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Review Paper

THE ASSESSMENT OF PROXIMITY OF URBAN GREEN SPACES IN NIŠ: A GEOSPATIAL ANALYSIS

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Abstract. *The basic prerequisite for realizing the benefits of the implementation of urban green areas (UGS), such as physical and mental health, social cohesion, improving the quality of life, improving air quality, mitigating the effects of heat islands, biodiversity or storm water management, is the spatial proximity of the UGS, their physical availability and accessibility. Applying spatial analysis tools in a GIS environment, the study explores the relationship between the built environment and urban parks in Niš, where such planning tools are underutilized despite the strategic recognition of the importance of UGS in official planning documents. By evaluating the spatial distribution and availability of different types of parks, the research highlights the concept of the "15-minute city" in urban planning. The research includes 48 parks and 33662 buildings generated from the OpenStreetMaps database. The results indicate a low percentage of buildings in close proximity to parks, with significant disparities compared to European cities of similar size. Highlighting the potential of GIS in urban planning decision-making processes, this paper argues for the integration of spatial proximity analysis tools to improve the implementation of UGS and maximize their social benefits.*

Key words: *urban planning, GIS, spatial proximity, built environment*

1. Introduction

Rapid urbanization and climate changes present two main challenges and risks facing humanity today on a global scale. Until 2050, two-thirds of whole population, which is approximately 6,5 billion people, will be urban [1]. At the same time, the potential risks

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of climate change at the global level are: a) an increase in the average temperature by 3°C until 2070; b) reduction of average amounts of rainfall of 20-40% until 2070; c) an increase in sea level in conjunction with an increase in storm events, and d) an increase in the frequency and intensity of stormy periods in the regional framework [2]. Although urban areas cover less than 3 percent of the Earth's surface, they are responsible for an estimated 71% of global energy-related carbon emissions [2]. Bearing that in mind, the UN defined in 2010 [3] three key challenges for sustainable urban development: 1) improving the quality of life in the cities; 2) reducing their ecological footprint and 3) adapting them to climate change, which were translated into the 11th Millennium Development Goal - Sustainable Cities and Communities a few years later [4].

The rapid urbanization, increase of impervious surfaces, continuous growth in the number and size of cities and the ensuing transformation of virgin landscapes on different scales pose significant challenges for reducing the rate of different forms of nature in the cities which are important for ensuring of human welfare. In the wider academic discussions about possible sustainable development and planning solutions, several eco-oriented urban concepts and strategic approaches have been developed in the last few decades. They are focused on the integration of nature and natural processes in built-up areas and deal with spatial and social challenges through the protection, sustainable management and restoration of natural and modified ecosystems.

The most present and influential eco- oriented concepts are: Nature-based solutions (NbS) [5-7]; Ecosystem-based adaptation (EbA) [8,9]; Urban Green Infrastructure (UGI) [10]; Urban Blue-Green Infrastructure (BGI) and Ecosystem services (ESS) [11,12].

Broadly speaking, NbS may be considered as an umbrella to the other three concepts - EbA, UGI and ESS [13], but also depends on UGI and ESS for its further definition and systematic uptake in urban areas [14]. EbA may be considered as a subset of NbS that is specifically concerned with climate change adaptation via the use of nature [14]. Compared to NbS and EbA, the UGI and BGI concept have had a clear link to the urban context from the start, strongly connected to urban planning and rooted in both urban landscape ecology and architecture [15-16]. However, due to multiple ways of describing and the broad range of interested stakeholders who promote them, it is difficult to establish clear differences between these concepts and to determine their precise relationships. It can be said that the biggest differences arise from the breadth of their scope and level of operationalization [14]. Regardless of them, the concepts are closely interrelated, partly overlapping and partly complementing each other. They share many features, starting with multi-functionality and the provision of multiple ecosystem services. But, the most significant common feature of eco-oriented urban concepts, from which the previous two also originate, is their foundation on a broad range of urban green spaces (from here on, UGSs), which are probably the most often used within these concepts to strengthen the role of nature in decision-making [17].

Due to evidence that nature positively affects human well-being [18-19], UGS research is driven by the growing interest in the environmental, social, and economic benefits of its application in urban environments, while the need for more UGS is high on the political agenda of cities around the world. Studies from multiple disciplines explore the interactions with or within UGS, creating a wide range of potentially related, but at the same time, different definitions and classifications of UGS. Nevertheless, the basic prerequisite for the realization of the benefits of the UGS implementation such us physical and mental health, social cohesion, improving quality of life, air quality improvement, heat island effect mitigation, biodiversity or storm water management, is UGSs spatial proximity, their physical accessibility and availability.

