URBANI IZZIV

URBAN CHALLENGE

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nature-based solutions

na naravi temelječe rešitve

zelena infrastruktura

green infrastructure

vitalnost

urban vitality

mest

post-socialist urban development

razvoj postsocialističnih mest

commoning

ustvarjanje skupnega dobra

urbano upravljanje

urban governance

krožno mesto

circular city

gender-based violence

nasilje na podlagi spola

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Revija ***Urbani izziv*** je namenjena razširjanju znanstvenih in strokovnih dognanj ter obravnavi problemov urejanja prostora. Na leto izideta dve številki. Prva številka izide junija, druga decembra. *Urbani izziv* se vsebinsko deli na dva dela. Prvi (daljši) del se imenuje Članki. V njem so objavljeni izvirni in pregledni znanstveni članki ter kratki znanstveni prispevki. Članki, ki so objavljeni v tem delu revije, so recenzirani. Drugi (krajši) del se imenuje Predstavitve in informacije in je namenjen objavi recenzij in predstavitvam (na primer knjig, projektov, dogodkov, predavanj, konferenc in podobno), knjižničnim informacijam, kritičnim razmišljanjem in podobnim vsebinam. Prispevki, ki so objavljeni v tem delu revije, niso recenzirani. *Urbani izziv* je dvojezična revija – vsi prispevki so objavljeni v slovenskem in angleškem jeziku. Povzetki in polna besedila člankov so vključeni v slovensko podatkovno zbirko COBISS in slovensko digitalno knjižnico dLib.si ter v mednarodne bibliografske baze SCOPUS Elsevier, ERIH PLUS, EBSCOhost (Art & Architecture Complete, Academic Search Complete), ESCI (Clarivate Analytics), ProQuest (ProQuest Central), CEEOL (Central and Eastern European Online Library), IBSS (International Bibliography of the Social Sciences), IBZ (International Bibliography of Periodical Literature in the Humanities and Social Sciences), GEODOK (Geographic Literature Database), EZB (Electronic Journals Library), CGP (Current Geographical Publications), ICONDA (International Construction Database), DOAJ (Directory of Open Access Journals), OCLC (Online Computer Library Center), Ulrich's Periodicals Directory, Academic Journals Database, Sciencegate, Index Copernicus International, J-Gate in Genamics JournalSeek. Revija je vpisana v razvid medijev, ki ga vodi Ministrstvo za kulturo Republike Slovenije, pod zaporedno številko 595. Revija izhaja s podporo Javne agencije za znanstvenoraziskovalno in inovacijsko dejavnost Republike Slovenije.

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Uvodnik: Vita Žlender

Napredek na področju digitalizacije, mobilnosti, dostopnosti podatkov in izmenjave znanja je močno razširil metodološki nabor orodij, ki so na voljo raziskovalcem in urbanistom. Geografski informacijski sistemi (GIS), prostorsko modeliranje in vse bolj tehnološko zapletene analitične tehnike omogočajo raziskovalcem, da proučujejo urbane pojave z doslej nedosegljivo natančnostjo in na podlagi tega razvijajo na dokazih temelječa priporočila za načrtovanje. Toda čeprav se metode nenehno razvijajo, ostajajo temeljni cilji urbanističnega načrtovanja večinoma nespremenjeni: prizadevanje za čistejša, prijetnejša za bivanje, vključujoča, trajnostna in odporna mesta.

S sodelavci smo pred kratkim preuredili pisarne in ob tej priložnosti poskrbeli tudi za čiščenje arhiva. To me je spomnilo na to kontinuiteto. Ko smo se soočili z desetletja staro projektno dokumentacijo, je sodelavka v šali pripomnila, da je bolje, da ne začnemo brati arhivskega gradiva, da ne bi ugotovili, da so bile številne ideje, ki jih danes štejemo za inovativne, že prej raziskane. V tej opazki je nekaj resnice. Številni izzivi in prizadevanja urbanističnega načrtovanja se ponavljajo. Vendar pa mora vsaka generacija raziskovalcev urbanega prostora ta vprašanja ponovno obravnavati ob upoštevanju spreminjajočih se družbenih razmer, okoljskih pritiskov in tehnoloških možnosti. Sodobna orodja omogočajo raziskovalcem, da dokaze pridobivajo hitreje in natančneje, vendar še vedno gradijo na temeljih, ki so jih položili prejšnji znanstveniki in strokovnjaki. V tem kontekstu ostaja aktualna znana metafora »stati na ramenih velikanov«.

Članki v tej številki revije Urbani izziv prikazujejo več poti, po katerih se trenutno raziskuje preoblikovanje mest. Obravnavajo raznovrstne teme, vendar si vsi prizadevajo za boljše razumevanje mestnih okolij ter opredelitev priložnosti za učinkovitejše načrtovanje, oblikovanje in upravljanje teh. Omeniti je treba, da ta številka vključuje dva pregledna članka. Prvi se osredinja na opredelitev pristopov za oblikovanje in načrtovanje bolj vključujočih in dostopnih javnih prostorov za najstnice. Drugi sistematično prouči literaturo o regenerativni urbani transformaciji ter opredeli ključne teme in izzive pri izvajanju ter posledice za oblikovanje politik. Vprašanja urbane regeneracije raziskujejo tudi avtorji primerjalne študije nekdanjih vojaških lokacij v Ljubljani, Pragi in Pulju. Z osredinjanjem na vidik teorije skupnih virov avtorji raziščejo potencial praks skupnega upravljanja, da prispevajo k prilagodljivi ponovni rabi mestnih območij in alternativnim oblikam družbene organizacije. Vitalnost mest je še eden od vidikov urbane transformacije, ki se obravnava v tej številki. Avtorji razvijajo metodologijo za merjenje in kartiranje vitalnosti in jo preizkusijo v srbskem mestu Niš. Kakovost okolja je ena od pomembnih dimenzij urbane transformacije. Uvodni članek te številke uporabi analizo na podlagi orodij GIS in podatke iz mestnega registra zelenih površin za proučitev potenciala za vezavo ogljika pri mestnih drevesih v Bukarešti v Romuniji. Ugotovitve avtorjev kažejo, da kljub večji učinkovitosti vezave ogljika pri avtohtonih vrstah skupni prispevek obstoječih dreves in grmovnic ostaja zanemarljiv v primerjavi s skupnimi ravnmi emisij v mestih. Avtorji poudarjajo pomen ciljno usmerjenih strategij, temelječih na naravi, in širitve avtohtone vegetacije pri upravljanju vezave ogljika v mestih.

Prispevki v tej številki kažejo, da so poti do urbane preobrazbe raznovrstne. Segajo od na naravi temelječih rešitev in prostorske analize do prilagodljive ponovne rabe, regenerativnega načrtovanja in vključujočega oblikovanja javnega prostora. Čeprav se pristopi razlikujejo, imajo skupni cilj: izboljšanje kakovosti, trajnosti, pravičnosti in odpornosti urbanih okolij.

Pathways to urban transformation

Editorial by Vita Žlender

Advances in digitalization, mobility, data availability, and knowledge exchange have greatly expanded the methodological toolkit available to urban researchers and planners. Geographical information systems (GIS), spatial modelling, and increasingly sophisticated analytical techniques allow researchers to examine urban phenomena with unprecedented precision and to develop evidence-based planning recommendations accordingly. However, although the methods continue to evolve, the fundamental aims of urban planning remain largely unchanged: the pursuit of cleaner, more liveable, inclusive, sustainable, and resilient cities.

We recently rearranged our offices and cleaned up our archive along the way – which reminded me of this continuity. Faced with decades-old project documentation, a colleague jokingly remarked that it is better not to look too closely, lest we discover that many of the ideas we consider innovative today had already been explored previously. There is some truth in this observation. Many of the challenges and aspirations of urban planning are recurring. However, each generation of urban researchers must revisit these questions in light of changing social conditions, environmental pressures, and technological possibilities. Contemporary tools allow researchers to establish evidence more rapidly and rigorously, but they continue to build on foundations laid by earlier scholars and practitioners. The well-known metaphor of "standing on the shoulders of giants" remains relevant in this context.

The articles in this issue of *Urbani izziv* illustrate several pathways through which urban transformation is currently being explored. They address diverse topics, but they all seek to improve our understanding of urban environments and identify opportunities for more effective planning, design, and governance. It is worth highlighting that this issue includes two review articles. The first focuses on identifying approaches for designing and planning more inclusive and accessible public spaces for adolescent girls. The second systematically examines the literature on regenerative urban transformation, identifying key themes, implementation challenges, and implications for policymaking. Questions of urban regeneration are also explored in a comparative study of former military sites in Ljubljana, Prague, and Pula. Through the lens of commons theory, the authors explore the potential of commoning practices to contribute to adaptive urban reuse and alternative forms of social organization. Urban vitality is another aspect of urban transformation explored in this issue. The authors develop a methodology for measuring and mapping urban vitality and test it in the city of Niš, Serbia. Environmental quality is another important dimension of urban transformation. The opening article of this issue uses GIS-based analysis and data from the city's Green Registry to examine the carbon sequestration potential of urban trees in Bucharest, Romania. The findings demonstrate that, despite the greater sequestration efficiency of native species, the overall contribution of existing trees and shrubs remains negligible relative to overall urban emission levels. The authors emphasize the importance of targeted nature-based strategies and the expansion of native vegetation in urban carbon sequestration management.

The contributions in this issue demonstrate that pathways to urban transformation are diverse. They range from nature-based solutions and spatial analysis to adaptive reuse, regenerative planning, and inclusive public space design. Although the approaches differ, they share a common objective: improving the quality, sustainability, equity, and resilience of urban environments.

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Athanasios-Alexandru GAVRILIDIS

Estimating carbon sequestration based on urban tree species: Findings from Bucharest

Urbanization has intensified since the First Industrial Revolution, generating acute socioeconomic and environmental pressures for local authorities, particularly in relation to air quality management. Declining air quality in urbanized areas remains a central challenge, and urban spaces with vegetation, especially urban trees, are increasingly valued for their regulatory ecosystem services. This study examines the potential of urban trees for CO_2 sequestration in Bucharest, Romania. Tree distribution and species composition were spatially represented with geographic information systems (GIS) based on data from the city's Green Registry, and sequestration potential was quantified using validated assessment tools. The results reveal pronounced spatial disparities, with substantial deficiencies in tree cover across several districts. The capacity of areas covered by trees and shrubs to sequester CO_2 is negligible relative to overall urban emission levels. Native species display greater sequestration efficiency, although nonnative species dominate urban landscapes, largely reflecting financial and aesthetic preferences in planting practices. These findings underscore the limited regulatory impact of current urban tree cover on carbon sequestration and emphasize the need for targeted, nature-based strategies – particularly the expansion of native vegetation – to support urban carbon sequestration management.

Keywords: GIS, nature-based solutions, ecosystem services, green infrastructures, Romania

1 Introduction

The Industrial Revolution and the technological advancements of the past century have accelerated the pace of global urbanization, resulting in the emergence of highly dense urban settings (Morris 2013). Historical factors, geographic location, and the availability of key resources have allowed several human settlements to evolve into major economic hubs (Gavrilidis et al., 2015). However, the polarization of resources and population often leads to overcrowding (Booth et al., 2020). If not effectively managed, overcrowding negatively affects the overall quality of urban life, acting as a key driver of urban sprawl and environmental degradation (Gavrilidis et al., 2019). Increasing urban density necessitates the expansion of built-up areas, a process that is frequently detrimental to natural and semi-natural landscapes (Dewan & Corner, 2014). The reduction of areas covered by vegetation in already densely populated urban environments has medium- and long-term consequences for the well-being of urban residents (Popa et al., 2022). Urbanization is regarded as a dynamic socioeconomic phenomenon, influenced by a range of natural and anthropogenic factors, and contributing to high population densities and increased pressure on undeveloped land. The complexity and rapid pace of transformations occurring in urban environments have compelled researchers to assess the effects of ongoing urbanization trends. In this context, policymakers and decision-makers tend to prioritize grey infrastructure and the expansion of residential, commercial, logistics, industrial, and business centres because such developments generate direct economic returns (Dong et al., 2017).

