-10 minutes).

5.3 Identification of areas with lack of local green spaces

After applying this methodology, it was extended to identify areas in need of this type of urban green space on contiguous parishes: Penha de França and São Vicente. The process and associated concepts were the same for the delimitation of service areas only in this case had an inverse approach. First we need to identify the existing green spaces that have neighbourhood characteristics and the free areas to implement this type of space. Following the same logic of the methodology and being into account the 10 minutes reference value it were delimitated the service areas of the urban green spaces identified. By having this information in geographic support it can concludes that the free areas that are not within service areas are therefore potential areas to then implement this type of urban green space. It can also calculate the area with lack of local green spaces with the proportion of the all territory and it noticed that 53% of the area of Penha de França and 47% of São Vicente is in that condition. It can be observed (fig. 3) that there are four potential free spaces to implement these spaces. However it is important not to make this decision only based on this result apparently reducer, since it must take into account the surrounding space's characteristics.

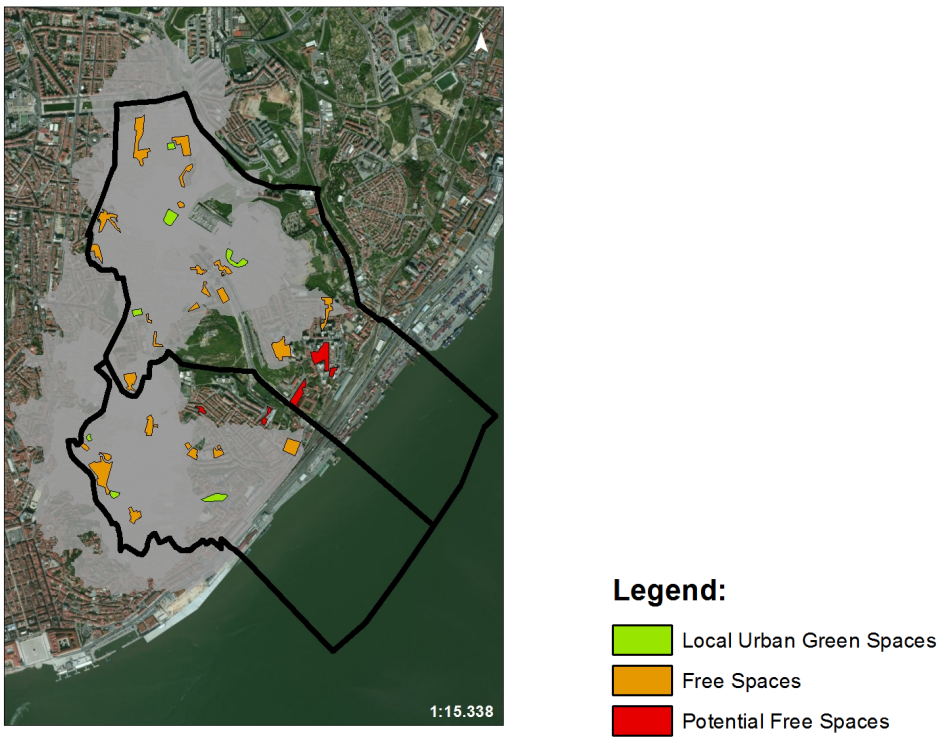


Fig. 3. Areas with lack of local green spaces on Penha de França and São Vicente parishes, Lisbon and identification of free spaces

6 Conclusions

The observations and conclusions get from this paper will address to some of the associated studies, including the weighting of attributes according to the survey results. It was therefore found that security, proximity (distance and time), ease of travel (slope), and presence of trees and shadow on the route are the factors with the greatest weight to the choice of local urban green space and its access. It was found that the dynamics of accessibility override the characteristics of attractiveness inherent to the space itself once users have a practical perspective respectively to access and use of these spaces. The users value above the proximity of the space and the fastest and most direct route. The attributes related to the impediment to movement, translating into attributes with direct practical implications in the individual, hold more consideration compared to the quality of space, the urban environment and individual characteristics. Since the proximity and easiness of the route are essential factors to the use and access to these spaces, this findings may elucidate for future research and intervention proposals that leads to the idea of a network of local urban green spaces in the urban environment. It can also be observed that the two analyzed spaces have distinct service areas and both respect overwhelmingly the general recommendations of 10 minutes (maximum travel time for this type of urban green space).

The methodology is an alternative approach to the standard indicator of capitation of green spaces, validating the need for intervention on territories which are not covered by services areas. This explored extension of the methodology allows viewing the actual area in which action is needed and from the geographic modeling creating scenarios to minimize the area of need, thus identifying the optimal location.

Since most individuals value the distance to green space and a direct and rapid access, the formation of a more dense and continuous network of this type of urban green spaces, based on proximity and easy accessibility factors seems to be the best offer to address their lack, ensuring its regular use and potentiate geographically the benefits associated to these spaces.

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