A GIS proximity analysis is seen as an important tool in urban planning in the process of the determination of the types, spatial distribution, connection and role of UGS in the UGI at various urban scales (from macro to micro level). Although this planning tool is used in many countries, it is a novelty for urban planning practice in Serbia. Namely, although the role of UGS in urban green infrastructure is recognized at the national and local levels through several strategic documents and plans, the operationalization of the expressed strategic commitments through the process of urban planning and design is still missing.

For this reason, paper aims to point out the possibilities and importance of applying this tool in urban planning and the decision-making process. The city of Niš, the third largest city and macro-regional center of Serbia, was chosen as the research platform due its population size and presence of various UGS types. The research focuses on: 1) parks (extensive urban parks, neighbourhood/residential parks and pocket parks) and 2) riverbank green, linear parks or urban corridors as the largest UGSs in Niš, which are also recognized in the majority of current UGS typologies as important and often present UGS types [20-22].

The paper evaluates the spatial proximity of the chosen UGS types which are identified on the territory of the urban settlement Niš (which represents the central part of the administrative territory of the city of Niš), and examines their accessibility from the aspect of the ''15-minute city'' urban planning concept [23-25].

2. Urban Green Space: Setting the Context

A several definitions of UGS are present. Analyzing the conglomeration of UGS definitions within different disciplines, Taylor and Hochuli believe that there are two possible interpretations of UGS that could provide a more functional understanding [18]. The first is that UGS refers to bodies of water or areas of vegetation in a landscape, such as forests and wilderness areas, street trees and parks, gardens and backyards, geological formations, farmland, coastal areas and food crops. This interpretation refers to an overarching concept of nature or natural areas, both in general and urban context. Within this interpretation UGS can be defined as green spaces broadly encompass publicly accessible areas with natural vegetation, such as grass, plants or trees and may include built environment features, such as urban parks, as well as less managed areas, including woodland and nature reserves [26].

The second interpretation represents urban vegetation, including parks, gardens, courtyards, urban forests, and urban farms—usually associated with a vegetated variant of open space [18]. This interpretation could be described as a subset of the comprehensive concept of UGS that is limited to the urban environment and a subset of open space. This understanding describes people-focused land use that requires human participation and planning to be successful, even to ensure its conservation [27]. Within this interpretation, UGS can be defined as any vegetated land adjoining an urban area which includes bushland, nature reserves, national parks, outdoor sports fields, school playgrounds and rural or semi-rural areas immediately adjoining an urban area [28]. So, UGS is usually, but not always, comprised of vegetation and associated with natural elements [18].

Due to various ways to definitions, as well as their diverse characteristics, the different UGS typologies are present. For example, [20] recognize 25 UGS types, divided into four main groups: 1) amenity green space; 2) functional green space; 3) semi-natural habitats, and 4) linear green space, which are later divided into 10 subgroups. Bell et al. (2003) considered under UGS the following: parks and gardens, natural and semi-natural spaces, green corridors, allotments, community gardens and urban farms, outdoor sport facilities, amenity green spaces, provision for children and young people, cemeteries, disused churchyards and other burial grounds, as well as other public spaces, such as squares, pedestrian areas or cycling areas [21]. Some other typologies are based on usage [29], dimensions and size of green spaces that are important for urban consolidation, i.e. naturalness, activity types, etc. [30], or cover informal UGS [31]. Within Greensurge project (2017) 44 UGS green (and blue) elements are recognized [22].

However, in each of the mentioned UGS definition and typologies, parks (with their subcategories) are recognized as one of the key UGS types. Parks are recognized through their subcategories which represent the spatial level, importance and role of the park and use of the urban environment - such as citypark, district-park, neighbourhood park, residential park or pocket park (Fig. 1), or represent the form of the park - such as linear park (Fig. 2). For the purposes of this research, all the listed subcategories of parks were considered.

The performance and benefits of implementation of city, neighbourhood and residential parks are shown in Fig. 1.

Description

Residential parks are part of the UGI and serve residential areas as the nearest main entry point for nature based recreation. They positive effects for urban climate, recreation, and biodiversity. Larger spatial elements of UGI like city or neighbourhood parks often deliver more functions and combine various uses (e.g. sport fields). Smaller spatial elements of UGI that also act as residential parks include playgrounds and pocket parks.