The reduction of permeable surfaces in urban areas alters stormwater runoff patterns, increasing both sewage system maintenance costs and the extent of damage during and after heavy rainfall events (Kong et al., 2017). Furthermore, the loss of vegetated areas because of infill development leads to declining air quality, increased noise pollution (Badiu et al., 2018), and intensification of the urban heat island effect (Gunawardena et al., 2017). As built-up densities increase, available land has become one of the most highly valued urban resources (Gavrilidis et al., 2020). Consequently, a key challenge for city planners, policymakers, and decision-makers is maintaining a balanced relationship between built-up and undeveloped land (Kronenberg et al. 2020). Against this backdrop, although most countries have acknowledged the importance of achieving the Sustainable Development Goals (SDGs) (United Nations, 2015), researchers have emphasized that meeting these targets entails substantial costs and requires the development of appropriate financial tools and programmes (Barua, 2020). The SDG targets and monitoring indicators highlight the need for economic development alongside the efficient management of natural resources. Three of the ten targets of SDG 11 – most relevant to this study – address the preservation of natural features and equitable access to them within urban and urbanized areas. Accordingly, a critical priority for research lies in demonstrating to local and national authorities that integrating natural features into urban landscapes offers a viable pathway to achieving multiple sustainability targets in cities. However, to meet the SDGs over the coming decade, researchers must also understand the needs of policymakers and other stakeholders, and they must develop effective methods that deliver practical and actionable evidence (Allen et al., 2021).

Undeveloped land is becoming increasingly scarce in large cities, making the planning of substantial urban green features particularly challenging. As urban expansion continues, large green spaces, such as parks and gardens, have become less accessible and increasingly subject to infill development (Stoia et al., 2022). In response to these pressures, the concept of ecosystem services has emerged as a framework to support decision-makers and the wider public in recognizing the benefits provided by ecosystems (Costanza et al., 1997). Given the relative scarcity of these benefits in urban environments, the integration of ecosystem services approaches into urban planning and management is strongly recommended (Bolund & Hunhammar, 1999). The implementation of nature-based solutions in urban planning and policy frameworks can enhance community resilience (Antuna-Rozado et al,. 2019; Bartlett & Mistry 2021). Organizing natural features into an urban green infrastructure network improves the provision of ecosystem services at the city scale (Van Oijstaeijen et al., 2020; Zhang et al. 2021). Extensive green areas dominated by trees and shrubs form the backbone of effective urban green infrastructure (Sanesi et al., 2017). Such areas, located within or at the edges of large cities, are widely recognized as critical assets for sustainability and improved quality of life (Felappi et al., 2020). The ecosystem services they provide are of considerable value (Li, 2021), placing them at the centre of multiple conservation policies (Goodspeed et al., 2022). Urban forests, although relatively uncommon in urban environments, differ substantially in definition and management from natural forests. In the context of the urgency surrounding the SDGs and carbon neutrality, local stakeholders and authorities are increasingly encouraged – through sectoral policies and financing programmes – to invest in the protection and expansion of urban forests (Wu et al., 2022).

Urban forestry is regarded as the art, science, and technology of managing trees and other forest resources within and around urban cores, with the aim of maximizing the physiological, sociological, economic, and aesthetic benefits that forests provide (Konijnendijk et al., 2006). Prior studies have highlighted how forests located within or surrounding cities can function as car-

bon sinks, actively sequestering carbon, as well as carbon stores, accumulating carbon in biomass. The efficiency of carbon-cycle management is strongly dependent on factors such as species composition and age structure (Boukili et al., 2017; Vais et al., 2023). Clearly, the carbon sequestration capacity of urban forests differs from that of natural forests due to intensive management practices, younger age structures, and frequent biomass removal (Fares et al., 2017). However, the amount of carbon sequestered by urban forests is considered relatively small in comparison to anthropogenic emissions, and their contribution to climate-change mitigation through sequestration is limited or negligible at the urban scale (Chen, 2015; Velasco et al., 2016). Even so, urban forests possess significant economic value as carbon sinks (Bherwani et al., 2024). In this context, planning and designating urban forests that fulfil the criteria outlined in the definition above presents significant challenges for local authorities, particularly due to high built-up densities and limited land availability. Consequently, local decision-makers should prioritize enhancing urban tree density as an alternative strategy. Although areas with higher tree density cannot fully substitute for the ecosystem services provided by forest ecosystems, the benefits they offer can substantially contribute to improving the economic, social, and environmental dimensions of urban living. The presence of tree- and shrub-covered areas within cities amplifies the benefits delivered by individual trees and shrubs, even when these elements do not collectively function as a fully integrated ecosystem. Furthermore, these benefits operate synergistically with those provided by natural and semi-natural ecosystems located at the urban periphery.

Whereas forest management typically adheres to strict regulations and requires specialized personnel (Ciornei, 2019; Ciornei & Munteanu, 2020), the management and maintenance of urban areas covered with trees and shrubs require different practices, uses, and skill sets. In this context, the focus should be on enhancing the provision of ecosystem services. The quality of these services depends on the management practices employed, as well as on species composition and vegetation quality (Mexia et al., 2018). Trees and shrubs act as significant carbon sinks, and their incorporation into urban environments plays a crucial role in climate-change adaptation and in mitigating the deterioration of urban air quality (Lashof & Neuberger, 2023). Careful species selection for planting, aimed at increasing tree density and expanding these types of areas, can strengthen cities' resilience to environmental hazards while improving residents' quality of life. This study investigates whether the density, distribution, and composition of urban trees in one of the most polluted capital cities in Europe play a role in CO_2 sequestration. To address this research question, the study's objectives were to assess the status of land covered with trees and shrubs, and associated tree densities, to identify the dominant species present, and to estimate the amount of carbon sequestered in Bucharest, disaggregated by tree species.

2 Data and methods

2.1 Study area

Bucharest, the capital of Romania, is located in the southeast of the country, in a plain. The city had a population of 1.79 million in 2021. When the additional 430,000 inhabitants of surrounding Ilfov County are included (National Institute for Statistics, 2023), Bucharest forms Romania's most densely populated urban agglomeration. Over the past thirty years, the population within the city boundaries has decreased by 1.5%, corresponding to an average annual growth rate of −0.5%. In contrast, Ilfov County's population has grown by nearly 40%, with an average annual increase of 1.82% (Figure 1). Consequently, at the regional level (Bucharest and Ilfov County combined), the population has increased by 5.95% over the last three decades. Considering the demographics of the surrounding county is essential when analysing Bucharest because a large share of the population commutes to the city for employment and social activities (Cristea et al., 2017). Examining these demographic trends alongside changes in the number of dwellings reveals a pattern of urban sprawl in Bucharest and Ilfov County, a phenomenon identified in previous studies (Suditu, 2009; Simion & Nistor, 2012). Over the past three decades, the number of dwellings in Bucharest has increased by 26%, with an average annual growth rate of 1.03%, whereas in Ilfov County the number of dwellings has surged by 69%, corresponding to an average annual increase of 3.87%. These trends indicate an expansion of built-up areas at the expense of natural and semi-natural landscapes because new residential developments are accompanied by infrastructure and other urban functions (e.g., commercial, logistics, and business uses).

Romanian regulations classify a wide range of land uses and land covers as green spaces (*Lege nr. 24/2007 (republicată)*, Monitorul Oficial, no. 764/2009). However, some of these areas, such as institutional gardens, are not open to the public, whereas others, including sports grounds or cemeteries, are largely composed of concrete structures. National statistics on green space are based on these regulatory classifications. According to official data, Bucharest has lost approximately 7% of its green space since the fall of the communist regime (National Institute for Statistics, 2023). Similar conclusions have been reached in previous studies, which identified the primary loss of green space as occurring in gardens adjacent to multi-dwelling housing projects, in which these areas were rapidly converted into parking lots (Badiu et al. 2018). When

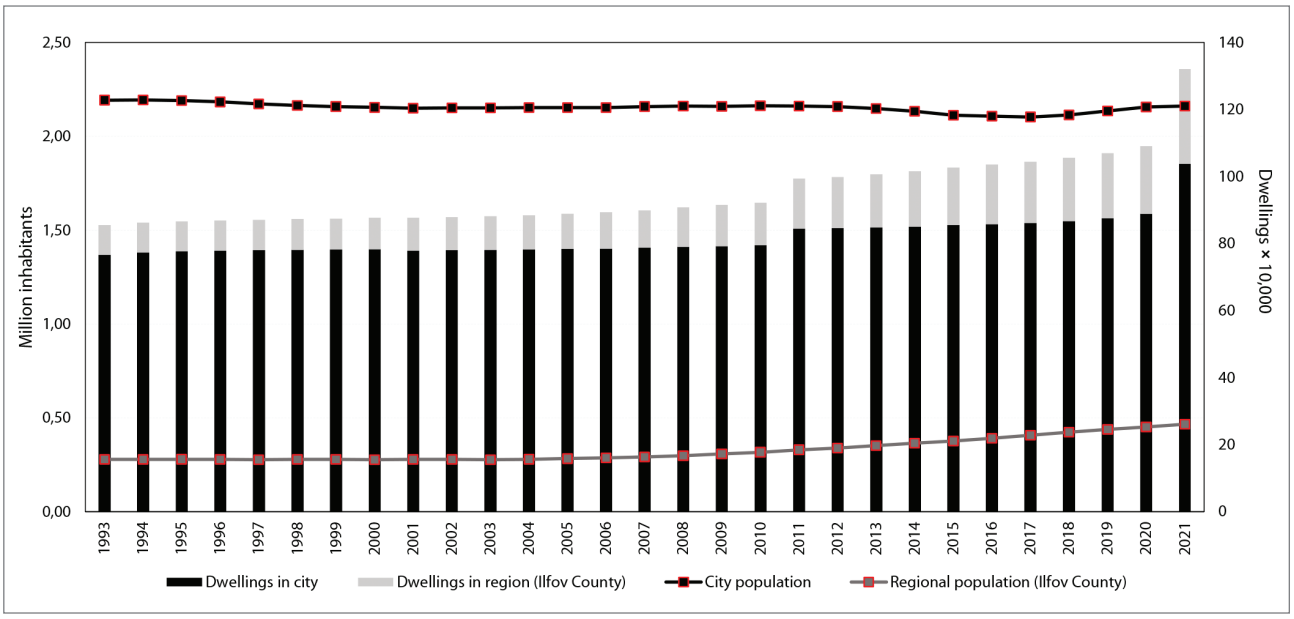

Figure 1: Population and dwelling number dynamics in Bucharest and surrounding Ilfov County in the past three decades (data source: National Institute of Statistics, 2023).

data for Bucharest are combined with those of surrounding Ilfov County, the total land area classified as green space has increased by approximately 14% over the past thirty years. This trend is attributable to the fact that in Ilfov County the development of new built-up areas has included the planning of new green spaces, classified as such under national regulations, whereas within Bucharest's administrative boundaries these urban green spaces have been reduced in size. In both Bucharest and Ilfov County, the largest and most compact natural and semi-natural areas are located in the north (Figure 2).

2.2 Analysis of urban areas covered with trees and shrubs

Areas covered with trees and shrubs were defined as land patches consistent with the FAO definition of "other land with tree cover." Specifically, this category includes urban land uses with tree cover exceeding 0.5 hectares, a canopy cover greater than 10%, and trees capable of reaching a height of at least five metres at maturity. This definition encompasses both forest and non-forest tree species (Hendriks et al., 2021). The data used to analyse the distribution of areas covered with trees and shrubs in Bucharest were derived from two sources: georeferenced point features from the Bucharest Green Registry (Primăria Municipiului București, 2010) and the 2018 small woody features vector layers from the EU's Copernicus platform. Both datasets were processed using ESRI's ArcGIS Pro software. Green Registry data were analysed by creating a grid with a cell size of 1 hectare using the Create Fishnet tool in ArcGIS Pro. The Intersect function within the same GIS environment was then used to extract the number of trees and shrubs per hectare. The small woody features layers were used to compare distribution patterns between the two datasets, given their differing methodologies (Table 1).

2.3 Urban tree and shrub species analysis, and carbon sequestration estimates

The data used to plot the urban tree species abundance were extracted from the Bucharest Green Registry. Although the

Table 1: Input data used for the distribution analysis of urban areas covered with trees and shrubs.

Data	Type	Year	Processing method
Trees	Point	2010	The geolocations of trees and shrubs were gathered during a general survey ordered by the local municipality in 2010 to generate the Green Registry of Bucharest. This database consisted of vector points that were further processed in the study using a grid with the cell size of 1 ha.
Small woody features	Polygon	2018	Supervised classification of satellite image time series from VHR_IMAGE_2018 acquired from May 2017 to September 2019. For patchy structures of trees and scrub the MMU is > 200 m^2 (size limit of 50,000 m^2). The MMW for linear structures/elements is < 30 m. The MML for linear structures/elements is > 30 m. The positional accuracy is less than 5 m.

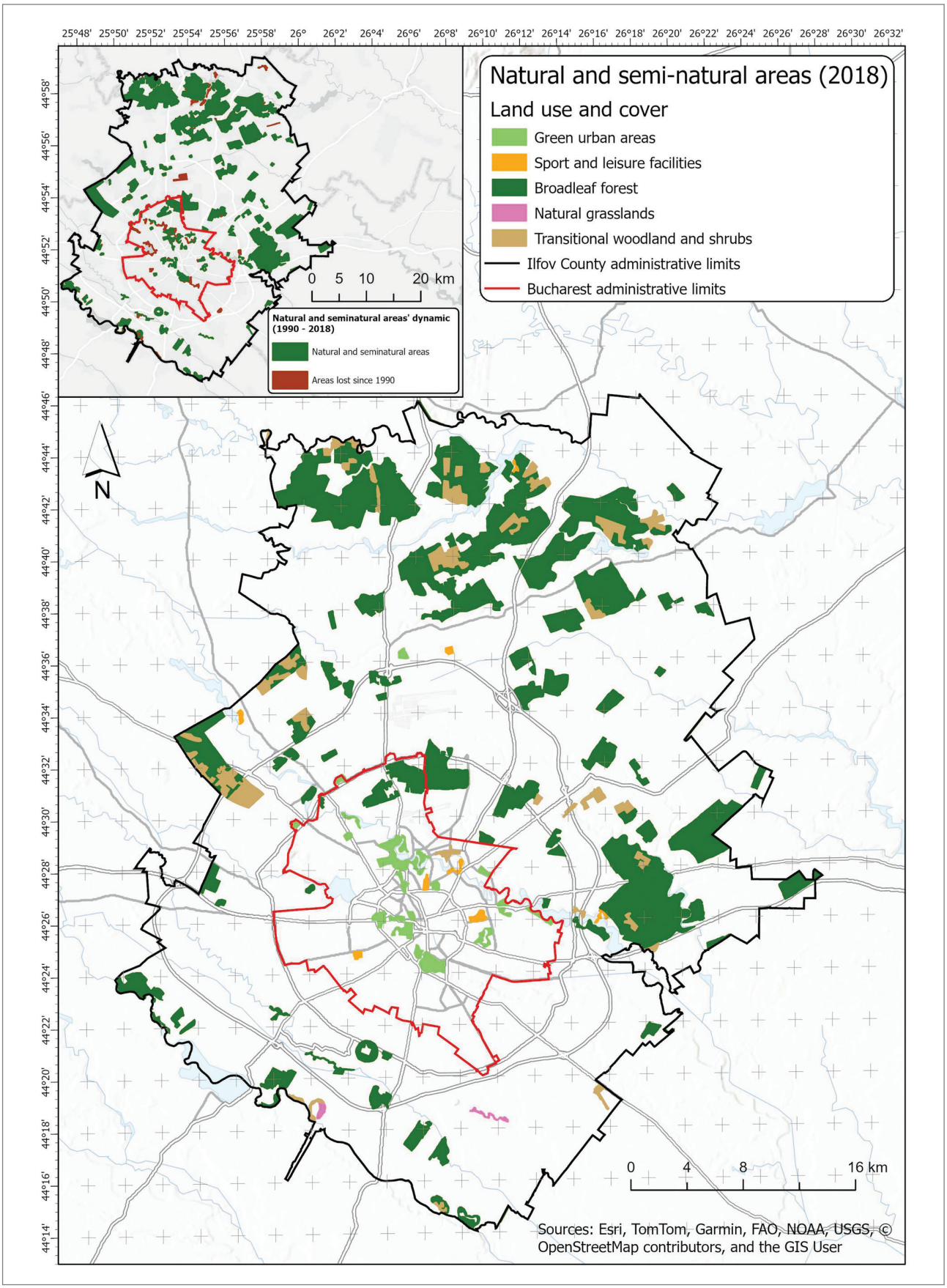

Figure 2: Distribution of natural and semi-natural areas in Bucharest and Ilfov County in 2018. Inset: Natural and semi-natural areas lost since 1990 (spatial data source: https://land.copernicus.eu/en).

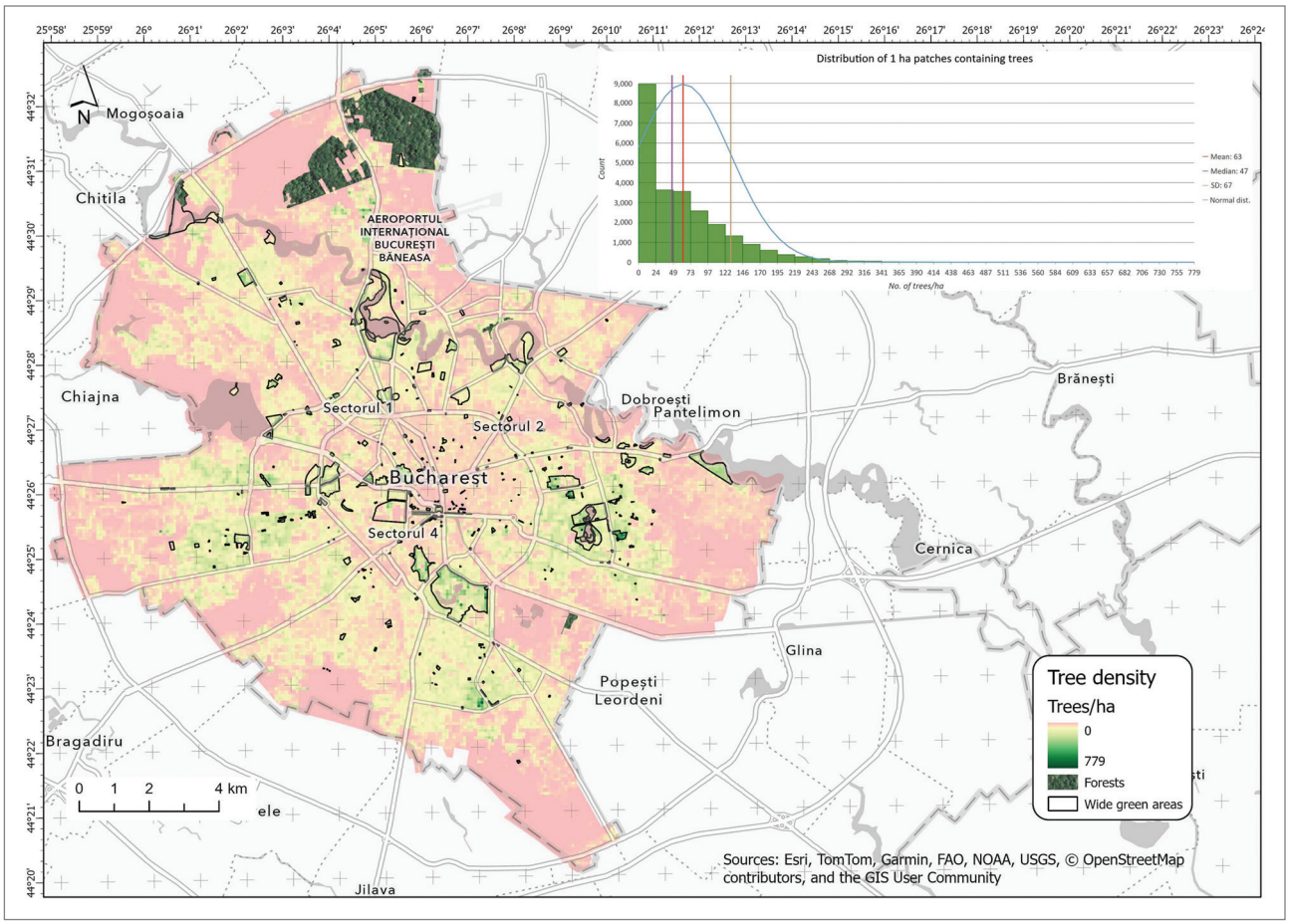

Figure 3: Urban tree density distribution within Bucharest, expressed in number of trees per hectare.

dataset lacks detailed geolocation data (such as species, age, and height), the Green Registry includes overall information on the number of individuals for each species. The data were further processed to classify species based on several criteria: plant type (tree/shrub), leaf type (coniferous/deciduous), origin (native/nonnative), and allergenic potential (allergenic/non-allergenic). In addition, the dataset was utilized to determine the total number of individuals for each species. These data were processed using Microsoft Excel. To estimate the carbon sequestration capacity of tree species in Bucharest, values reported by the European Environment Agency (EEA) and the One Tree Planted platform were aggregated. According to the EEA, a mature tree sequesters approximately 21.77 kg of CO_2 per year and releases oxygen in the process (European Environmental Agency 2010). The One Tree Planted platform estimates that an average tree absorbs around 10 kg of CO_2 annually (Bernet, 2023). Given that the atomic weight of carbon is 12 and that of oxygen is 16, the molecular weight of CO_2 is 44. Consequently, the amount of carbon in a given quantity of CO_2 can be calculated by multiplying the amount of CO_2 by 0.27 (Farquhar & Lloyd, 1993). Owing to variability in carbon sequestration rates – driven by factors such as species, age, and height – an average value of 4.29 kg of carbon sequestered per tree per year was adopted for this study. Using this estimate, the urban tree density grid created for Bucharest was applied to map the amount of carbon sequestered per hectare across the city. Furthermore, drawing on data from previous studies assessing air-pollutant sequestration by tree species (Nowak et al., 2006, 2013), the most effective native tree species in mitigating urban pollution – particularly in terms of carbon sequestration – were identified. Finally, the total amount of carbon sequestered by each urban tree species in Bucharest was estimated based on the number of individual trees and the average amount of carbon absorbed by a single mature tree.