Conditions for Implementation:

- Connectivity to the surroundings
- Equal distribution throughout urban areas
- Suitable size
- Proportion of trees in relation to area

Similar terminology:

Urban park
Pocket Park
Parklet

Performance – Ecosystem Services				
Cooling service	Transpiration			
	Shading			
	Evaporation			
	Building (Insulation)			
	Reflection (Albedo)			
Surface water regulation	Water conveyance			
	Water infiltration			
	Water retention			
	Water storage			
	Water re-use			
Water purification	Water filtering			
	Water bio-remediation			
Air purification and noise reduction	Deposition			
	Air biofiltration			
	Noise reduction			
Biodiversity	Habitat provision			
	Connectivity			
Socio-Cultural services	Beauty/Appearance			
	Usability/Functionality			
	Social interaction			
	Education			
Provisioning service	Food/Energy/Material			
Climate regulation	CO2 sequestration			

Fig. 1 City, neighborhood and residential parks – Performance and benefits of implementation (Source: https://unalab.eu/en/node/165).

Riverfront green can be also seen as a linear park and a form of urban corridor. A linear park is an outdoor area that connects landmarks, parks, or open spaces for passive or active recreation. Many linear parks stretch through urban areas and provide much-needed greenery. These parks can be built on old transportation infrastructure, greenways or waterfront areas, as in case of Niš. Linear parks along riverfront have a lot of potential for connect UGI with surrounding natural environment. In addition, line of green infrastructure that penetrates the centre of a city allows more residents from more locations to reap its benefits, promoting the benefits of the green spaces more effectively than a square or rectangular park.

Their performance and benefits of implementation of linear park and green corridors along riverfront are shown in Fig. 2.

Description
Areas of derelict infrastructure, e.g. railway lines, that are transformed into linear parks play an important role in UGI networks and help to re-nature cities. Regeneration along waterways and rivers also often results in linear, interconnecting parks. Green corridors can increase accessibility to green spaces while promoting environmentally sustainable transportation like walking and cycling. They also may support biodiversity via improved ecological networks and habitat connectivity.

Conditions for Implementation:

- Abandoned traffic infrastructure with enough surrounding space is often convenient for the establishment of green corridors, as well as river front

Similar terminology:
Linear park
Green belts

Performance – Ecosystem Services				
Cooling service	Transpiration			
	Shading			
	Evaporation			
	Building (Insulation)			
	Reflection (Albedo)			
Surface water regulation	Water conveyance			
	Water infiltration			
	Water retention			
	Water storage			
	Water re-use			
Water purification	Water filtering			
	Water bio-remediation			
Air purification and noise reduction	Deposition			
	Air biofiltration			
	Noise reduction			
Biodiversity	Habitat provision			
	Connectivity			
Socio-Cultural services	Beauty/Appearance			
	Usability/Functionality			
	Social interaction			
	Education			
Provisioning service	Food/Energy/Material			
Climate regulation	CO2 sequestration			

Fig. 2 Urban corridors-riverfront green-linear parks: Performance and benefits of implementation.

UGSs are a key physical and functional urban form in the process of implementation of eco-oriented urban concepts in urban practice. They play multiple roles and making cities more sustainable, well-functioning. UGS can: 1) provide recreation in everyday life, at different city scales; 2) contribute to the conservation of biodiversity; 3) contribute to the cultural identity; 4) help maintaining and improving the environmental quality; and 5) bring natural solutions to technical problems, for example storm water management [32].

3. METHODOLOGY AND DATA

3.1. Study area

With an area of 596.73 km^2 and 178,976 inhabitants in the urban area and 249,816 inhabitants in the administrative territory, the City of Niš is the third most populous city in Serbia, a macro-regional center in the network of Serbian cities and a socio-economic, administrative and university center of the regions of Southern and Eastern Serbia [33]. Since 2004, the city of Niš has been administratively divided into five city municipalities: Medijana, Palilula, Pantelej, Crveni Krst and Niška Banja. In addition to the urban settlements of Niš and Niška Banja, there are also 68 rural settlements on the administrative territory. This study focuses on chosen park types which are identified on the territory of the urban settlement Niš (which represents the central part of the administrative territory of the city of Niš), with high population density and a well-developed transportation system, so it can accurately represent the context (Fig. 3).