3 Results

3.1 Distribution of urban areas covered with trees and shrubs

The urban tree density analysis in Bucharest revealed significant spatial disparities. The outskirts of the city, together with central areas, exhibit a notable lack of trees, with these zones recording a higher prevalence of one-hectare patches devoid of tree cover (Figure 3). In contrast, the intermediate zones of

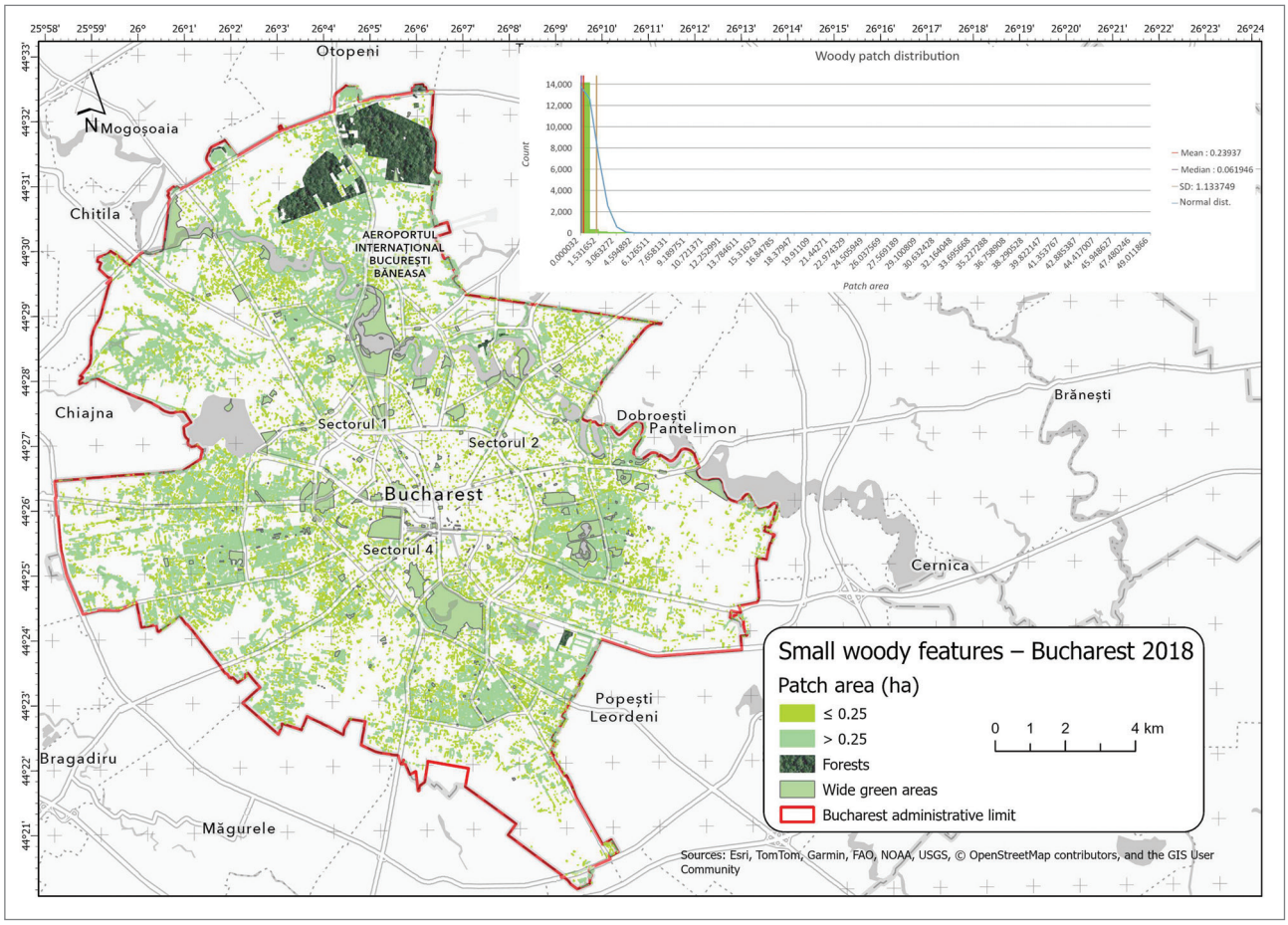

Figure 4: Small woody features distribution within Bucharest.

the city display a greater number of one-hectare patches with higher tree densities. Neighbourhoods in the eastern, western, and southern parts of Bucharest show relatively higher tree densities per hectare compared with other areas. The highest tree densities per hectare are concentrated in large parks, which serve as key green assets within the city. Of the total one-hectare land patches generated to cover Bucharest's administrative boundaries, approximately 36% have a tree density of fewer than twenty-four trees per hectare, and around 41% of the patches contain between twenty-five and one hundred trees. The spatial representation of the small woody features layer highlights a distribution pattern that confirms the findings from the tree density analysis (Figure 4). Neighbourhoods in the east, west, and south exhibit the highest coverage of areas covered with trees and shrubs, whereas the outskirts and the city centre continue to show a noticeable lack of such features. These areas are often located at the edge of large parks dispersed throughout the city. Of the small woody features patches covering Bucharest, approximately 87% are smaller than 0.25 hectares – a minimum threshold defined by national regulations for a group of trees to qualify as a forest. Despite these patches being smaller than 0.25 hectares, cumulatively they represent around 26% out of the total small woody features existing in Bucharest. This indicates that Bucharest benefits from larger, more compact woody features that contribute substantially to its overall tree cover.

3.2 Urban tree and shrub species and their efficiency in carbon sequestration

The Bucharest Green Registry reports a total of 1,647,517 trees and shrubs distributed across the city, comprising 219 recognized species. However, only around 11% of the recorded trees have been definitively identified at species level. As illustrated in Figure 5, of the identified species, 76% are tree species and 24% are shrubs. The majority (78%) are deciduous species. A notable finding is that most tree and shrub species are nonnative (67%), with a smaller proportion being native. In addition, a substantial number of species are considered allergenic (35% of the total species). The analysis of the number of identified individuals per tree and shrub species revealed that all species with populations exceeding 10,000 individuals are trees. Among these species, 38% are nonnative. The most widespread nonnative species include box elder (*Acer negundo*), black locust (*Robinia pseudoacacia*), Oriental arborvitae (*Platycladus orientalis*), arborvitae (*Thuja occidentalis*), white

ash (*Fraxinus americana*), tree of heaven (*Ailanthus altissima*), and lilac (*Syringa vulgaris*), each with more than twenty thousand individuals recorded across the city. The most abundant species in Bucharest is pedunculate oak (*Quercus robur*), with 114,250 individuals, accounting for 9% of the total number of trees and shrubs identified in the city.

Using the previously established average carbon sequestration capacity of an adult tree (4.29 kg/year), it is estimated that trees and shrubs in Bucharest sequester approximately 6,090 tonnes of carbon annually. As expected, neighbourhoods with higher urban tree densities per hectare correspond to areas where the largest amounts of carbon are sequestered (Figure 6). The highest recorded value for a single one-hectare patch was 3.34 tonnes of carbon sequestered in one year. Based on the gross carbon sequestration capacity of various tree and shrub species, the most effective native species in Bucharest are silver birch (*Betula pendula*), cherry plum (*Prunus cerasifera*), sessile oak (*Quercus petraea*), downy oak (*Quercus pubescens*), pedunculate oak (*Quercus robur*), sycamore (*Acer pseudoplatanus*), field maple (*Acer campestre*), hornbeam (*Carpinus betulus*), and manna ash (*Fraxinus ornus*). Each of these species can sequester more than 5 kg of carbon per year. When considering both the number of individuals present in Bucharest and their carbon sequestration capacity, it is noteworthy that four of the five most efficient tree and shrub species for carbon sequestration are nonnative (Figure 7). However, the superior performance of these nonnative species is primarily attributable to their higher abundance rather than to greater carbon sequestration capacity at the individual tree level.

4 Discussion

This study identified critical areas in Bucharest in terms of urban tree and shrub cover. This was complemented by an estimation of carbon sequestration capacity based on the tree species present in the city. Together, these results may provide a foundation for the development of coherent and effective plans aimed at expanding areas covered with trees and shrubs in Bucharest. Urban environments are dynamic systems, and unbuilt land is a vital resource. In this context, planning or designing urban forests for climate-change adaptation and carbon sequestration becomes a multifaceted challenge. The specific challenges associated with urban green infrastructure planning are largely linked to governance and management, particularly due to the weak integration of urban forestry into urban planning frameworks. These concerns generally relate to species and layout selection, maintenance and monitoring costs, and the survival of planted specimens (Suhane et al., 2024). The last issue is not necessarily related to the selection of tree or shrub species suited to local climatic conditions, but

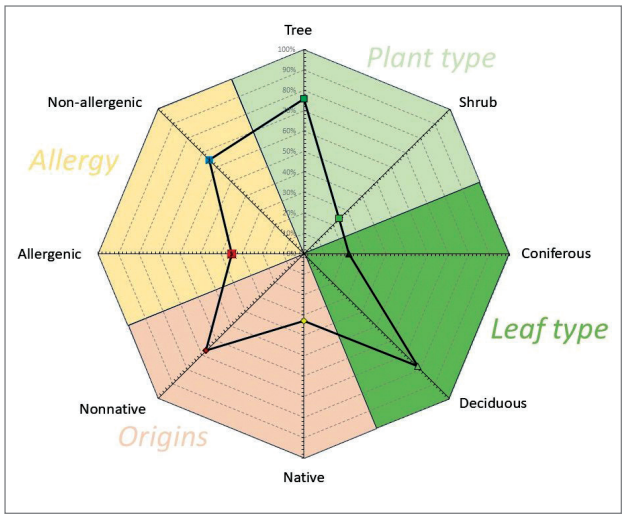

Figure 5: Characteristics of species among urban trees and shrubs in Bucharest.

rather to the quality and quantity of urban soils (Jim et al., 2018). Therefore, although establishing extensive urban forests in large cities is constrained by land scarcity, increasing the density of trees and shrubs on available land may be a suitable alternative approach.

The distribution of trees in Bucharest can be explained by the challenges outlined above because land availability for planting is limited in the city centre, and suitable soils are either absent or inadequate in terms of quality. Higher tree densities were recorded further from the city centre, particularly in neighbourhoods planned during the communist period, supporting findings related to uneven green space distribution in large cities (Tatlić et al., 2024). As an eastern European city where post-communist planning approaches overlapped with the centralized communist planning paradigm (Csomós et al., 2021), Bucharest shows disparities in the distribution of areas covered with trees and shrubs that resemble patterns identified in previous studies conducted in post-communist cities. Sector-based and fragmented planning systems, combined with weak legal enforcement mechanisms, are considered key drivers of disparities in urban green space distribution (Vasiljević et al., 2018). Previous studies have associated the distribution of urban areas covered with trees and shrubs primarily with social and economic factors rather than environmental or ecological ones. In Bucharest, the distribution of such green urban areas is strongly linked to the current planning framework and the legacy of earlier planning approaches, whereas in other contexts this distribution is associated with racial segregation, population density, income, and housing characteristics, alongside physical landscape features (Schwarz et al., 2015; Foster et al., 2024). Analyses from Western societies support the idea that wealthier neighbourhoods are greener, whereas poorer and mi-