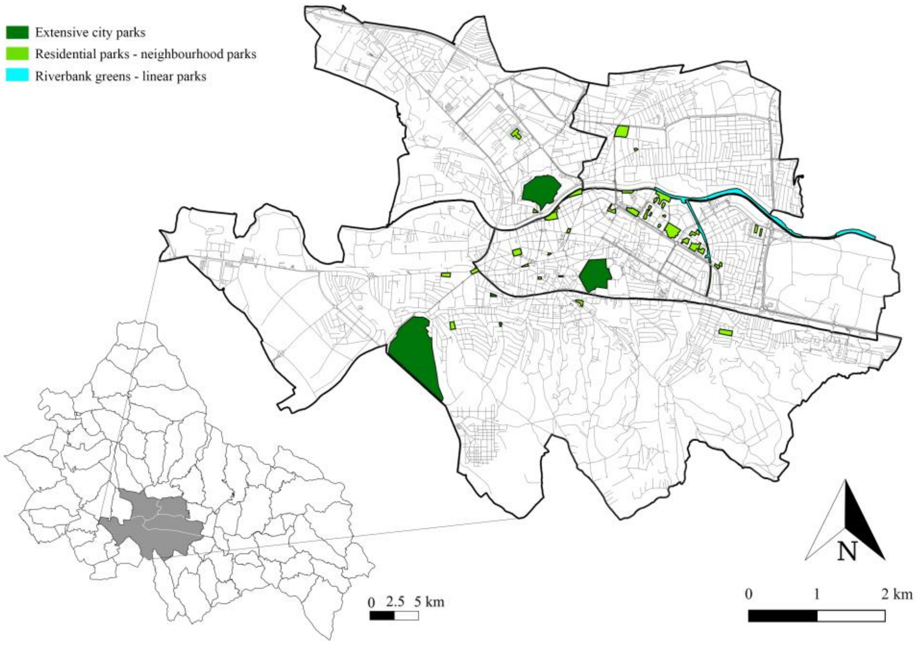

Fig. 3 Study area.

This study considers various sizes of parks raging from extensive city parks and community parks to small "pocket parks". The criterion for selecting was that each can support either leisure or recreational activities. In the final analysis they are divided only in two categories: extensive city parks and riverbank green, and community/neighborhood parks. In total, 48 parks are identified spanning a combined area of 117.67 hectares. On average, each individual has 6.4 (4.7) square meters of green space. Their spatial distribution is shown in Fig. 3. The largest share of pocket, residential parks and linear riverbank green are located in the most densely populated zone in the municipality of Medijana.

3.2. Accessibility to different categories of parks

The fact that a particular park is available does not mean that it is accessible. When it comes to accessibility there is no universally accepted definition. The accessibility considers the various physical, social, and economic factors that influence people's ability to enjoy and benefit from parks, or as Parker and Doak defines it, a relative and dynamic capacity to reach or be reached. In this research authors focus on physical proximity [34]. Due to lack of population data at the level of individual building, block or neighborhood, the proximity is analyzed as a distance between every building in the selected area and parks, as a proxy indicator of the accessibility.

Numerous methodological approaches are available for measuring distances, however, two the most prevalent are Euclidean distance and network distance [35]. Euclidean distance, commonly referred to as straight-line distance, denotes the direct length of the geometric line linking two specified points, where one acts as the origin and the other as the destination. In contrast, network distance relies on specialized network analysis techniques tailored to address inquiries pertaining to linear networks. Thus, there is a notable difference in the service area those approaches offer. The service area is employed in spatial analysis to identify the locations within a specific distance or proximity of a particular point or feature of interest.

In GIS-based assessment a buffer-based service area defined by Euclidean distance denotes a geographic zone surrounding a designated point or feature, like parks, with predefined distance (Fig. 4a). On the other hand, a network-based service area pertains to a geographic zone delineated by the accessibility of locations within a transportation network (Fig. 4b). Network-based service areas are established by travel routes and specified travel times within the transportation network, considering actual road network topology and travel speeds. Therefore, network-based service areas in GIS analytics offer a more authentic depiction of accessibility than buffer-based service areas by accounting for actual travel routes and transportation infrastructure. Thus, in this study the network-based approach is applied.

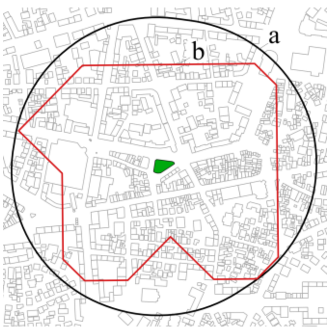

Fig. 4 Euclidian vs network based service area.