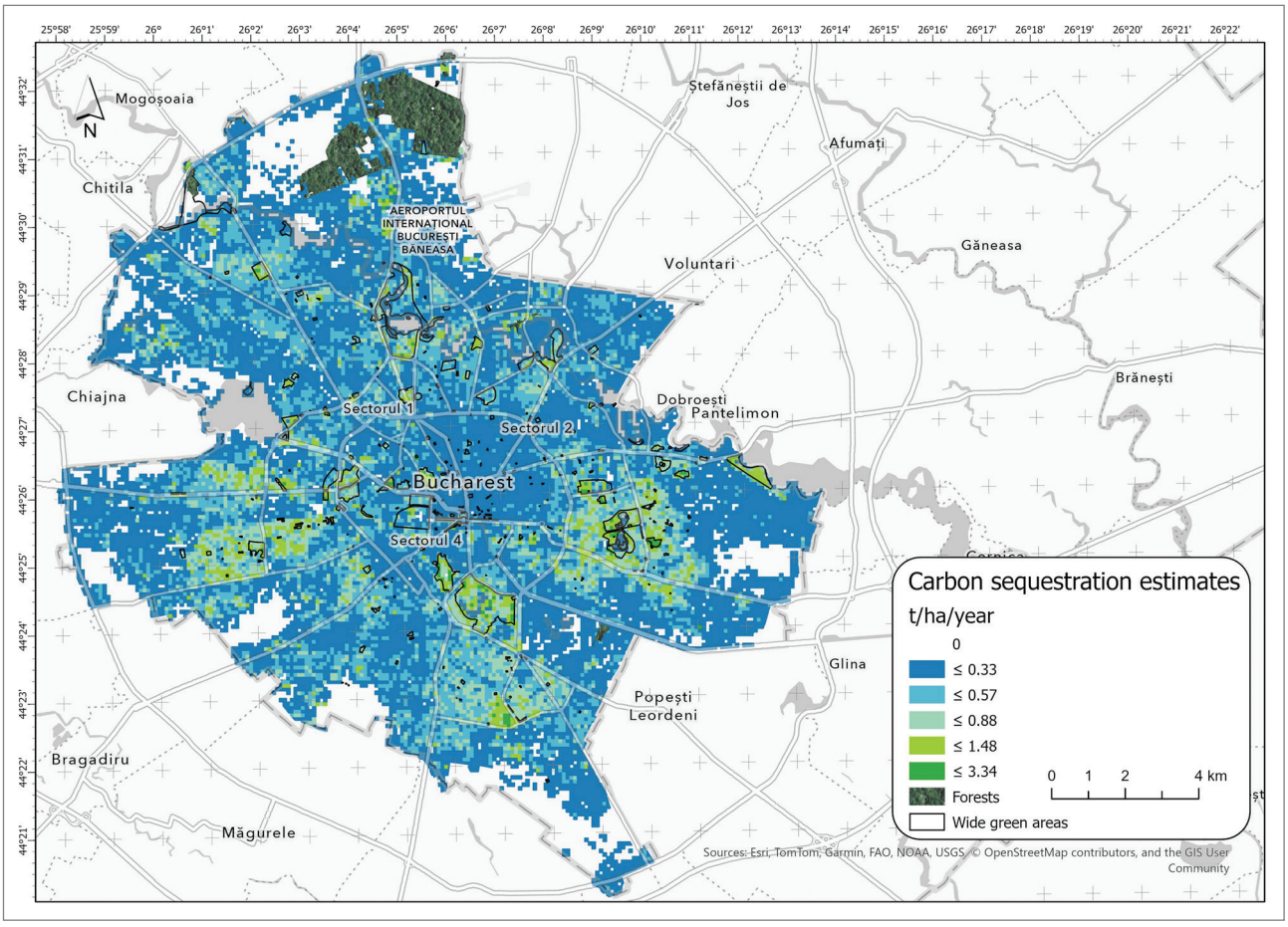

Figure 6: Carbon sequestration by urban trees (t/ha/year) in Bucharest.

nority-populated areas tend to have less green space. However, in Bucharest, newly planned neighbourhoods, typically inhabited by higher middle-class populations, are often deprived of areas covered with trees and shrubs, whereas older neighbourhoods, predominantly inhabited by lower middle-class populations, tend to be greener. This outcome reflects the market-led planning approaches introduced in the 1990s and continuing today, under which land parcels generate higher returns for developers when built up. Consequently, the provision of urban green spaces in such neighbourhoods is treated as a legal obligation and is often reduced to the minimum area required, with the lowest possible level of investment.

The results of the tree species analysis in Bucharest were as expected, given the biogeographical region the city is located in. However, a significant concern remains the high prevalence of nonnative species, some of which are invasive or have the potential to become invasive. Consistent with previous studies, the most common nonnative species in Bucharest include box elder (*Acer negundo*), tree of heaven (*Ailanthus altissima*), black locust (*Robinia pseudoacacia*), and white mulberry (*Morus alba)* (Sîrbu et al., 2021; Gavrilidis et al., 2023). Large urban environments often act as hubs for the introduction

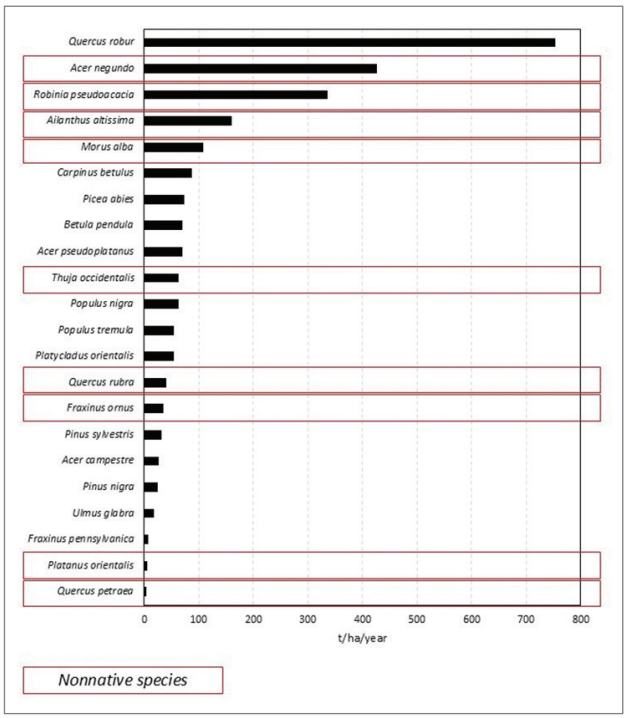

Figure 7: Tree/shrub species contributing the most to carbon sequestration per year in Bucharest (number of individuals multiplied by gross carbon sequestration expressed in t/ha/year).

of nonnative species into national ecosystems (Kaczorowska 2020), and Bucharest is no exception. Most of the dominant nonnative tree species in the city were deliberately introduced at various times, primarily for aesthetic purposes. Following their introduction, these species have thrived and have become dominant components of Bucharest's urban landscape. Nonnative invasive tree and shrub species thrive in urban settings due to the urban microclimate, which is warmer and drier, as well as their relatively low ecological requirements. As highlighted in previous studies, black locust (*Robinia pseudoacacia*) performs particularly well in urban environments because its ecological requirements align closely with urban ecological conditions (Franceschi et al., 2023). This species is often preferred in cities because of its lower acquisition and maintenance costs and the comparatively lower mortality rates of planted specimens. Previous research on urban tree species has also shown that ash (*Fraxinus* spp.) and maple (*Acer* spp.) are characterized by higher drought tolerance (Sjöman et al. 2024); therefore, the presence of these species in Bucharest is consistent with earlier findings.

Regardless of whether a tree species is native or nonnative, its contribution to carbon sequestration is unequivocally positive (Lashof & Neuberger, 2023). The findings of this study indicate that, in addition to the forest located in the northern part of Bucharest, the city relies on three other major carbon sinks in the east, west, and south. However, the lack of interconnectivity among these sinks limits their overall efficiency, preventing the city from fully benefiting from their regulatory ecosystem services. Furthermore, the absence of linkages between these carbon sequestration sinks – whether through linear green corridors or smaller areas covered with trees and shrubs – poses a risk of gradual degradation and reduced effectiveness in carbon retention (Hansen et al., 2022). Previous research suggests that, although urban forests are an important asset for climate-change adaptation, relying exclusively on them to achieve carbon neutrality is insufficient (Velasco et al., 2016). In-depth studies on the carbon sequestration capacity of urban trees remain relatively scarce in Europe, and most research estimates sequestration based on tree cover or species composition using allometric relationships developed for American tree species (Bherwani et al., 2024). For Bucharest, the average estimated carbon sequestration by trees and shrubs is approximately 0.26 t/ha/year. By comparison, studies have reported average urban forest sequestration rates of around 2 t/ha/year in Chinese cities (Chen, 2015), and estimates for Tehran suggest values of approximately 1 t/ha/year (Rasoolzadeh et al., 2024). Species with high carbon sequestration capacity identified in the Tehran study include black locust (*Robinia pseudoacacia*), elm (*Ulmus* spp.), ash (*Fraxinus* spp.), pine (*Pinus* spp.), and plane (*Platanus* spp.), which is consistent with the findings of this study for Bucharest. Analyses from American cities indicate that urban trees in Baltimore – a city comparable to Bucharest in terms of area, climate, and vegetation – exhibit an annual gross carbon sequestration of approximately 14,800 t (≈ 0.62 t/ha/year; Nowak & Crane, 2002).

The literature has clearly established the importance of urban areas covered with trees and shrubs for carbon sequestration efforts. Recent studies have highlighted CO_2 as a major air pollutant due to its role in driving climate change (Hadipoor et al., 2021). Estimates of CO_2 sequestration by four urban parks in Rome correspond to approximately 3.5% of the city's total greenhouse-gas emissions (Gratani et al., 2016), whereas in Beijing the estimated annual CO_2 sequestration is equivalent to only 0.2% of total emissions (Tang et al., 2016). In Indian cities, trees planted along roadsides were estimated to sequester carbon equivalent to 22% of urban CO_2 emissions (Kiran & Kinnary, 2011). Despite these findings, it remains unclear to what extent the costs and efforts incurred by municipalities to expand and develop robust and functional green infrastructure networks are justified solely in terms of carbon sequestration outcomes. Even the monetary valuation of the carbon sequestration capacity of urban trees – although useful for policy framing and illustrating economic relevance – is not sufficiently precise to be treated as an exact financial figure (Nowak & Crane, 2002; Bherwani et al., 2024). Furthermore, growing urban populations are associated with increasing demand for affordable housing and transport infrastructure. Preserving unbuilt land therefore becomes an increasingly complex challenge for local decision-makers because social pressure intensifies from both directions: the need to provide housing and the need to ensure adequate urban green spaces. The carbon sequestration values reported in this and previous studies may appear insufficiently compelling to motivate stronger regulation of urban planning frameworks focused on the quality and quantity of green infrastructure. Nevertheless, there is no scientific doubt that the loss of existing urban green space would lead to a critical decline in urban quality of life.

4.1 This study's strengths and limitations

A key asset of this study was the availability of the tree location database from the Bucharest Green Registry. In the absence of this resource, the only alternative would have been the small woody features layer, which is sufficiently accurate for general assessments. However, access to both datasets allowed cross-validation of the information. The replicability of the methods applied in this study depends on the availability of geospatial data on urban trees and shrubs. When such data are complemented by information on tree and shrub species, similar assessments can be readily replicated in other urban contexts. Nevertheless, Bucharest's Green Registry has not been updated since 2012; therefore, conditions may have changed

significantly over the years. An updated assessment of tree distribution and species composition could reveal changes in certain parts of the city, but the overall patterns identified in this study are unlikely to differ substantially. Furthermore, the lack of data on tree age and species linked to specific locations limited the depth of the analysis. Despite this limitation, the general statistics on tree species still provide a broad overview of the species that Bucharest relies on for carbon sequestration.

5 Conclusion

This study underscores that achieving carbon neutrality through nature-based solutions in Bucharest will require substantial effort, expert-driven planning, and politically prudent decision-making. Continuing with a "business as usual" approach could yield outcomes worse than maintaining the current status quo, underscoring the urgency of adopting informed and strategic actions. By achieving the proposed objectives, this study revealed that Bucharest is underperforming in comparison with similar cities in terms of carbon sequestration capacity through urban trees and shrubs. However, the areas covered with a significant density of trees and shrubs are mostly dispersed throughout the city. The current situation provides a proper foundation for the further development of Bucharest's urban green infrastructure, with a particular focus on expanding the areas covered by trees and shrubs. Priority should be given to the city's outskirts, where sufficient land is still available for the design and implementation of such features. In contrast, the city centre, where land availability is more constrained, would benefit from innovative approaches, such as suspended or vertical forests.

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Data availability statement

The land-cover and land-use data for Bucharest and Ilfov County were obtained from the Corine Land Cover (CLC) database and Urban Atlas, and they are freely accessible upon registration. Tree geolocation data were provided by Bucharest City Hall and are available upon request but cannot be shared with third parties. Derived datasets produced in this study, such as tree densities and annual carbon sequestration per hectare, and the species-level tree and shrub counts, are openly available in the OSF repository at https://osf.io/g3xva/overview (Gavrilidis, 2026); this article must be cited if these data are used in other publications.

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Proučevanje vezave ogljika na podlagi drevesnih vrst v mestih: izsledki iz Bukarešte

Urbanizacija se je od prve industrijske revolucije okrepila, kar je povzročilo resne družbeno-gospodarske in okoljske pritiske na lokalne oblasti, zlasti na področju upravljanja kakovosti zraka. Čedalje slabša kakovost zraka ostaja glavni izziv na urbaniziranih območjih, zato so mestni zeleni prostori, zlasti tisti, porasli z drevesi, zaradi svojih regulacijskih ekosistemskih storitev vse bolj cenjeni. Avtorja v članku proučujeta zmožnost dreves v Bukarešti, da vežejo CO_2. Prostorsko razporeditev dreves in njihovo vrstno sestavo sta prikazala z uporabo geografskih informacijskih sistemov na podlagi podatkov iz mestnega registra zelenih površin, zmožnost vezave pa sta določila s preizkušenimi ocenjevalnimi orodji. Rezultati so pokazali izrazite prostorske razlike, pri čemer je za več mestnih okrožij značilno precejšnje pomanjkanje dreves. Količina CO_2, ki ga vežejo območja, poraščena z drevesi in grmovjem, je v primerjavi s skupnimi ravnmi emisij v mestu zanemarljiva. Avtohtone vrste učinkoviteje vežejo ogljik, vendar v mestni krajini prevladujejo tujerodne vrste, kar je posledica predvsem finančnih in estetskih preferenc v zasaditvenih praksah. Navedene ugotovitve poudarjajo majhen regulacijski vpliv mestnih dreves na vezavo ogljika in izpostavljajo potrebo po ciljno usmerjenih, na naravi temelječih strategijah, zlasti širjenju avtohtone vegetacije, kar bi olajšalo upravljanje vezave ogljika v mestih.

Ključne besede: geografski informacijski sistem, na naravi temelječe rešitve, ekosistemske storitve, zelena infrastruktura, Romunija

1 Uvod

Industrijska revolucija je skupaj s tehnološkim napredkom v 20. stoletju pospešila urbanizacijo po svetu, zaradi česar so nekatera mestna območja izjemno gosto poseljena (Morris, 2013). Zaradi zgodovinskih dejavnikov, geografske lege in razpoložljivosti ključnih virov so se številna naselja razvila v pomembna gospodarska središča (Gavrilidis idr., 2015). Polarizacija virov in prebivalstva pa pogosto vodi v prenatrpanost (Booth idr., 2020) in če ta ni ustrezno upravljana, negativno vpliva na splošno kakovost življenja v mestu, pri čemer je prav ta ključni vzrok nenačrtnega širjenja mest in razvrednotenja okolja (Gavrilidis idr., 2019). Zaradi čedalje večje gostote mestnega prebivalstva je treba širiti pozidavo, kar pogosto negativno vpliva na naravne in polnaravne krajine (Dewan in Cornerc, 2014). Krčenje zelenih površin v gosto poseljenih mestnih okoljih ima srednjeročne in dolgoročne posledice za blaginjo mestnih prebivalcev (Popa idr., 2022). Urbanizacija je dinamičen družbeno-gospodarski pojav, na katerega vplivajo raznovrstni naravni in antropogeni dejavniki, hkrati pa prispeva k veliki gostoti prebivalstva in povečanemu pritisku na nepozidana zemljišča. Zapletenost mestnih okolij in kako hitro se ta preobrazijo, sta raziskovalce spodbudila k proučevanju učinkov aktualnih urbanizacijskih trendov. V tem okviru oblikovalci politik in odločevalci pogosto dajejo prednost sivi infrastrukturi ter širitvi stanovanjskih naselij ter trgovskih, logističnih, industrijskih in poslovnih središč, saj takšni posegi ustvarjajo neposredne gospodarske donose (Dong idr., 2017).

Zaradi krčenja prepustnih površin v mestih se spreminjajo značilnosti odtekanja padavinskih voda, kar povečuje stroške vzdrževanja kanalizacijskih sistemov ter škodo med intenzivnimi padavinami in po njih (Kong idr., 2017). Poleg tega se z izgubo zelenih površin zaradi dopolnilne gradnje slabša kakovost zraka, povečuje obremenitev s hrupom (Badiu idr., 2018) in krepijo učinki mestnih toplotnih otokov (Gunawardena idr., 2017). Z naraščanjem gostote pozidave postajajo razpoložljiva zemljišča eden najdragocenejših mestnih virov (Gavrilidis idr., 2020). Ključni izziv za urbaniste, oblikovalce politik in odločevalce je zato ohranjanje uravnoteženega razmerja med pozidanimi in nepozidanimi površinami (Kronenberg idr., 2020). Čeprav večina držav priznava pomen doseganja ciljev trajnostnega razvoja (Združeni narodi, 2015), raziskovalci poudarjajo, da je uresničevanje teh ciljev povezano s precejšnjimi stroški, hkrati pa je za to treba razviti ustrezna finančna orodja in pripraviti programe (Barua, 2020). Cilji trajnostnega razvoja in pripadajoči kazalniki poudarjajo potrebo po hkratnem gospodarskem razvoju in učinkovitem upravljanju naravnih virov. Trije izmed desetih podciljev cilja 11, ki je za analizo v tem članku najpomembnejši, se nanašajo na ohranjanje naravnih prvin ter enakopraven dostop do njih na mestnih in urbaniziranih območjih. Posledično je ena ključnih raziskovalnih prednostnih nalog lokalnim in državnim oblastem dokazati, da vključevanje naravnih prvin v mestno krajino odpira učinkovito pot k hkratnemu doseganju več trajnostnih ciljev v mestih. Za dosego ciljev trajnostnega razvoja v prihodnjem desetletju pa morajo raziskovalci razumeti tudi potrebe oblikovalcev politik in drugih deležnikov ter oblikovati učinkovite metode, ki zagotavljajo praktične in uporabne rezultate (Allen idr., 2021).

V velikih mestih so nepozidana zemljišča čedalje redkejša, kar pomembno otežuje načrtovanje večjih zelenih površin. Z nadaljnjim širjenjem mestnih območij postajajo večji zeleni prostori, kot so parki in vrtovi, vse manj dostopni in vse bolj izpostavljeni dopolnilni gradnji (Stoia idr., 2022). Kot odziv na te pritiske se je uveljavil koncept ekosistemskih storitev, ki odločevalcem in širši javnosti daje okvir za prepoznavanje koristi, ki jih zagotavljajo ekosistemi (Costanza idr., 1997). Zaradi precejšnjega pomanjkanja teh koristi v mestnih okoljih se močno priporoča vključevanje pristopov, ki upoštevajo ekosistemske storitve, v urbanistično načrtovanje in upravljanje prostora (Bolund in Hunhammar, 1999). Uvajanje na naravi temelječih rešitev v urbanistične in politične okvire lahko poveča odpornost skupnosti (Antuna-Rozado idr., 2019; Bartlett in Mistry, 2021). Z ureditvijo naravnih prvin v mrežo mestne zelene infrastrukture se izboljša zagotavljanje ekosistemskih storitev na ravni mesta (Van Oijstaeijen idr., 2020; Zhang idr., 2021). Obsežne zelene površine, na katerih prevladujejo drevesa in grmovje, so hrbtenica učinkovite mestne zelene infrastrukture (Sanesi idr., 2017). Tovrstna območja, umeščena znotraj velikih mest ali na njihovih robovih, so splošno prepoznana kot ključni viri za doseganje trajnostnega razvoja in izboljšanje kakovosti življenja (Felappi idr., 2020). Ekosistemske storitve, ki jih zagotavljajo, imajo precejšnjo vrednost (Li, 2021), zato so v ospredju številnih varstvenih politik (Goodspeed idr., 2022). Čeprav so mestni gozdovi razmeroma redki, se po opredelitvi in upravljanju precej razlikujejo od naravnih gozdov. Glede na to, da je nujno doseči cilje trajnostnega razvoja in ogljične nevtralnosti, se lokalni deležniki in oblasti s sektorskimi politikami in programi financiranja vse pogosteje spodbujajo k vlaganju v varstvo in širitev mestnih gozdov (Wu idr., 2022).

Urbano gozdarstvo je umetnost, znanost in tehnologija upravljanja dreves in drugih gozdnih virov v urbanih središčih in njihovi okolici, da se ustvarijo večje fiziološke, sociološke, gospodarske in estetske koristi, ki jih zagotavljajo gozdovi (Konijnendijk idr., 2006). Prejšnje raziskave so pokazale, da lahko gozdovi v mestih ali v njihovi neposredni okolici delujejo kot ponori ogljika, ki aktivno vežejo ogljik, in kot zbiralniki ogljika, v katerih se ogljik kopiči v biomasi. Učinkovitost upravljanja kroženja ogljika je močno odvisna od dejavnikov, kot sta vrstna sestava in starostna struktura gozdov (Boukili idr., 2017; Vais idr., 2023). Jasno je, da se zaradi intenzivnega

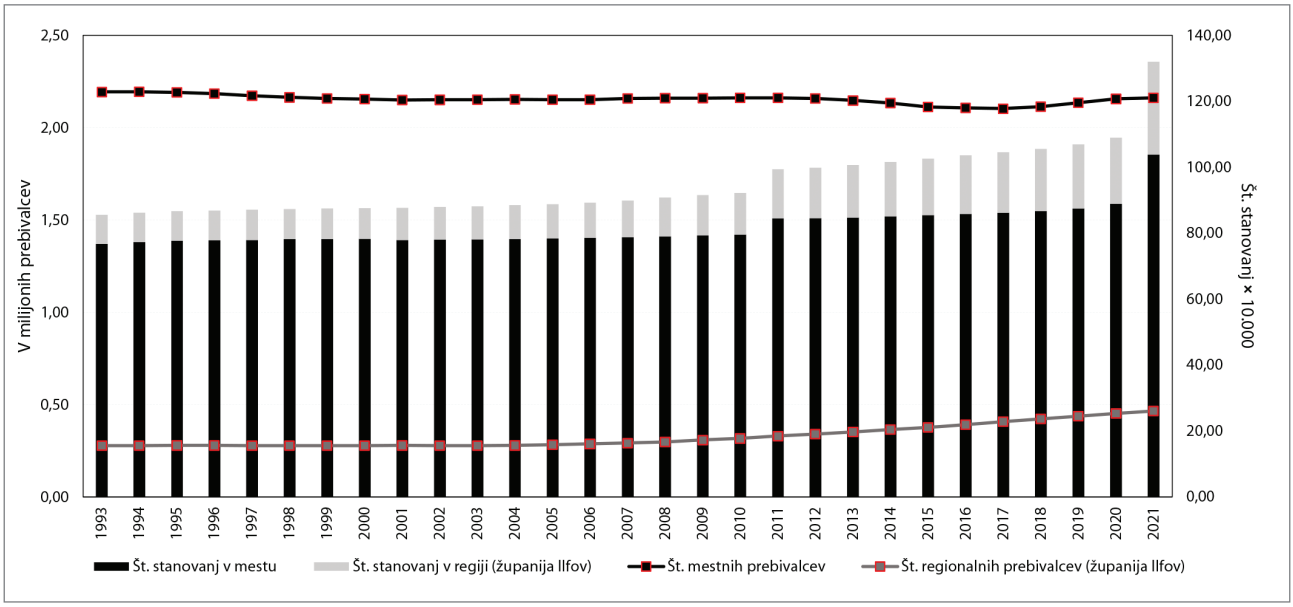
upravljanja, mlajših dreves in pogostega odstranjevanja biomase zmožnost mestnih gozdov za vezavo ogljika razlikuje od zmožnosti naravnih gozdov (Fares idr., 2017). Kljub temu je količina ogljika, ki ga vežejo mestni gozdovi, razmeroma majhna v primerjavi z antropogenimi emisijami, prispevek teh gozdov k blaženju podnebnih sprememb z vezavo ogljika pa je na ravni celotnega mesta majhen ali zanemarljiv (Chen, 2015; Velasco idr., 2016). Vseeno imajo mestni gozdovi kot ponori ogljika precejšnjo gospodarsko vrednost (Bherwani idr., 2024). V tem okviru sta načrtovanje in opredelitev mestnih gozdov, ki izpolnjujejo merila iz zgornje opredelitve, za lokalne oblasti velik izziv, zlasti zaradi velike gostote pozidave in omejene razpoložljivosti zemljišč. Posledično bi morali lokalni odločevalci dati prednost povečevanju gostote mestnih dreves kot alternativni strategiji. Čeprav območja z večjo gostoto dreves ne morejo v celoti nadomestiti ekosistemskih storitev gozdnih ekosistemov, lahko njihove koristi pomembno prispevajo k izboljšanju gospodarskih, socialnih in okoljskih razsežnosti življenja v mestu. Območja, poraščena z drevesi in grmičevjem, v mestih krepijo koristi posameznih dreves in grmovnic, tudi ko ti ne delujejo kot v celoti povezan ekosistem. Poleg tega te koristi delujejo v sinergiji s koristmi naravnih in polnaravnih ekosistemov na mestnem obrobju.