3.3. Defining the distances to parks

The analysis aims to assess the accessibility of parks within various walking distances in an urban area. It is critical to understand the distances that citizens are willing to walk in order to reach a park. Even though WHO recommends a consistent service distance of 300 m, there are many arguments in favor of formulating various levels of service distances corresponding to the sizes of parks, because parks of varying scales can provide diverse opportunities for activities and therefore provide different user experiences. For example, pocket parks are typically used for daily leisure activities and should be located as close to a residential unit as possible to facilitate frequent use by nearby residents. Large-scale parks, on the other hand, have demonstrated the ability to draw inhabitants from a longer distance because to the unique experience they may provide for urban dwellers [36,37]. The standards applied in this research take into account a "15 minutes cities" that revolves around the idea of creating neighborhoods where residents can access most of their daily needs, among others recreational and leisure activities, within a 15-minute walk from their homes [23]. Therefore, this study considers following walking distances corresponding to the specified time intervals:

- 0-5 minutes walking: Approximately 0-400 meters.
- 5-10 minutes walking: Approximately 400-800 meters.
- 10-15 minutes walking: Approximately 800-1200 meters.
- 15+ minutes walking: Approximately >1200 meters.

For each time interval corresponding isochrones is generated and the associated buildings were taken into consideration for further analysis.

3.4. Data Collection

For this study spatial data includes organized and equipped public parks, inventory of built-up area and street network data representing the road infrastructure in the study area (Table 1).

Table 1 Data

Data	Data sources	Methods
Land use	OpenStreetMap (OSM)	PlugIn "QuickOSM"
Road Network	OpenStreetMap (OSM)	PlugIn "QuickOSM"
Buildings footprint	OpenStreetMap (OSM)	PlugIn "QuickOSM"

Park vector data are derived from OSM and adjusted according to satellite images to improve accuracy. The inventory of parks was compared with to satellite images of the city and parks that were not included in OSM database were added manually.

Considering the fact that the origins of network analysis should be the access points, instead of centroids, of a park to simulate where people enter park, to establish the entrances and exits of each park, authors performed on-site surveys of all access points and compared them to satellite images. To calculate isochrones for the given walking distances TravelTime plugin processing algorithms is used through TravelTime API for QGIS (TravelTime 2023[1]). The algorithm is run from every entrance point for the parks

[1] https://github.com/traveltime-dev/traveltime-platform-qgis-plugin

bigger than 0,5 ha. For the smaller once it makes no bigger difference in generated network service area, thus for them, the centroids are generated and the algorithm is run from it. Isochrones generated for one time interval for all parks are merged into single isochrones to create a final service area for analysis.

4. RESULTS

The aim of the analysis was to identify, on a city-wide scale and in an indicative manner, where citizens impacted by a lack of closeness to public green spaces, those who must walk more than 15 minutes to reach a park are located. The map below depicts the territorial distribution of the parks in relation to built environment, i.e., the vicinity of the city's public green areas (Fig. 5). The proximity is given as walking time from the aforementioned parks.

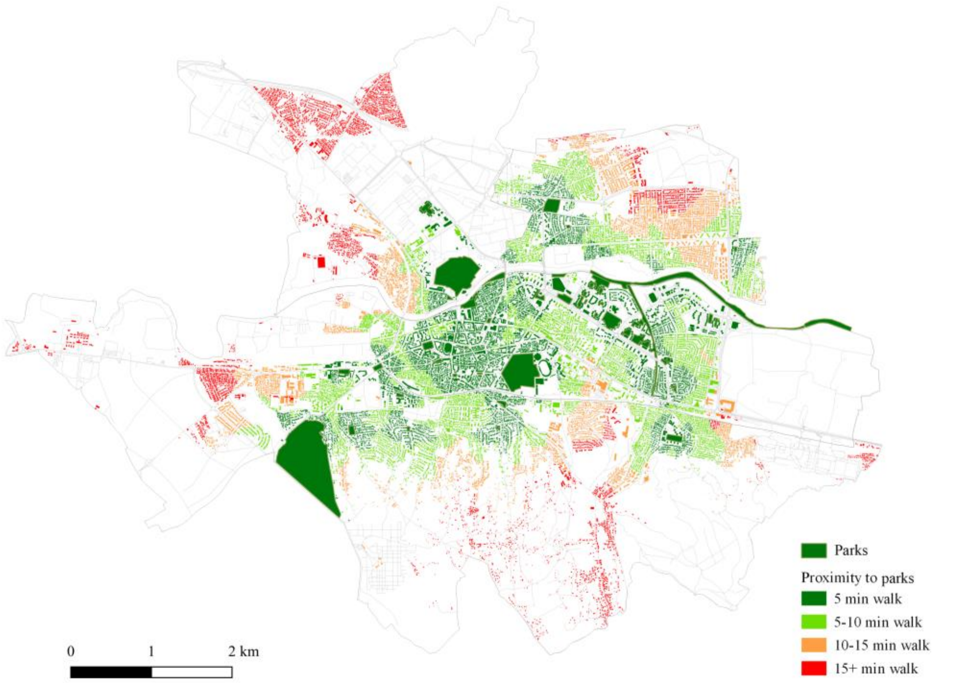

Fig. 5 Proximity to all types of observed parks.

First part of the analysis includes all types of parks identified, i.e., extensive urban parks, neighbourhood /residential parks, pocket parks, riverbank greens, linear parks or urban corridors. The proximity to mentioned parks are calculated for total 37662 buildings that were generated form the OSM database. The analysis shows that 11024 buildings (29.3%) are located within the 400-meters network distances or up to 5 minutes walking, 12818 buildings (34%) falls in the category where from each building 5-10 minutes walking is needed to the nearest park, 7108 buildings (18.9%) are located 10-15 minutes walking from the nearest park, and 6712 buildings (17.82%) are 15+ minutes walking away from closest park. Considering the “15 minutes cities” approach, the residences of 82.2% of all selected buildings (30950) can reach in less then 15 minutes walking some type of park, i.e., the residence of 17.8% of the buildings analyses falls in the category of disadvantaged population that need more than 15 minutes. In case of 10% of all buildings, this distance is more than 20 minutes. Most of the parks from this group (40 out of 48) comprise a neighbourhood/residential parks or pocket parks, which have a limited capacity to support longer and diverse recreational or leisure activities, and thus, results must be read considering the abovementioned.

Second part of analysis accounts only for the city parks, and riverbank greens that have an area larger than 3 ha (Fig. 6). These parks are not only larger in size but, generally, better equipped and organized to support various recreational and leisure activities, but also, in terms of size and green mass have greater capacities to provide environmental services. Thus, they offer a different image of the city-wide accessibility to parks.

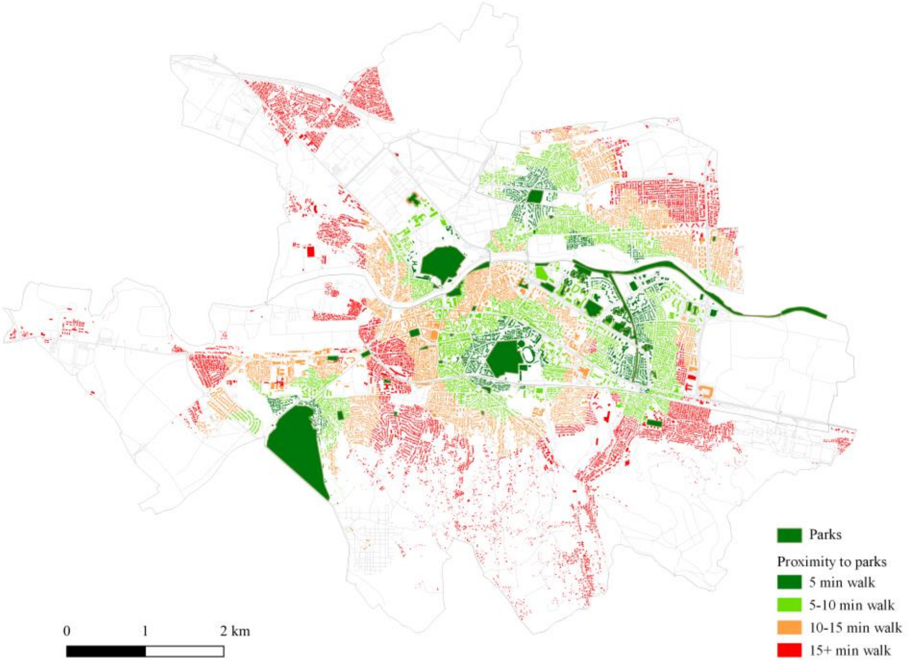

Fig. 6 Proximity to city and linear parks larger than 3 ha.