Za upravljanje gozdov praviloma veljajo strogi predpisi in je zanj potrebno specializirano osebje (Ciornei, 2019; Ciornei in Munteanu, 2020), upravljanje in vzdrževanje mestnih območij, poraščenih z drevesi in grmičevjem, pa terjata drugačne prakse, rabe in znanja. V tem okviru mora biti poudarek na boljšem zagotavljanju ekosistemskih storitev. Njihova kakovost je odvisna od uporabljenih upravljavskih praks ter od vrstne sestave in kakovosti vegetacije (Mexia idr., 2018). Drevesa in grmičevje so pomembni ponori ogljika, njihova vključitev v mestno okolje pa ima ključno vlogo pri prilagajanju na podnebne spremembe in blaženju čedalje slabše kakovosti mestnega zraka (Lashof in Neuberger, 2023). Premišljena izbira vrst za zasaditve, usmerjena v povečanje gostote dreves in širjenje tovrstnih območij, lahko okrepi odpornost mest proti okoljskim nevarnostim in hkrati izboljša kakovost življenja prebivalcev. Avtorja sta proučila, ali gostota, prostorska razporeditev in sestava dreves v eni izmed najbolj onesnaženih evropskih prestolnic vplivajo na vezavo CO_2. Cilji njune raziskave so bili analizirati stanje zemljišč, poraščenih z drevesi in grmovjem, in pripadajočo gostoto dreves, opredeliti prevladujoče vrste in oceniti količino vezanega ogljika v Bukarešti, ločeno po drevesnih vrstah.

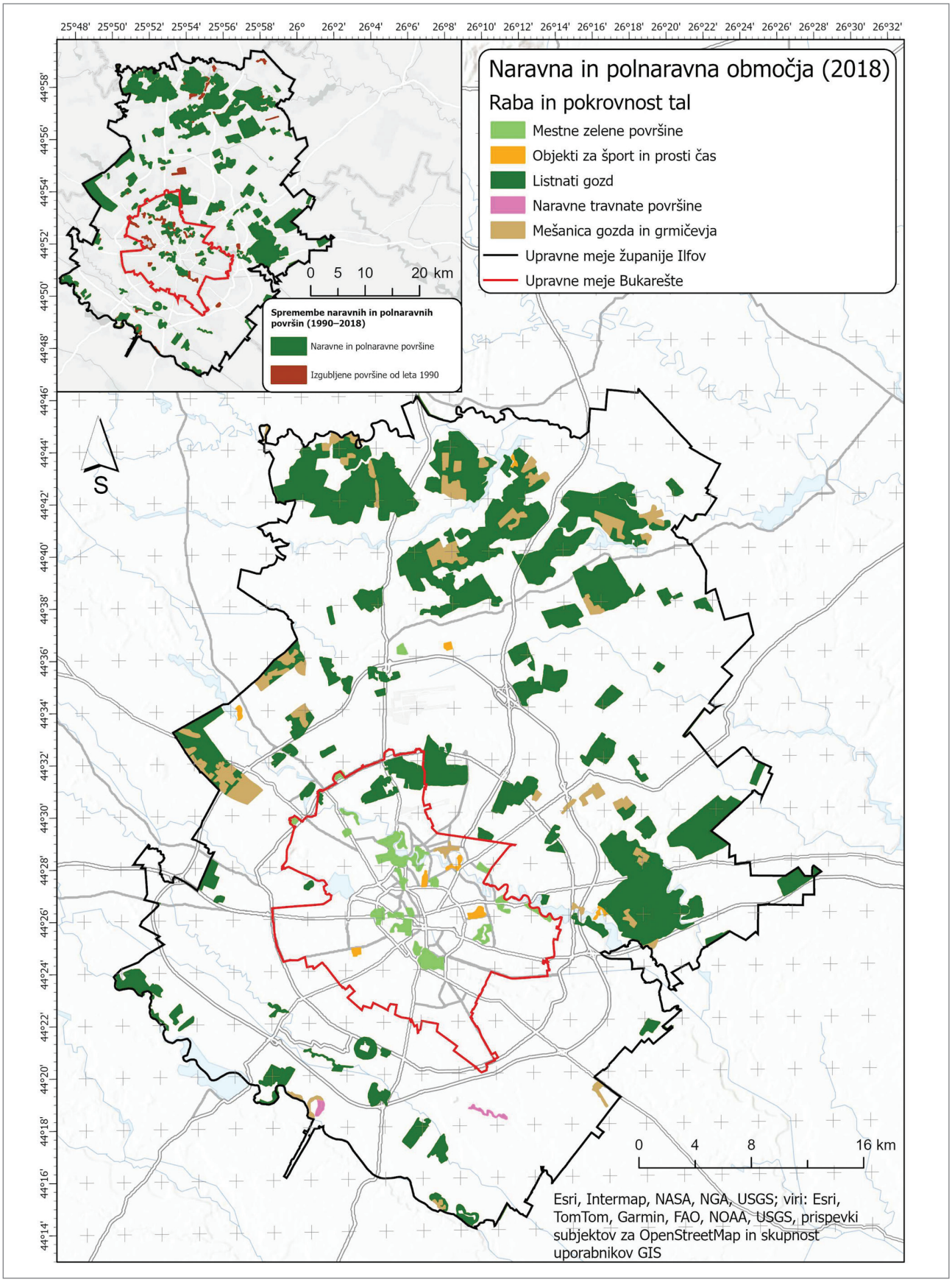
2 Podatki in metode

2.1 Območje raziskave

Bukarešta, glavno mesto Romunije, leži na ravnini v jugovzhodnem delu države. Leta 2021 je imela 1,79 milijona prebivalcev. Če upoštevamo še dodatnih 430.000 prebivalcev županije Ilfov, ki jo obdaja (Nacionalni inštitut za statistiko, 2023), tvori najgosteje poseljeno urbano aglomeracijo v Romuniji. V zadnjih 30 letih se je število prebivalcev znotraj mestnih meja zmanjšalo za 1,5 %, kar se ujema s povprečno letno stopnjo rasti − 0,5 %. Nasprotno pa se je prebivalstvo županije Ilfov povečalo za skoraj 40 %, s povprečno letno rastjo 1,82 % (slika 1). Na regionalni ravni (Bukarešta in županija Ilfov skupaj) se je prebivalstvo v zadnjih treh desetletjih tako povečalo za 5,95 %. Upoštevanje demografskih značilnosti županije Ilfov je pri analizi Bukarešte ključno, saj se velik delež njenih



Slika 1: Spremembe v številih prebivalstva in stanovanj v Bukarešti in županiji Ilfov v zadnjih 30 letih (vir: Nacionalni inštitut za statistiko, 2023)



Slika 2: Razporeditev naravnih in polnaravnih območij v Bukarešti in županiji Ilfov leta 2018. Okvirček zgoraj levo: izgubljene naravne in polnaravne površine od leta 1990 (vir: https://land.copernicus.eu/en)

Preglednica 1: Vhodni podatki, uporabljeni za analizo porazdelitve mestnih območij, poraslih z drevesi in grmičevjem

Podatki	Vrsta	Leto	Metodologija obdelave
Drevesa	Točke	2010	Podatki o geolokaciji dreves in grmičevja so bili zbrani leta 2010 s splošno anketo, izvedeno po naročilu lokalnih oblasti. Na njihovi podlagi je bil izdelan register zelenih površin Bukarešte z vektorskimi točkami, ki sta jih avtorja članka nato obdelala v mreži z velikostjo celic 1 ha.
Majhna drevesa in grmičevje	Poligoni	2018	Nadzorovano razvrščanje časovnih nizov satelitskih posnetkov iz podatkovne baze VHR_IMAGE_2018, narejenih med majem 2017 in septembrom 2018. Za zaplate dreves in grmičevja je najmanjša enota kartiranja 200 m^2 (največja pa 50.000 m^2). Največja širina in najmanjša dolžina linearnih elementov znašata 30 m. Prostorska ločljivost je manj kot 5 m.

prebivalcev zaradi dela in družabnih aktivnosti dnevno vozi v mesto (Cristea idr., 2017). Analiza teh demografskih trendov skupaj s spremembami v številu stanovanj je pokazala, da je za Bukarešto in županijo Ilfov značilno nenačrtno prostorsko širjenje, kar potrjujejo tudi predhodne raziskave (Suditu 2009; Simion in Nistor 2012). V zadnjih treh desetletjih se je število stanovanj v Bukarešti povečalo za 26 %, s povprečno letno stopnjo rasti 1,03 %, v županiji Ilfov pa za kar 69 %, kar ustreza povprečni letni rasti 3,87 %. Ti trendi kažejo na širjenje pozidanih površin na račun naravnih in polnaravnih krajin, saj se skupaj z novimi stanovanjskimi soseskami gradijo tudi infrastruktura in drugi objekti z raznovrstnimi urbanimi funkcijami (npr. trgovine, logistični centri in poslovne stavbe).