The proximity analysis to large parks shows following: only 3637 buildings (9.7%) fall within a service area of up to 5 minutes walking to park, or approximately 400 meters, 10432 buildings (27.7%) falls in a category where from each building 5-10 minutes walking is needed to the nearest park, 10351 buildings (27.5%) are 10-15 minutes walking away from the nearest park, and 13242 buildings (35.2%) are 15+ minutes walking away from closest park. In comparison to previous results, it is notable that the share of disadvantaged population, i.e., residence of 35.2% of observed buildings, that need more than 15 minutes walking to the nearest park, is practically doubled. So, 64.8% of buildings and their residence are within the 15 minutes time frame from the nearest park

In Table 2. Proximity to each of the large parks is presented. As it can be noted, the share of buildings that are less than five minutes walk from them are marginal, ranging from 0.2% in case of the City fort, to 2.7% in case of park Čair and Gabrovac river riverbank. Looking across all the time intervals, City fort and riverbank of Gabrovac River have the highest share of buildings belonging within their service area (accounting for 20% out of total number), comparing to other large parks.

Finally, we considered the areas with the highest population density, the part of the central zone that belongs to Mediana municipality that have an approximate population of more than 80000. Although we do not have the population data, it is safe to assume that parks located in the vicinity of this area are under the highest pressure (Fig. 7). Thus, the share of proximity to parks in this area is as following: as many as 5832 buildings or 57.9% are located less than 5 minutes walking from the closest park, 3956 buildings (39.28%) are 5-10minutes away form the nearest park and 254 buildings or 2.5% are between 10 and 15 minutes walking from the closest park. So, this zone conforms with the "15 minutes city" concept, when it comes to proximity to park.

Table 4 Proximity to parks larger than 3ha

Park	Walking distance		
	5min	10min	15min
Park Bubanj			
number of buildings within the service area	413	1224	1913
%	1.1	3.2	5.1
City Fort			
number of buildings within the service area	60	870	2448
%	0.2	2.3	6.5
Park Čair			
number of buildings within the service area	1055	2872	233
%	2.7	7.6	0.6
Nišava riverbank			
number of buildings within the service area	590	921	970
%	1.6	2.4	2.6
Gabrovac river riverbank			
number of buildings within the service area	1023	2058	667
%	2.7	5.5	1.8

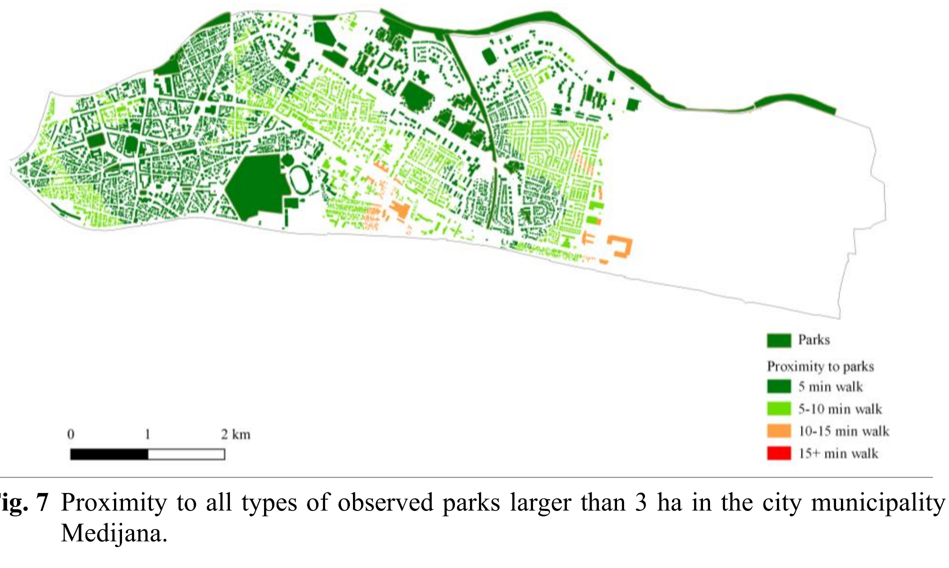

Fig. 7 Proximity to all types of observed parks larger than 3 ha in the city municipality Medijana.

5. Concluding discussion

Although, findings must be read in the context of the available data, they reveal a spatial relationship between the built environment and parks, pointing out areas that are in deficiency of organized public parks. They also highlight the fact that the physical proximity does not necessary means accessibility.

The presented results point to a rather low share in the number of buildings that are in the immediate vicinity of the park of any type (9.7% in case of large parks - 29.3% in case of all parks). The share of buildings distanced up to 15 minutes of a walk and more is between 36.7% (in case of all parks) and 62.6% (in case of large parks). For instance, the European cities of a similar size (under 250000 inhabitants) like Bern, Ljubljana, Reykjavík or Luxembourg, have between 50 and 98% of population living in approximately 10 minutes walking to the parks larger than 3ha [38]. Similar study conducted by Pojani (2022) [39]. shows that a high percentage of population has access to parks within 300 m, spanning from 49% in Milan, up to 70.8% in Prague. Both investigations reveal a significant difference in comparson to the City of Niš. Based on that, although this study focuses on the proximity of buildings, it is indicative that a significant share of population has a limited accessibility to parks in the City of Niš.

Two official planning documents for the City of Niš prioritize green infrastructure as a priority measures in the domain of environmental protection and climate change adaptation: 1) Development Plan of the City of Niš for the period 2021-2027[2], within Development direction 2: Territorial development and environmental protection, priority goals and measures are defined, which, among other things, relate to sustainable urban development, greenery and the application of nature based solutions; 2) Draft Strategy for the Development of the Urban Area of the City of Niš and the Municipalities of Svrljig, Merošina and Gadžin Han[3] – within priority objective 2: Promoting clean and fair energy transition, green and blue investments, climate change adaptation and mitigation, risk prevention and management, and sustainable urban mobility, this document defines development measures related to building or improving green infrastructure. This confirms the long-term intentions of the city planning administration for systematic improvement and development of UGS. However, both documents lack operational instruments and metrics for the implementation of the measures. In line with the aim of this study, the results point out the possibilities in applying the spatial proximity analysis to parks in urban planning and the decision-making process, and therefore can serve as instrument for the implementation of the abovementioned measures.

However, we recognize the following limitations of our methodology that highlight additional refinement to offer more precise information to urban planning and design: 1) private roads and footpaths are not included in the analysis. These pathways may be included in future investigations. However, a park may not be deemed fully accessible if it lacks safe and comfortable pedestrian infrastructure; 2) this study did not take into account the quality, size, or form of green areas. Future research might establish a park hierarchy based on weightings or score ranges, and assign varying accessibility distances based on park relevance. GIS can predict the quantity and form of green areas, but giving quality rankings requires detailed qualitative data and field inspections; 3) the study did not consider non-urban UGS near urban areas, which may be used for exercise and enjoyment by inhabitants in the suburbs. As a result, the number of urban green areas available to local residents may have been underestimated. Future study might examine the accessibility of both blue and green places, as they offer equivalent advantages. The access

[2] https://investnis.rs/wp-content/uploads/2021/04/Plan-razvoja-GN-za-period-2021-2027.pdf
[3] https://www.ni.rs/wp-content/uploads/2023/10/Strategija-razvoja-urbanog-podrucja-grada-Nisa-FINAL.pdf

to census data at the level of urban neighborhood, street or building would allow for location-allocation analysis that may provide a prediction of suitable location of new parks that will satisfy the conditions of high accessibility for all residence of the City of Niš.

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PROCENA BLIZINE URBANIH ZELENIH POVRŠINA U NIŠU: GEOPROSTORNA ANALIZA

Osnovni preduslov za ostvarivanje prednosti implementacije urbanih zelenih površina (UGS) kao što su fizičko i mentalno zdravlje, društvena kohezija, poboljšanje kvaliteta života, poboljšanje kvaliteta vazduha, ublažavanje efekata toplotnih ostrva, biodiverzitet ili upravljanje atmosferskim vodama, jeste prostorna blizina UGS-a, njihova fizička dostupnost i pristupačnost. Primenjujući alate za prostornu analizu u GIS okruženju, studija istražuje odnos između izgrađenog okruženja i urbanih parkova u Nišu, gde su takvi alati za planiranje nedovoljno iskorišćeni uprkos strateškom prepoznavanju važnosti UGS-a u zvaničnim planskim dokumentima. Ocenjujući prostornu distribuciju i dostupnost različitih tipova parkova, istraživanje naglašava koncept „15-minutnog grada“ u urbanističkom planiranju. Istraživanje uključuje 48 parkova i 33662 objekta generisanih iz OpenStreetMaps baze. Rezultati ukazuju na nizak procenat objekata u neposrednoj blizini parkova, sa značajnim disparitetima u poređenju sa evropskim gradovima slične veličine. Ističući potencijal GIS-a u procesima donošenja odluka o urbanističkom planiranju, ovaj rad se zalaže za integraciju alata za analizu prostorne blizine kako bi se poboljšala implementacija UGS-a i maksimizirale njihove društvene koristi.

Ključne reči: *urbano planiranje, GIS, prostorna blizina, izgrađeno okruženje*