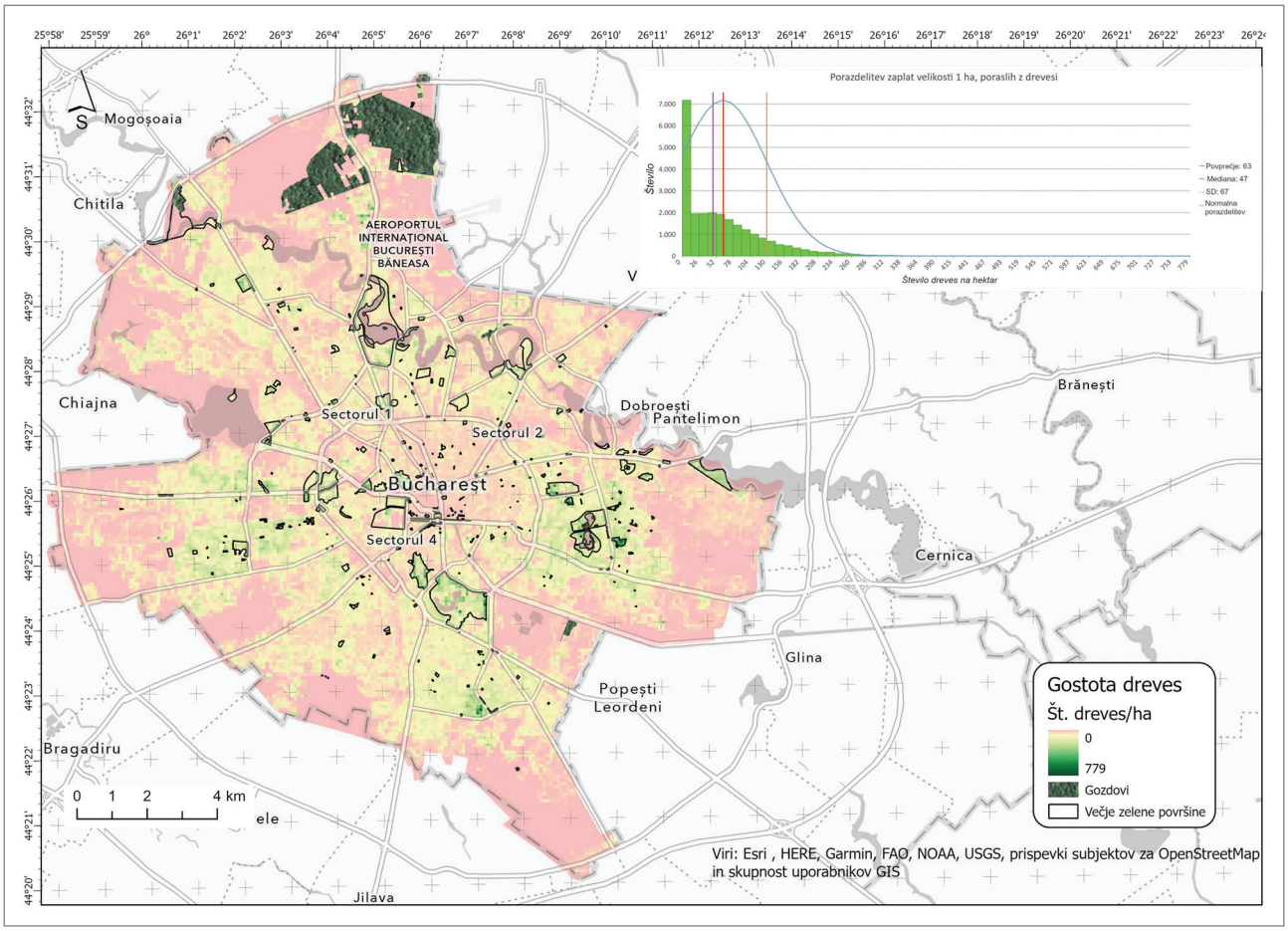
V romunskih predpisih so kot zelene površine opredeljene najrazličnejše vrste rab in pokrovnosti tal (*Lege nr. 24/2007 (republicată)*, Monitorul Oficial, št. 764/2009), vendar nekatere od teh površin (npr. vrtovi javnih ustanov) niso javno dostopne, druge, vključno s športnimi igrišči ali pokopališči, pa sestavljajo pretežno betonski elementi in objekti. Državni statistični podatki o zelenih površinah temeljijo na teh regulativnih opredelitvah. Po uradnih podatkih je Bukarešta od padca komunističnega režima izgubila približno 7 % zelenih površin (National Institute for Statistics, 2023). Podobno so ugotovili tudi v drugih raziskavah, te so pokazale, da se je največ zelenih površin izgubilo na vrtovih ob novih večstanovanjskih stavbah, kjer so bile hitro preoblikovane v parkirišča (Badiu idr., 2018). Na podlagi skupnih podatkov za Bukarešto in županijo Ilfov se je skupna površina zemljišč, kategoriziranih kot zelene površine, v zadnjih 30 letih povečala za približno 14 %. Navedeno je posledica dejstva, da so novogradnje v županiji Ilfov vključevale tudi načrtovanje novih zelenih površin, ki so kot take opredeljene tudi po državnih predpisih, medtem ko so se znotraj upravnih meja Bukarešte zelene površine skrčile. Tako v Bukarešti kot v županiji Ilfov so največja in najbolj sklenjena naravna in polnaravna območja na severu (slika 2).

2.2 Analiza mestnih območij, poraslih z drevesi in grmičevjem

Območja, poraščena z drevesi in grmičevjem, so bila opredeljena skladno z definicijo »drugih zemljišč, poraslih z drevesi«, ki jo uporablja Organizacija združenih narodov za hrano in kmetijstvo. Ta kategorija vključuje mestna zemljišča, ki so večja od 0,5 ha in so porasla z drevesi, višjimi od pet metrov, katerih krošnje pokrivajo več kot 10 % površine. Opredelitev vključuje tako gozdne kot negozdne drevesne vrste (Hendriks idr., 2021). Za analizo prostorske porazdelitve območij, poraščenih z drevesi in grmičevjem v Bukarešti, sta bili uporabljeni dve vrsti podatkov: georeferencirani točkovni elementi iz mestnega registra zelenih površin Bukarešte (Primăria Municipiului București, 2010) ter vektorski sloji majhnih dreves in grmičevja iz evropskega programa Copernicus iz leta 2018. Oba podatkovna niza sta bila obdelana s programskim orodjem ESRI ArcGIS Pro. Za analizo podatkov registra zelenih površin je bila z orodjem *Create Fishnet* v programu ArcGIS Pro izdelana mreža s celicami velikosti 1 ha. Nato je bilo s funkcijo *Intersect* (presek) v istem okolju geografskih informacijskih sistemov pridobljeno število dreves in grmovnic na hektar. Na podlagi slojev majhnih dreves in grmičevja je bila primerjana prostorska porazdelitev mestnih območij, poraslih z drevjem in grmičevjem, med obema podatkovnima nizoma, ki sta bila zbrana in obdelana z različno metodologijo (preglednica 1).

2.3 Analiza mestnih drevesnih in grmovnih vrst ter ocene vezave ogljika

Podatki za prikaz številčnosti vrst mestnih dreves so bili pridobljeni iz registra zelenih površin Bukarešte. Ta ne vsebuje podrobnih geolokacijskih podatkov (npr. o vrsti, starosti in višini dreves), vključuje pa podatke o številu primerkov vsake vrste. Z nadaljnjo obdelavo podatkov so bile vrste razvrščene na podlagi več meril: vrste rastline (drevo/grm), vrste listov (iglavci/listavci), izvora (avtohtona/tujerodna vrsta) in alergenosti (alergena/nealergena vrsta). Poleg tega je bilo navedeno



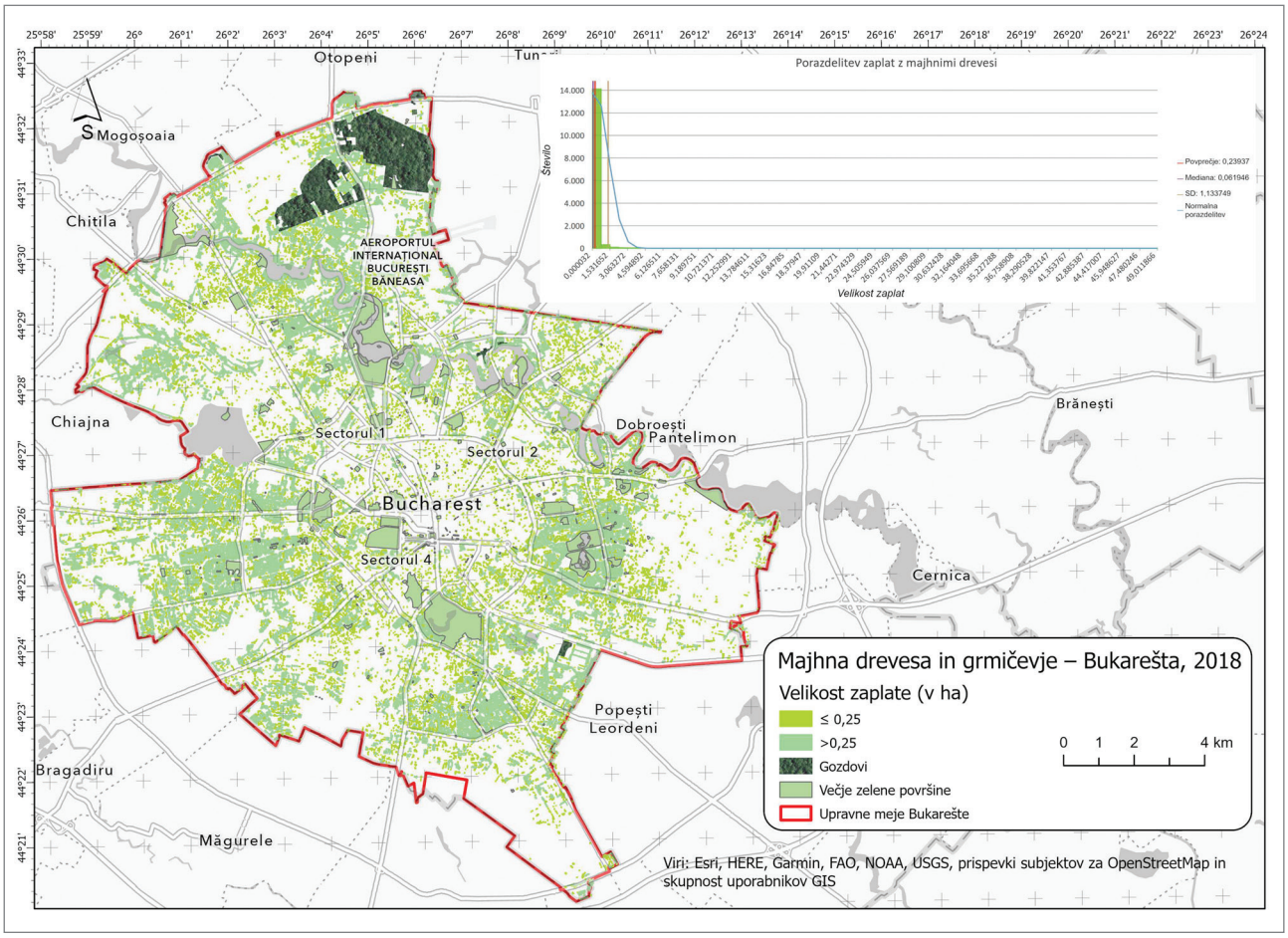
Slika 3: Porazdelitev gostote dreves v Bukarešti, izražene s številom dreves na hektar.

skupno število primerkov vsake vrste. Podatki so bili obdelani v programu Microsoft Excel. Za oceno zmožnosti vezave ogljika v drevesnih vrstah v Bukarešti so bile združene vrednosti, ki jih navajata Evropska agencija za okolje in platforma One Tree Planted. Po podatkih Evropske agencije za okolje (2010) odraslo drevo letno veže približno 21,77 kg CO_2 in pri tem sprošča kisik, po podatkih platforme One Tree Planted pa povprečno drevo letno absorbira približno 10 kg CO_2 (Bernet, 2023). Ker je relativna atomska masa ogljika 12, kisika pa 16, znaša molekulska masa CO_2 44. Količino ogljika v izbrani količini CO_2 je zato mogoče izračunati tako, da količino CO_2 pomnožimo z 0,27 (Farquhar in Lloyd, 1993). Zaradi spremenljivosti stopenj vezave ogljika, ki je odvisna od dejavnikov, kot so vrsta, starost in višina dreves, je bila v raziskavi uporabljena povprečna vrednost 4,29 kg vezanega ogljika na drevo na leto. Na podlagi te ocene je bila mreža gostote mestnih dreves, izdelana za Bukarešto, uporabljena za kartiranje količine vezanega ogljika na hektar po celotnem mestu. Poleg tega so bile na podlagi podatkov prejšnjih raziskav o vezavi onesnaževal zraka po drevesnih vrstah (Nowak idr., 2006, 2013) opredeljene avtohtone drevesne vrste, ki najbolj učinkovito blažijo urbano onesnaženje, zlasti z vidika vezave ogljika. Nazadnje je bila na podlagi števila posameznih dreves in povprečne količine ogljika, ki ga absorbira eno odraslo drevo, določena skupna količina ogljika, ki jo veže posamezna drevesna vrsta v Bukarešti.

3 Rezultati

3.1 Razporeditev mestnih območij, poraslih z drevesi in grmičevjem

Analiza gostote dreves v Bukarešti je pokazala precejšnje prostorske razlike. Za obrobje mesta in osrednja območja je opazno precejšnje pomanjkanje dreves, saj je na teh območjih večji delež zaplat velikosti 1 ha brez drevesnega pokrova kot drugje v mestu (slika 3). Več zaplat z večjo gostoto dreves je na vmesnih območjih. V soseskah v vzhodnem, zahodnem in južnem delu Bukarešte je gostota dreves na hektar razmeroma večja kot na drugih območjih. Največje gostote dreves na hektar so bile ugotovljene v večjih parkih, ki so ključne zelene strukture mesta. Od vseh zaplat velikosti 1 ha znotraj upravnih meja Bukarešte jih ima približno 36 % manj kot 24 dreves na hektar, približno 41 % pa med 25 in 100. Iz prostorskega

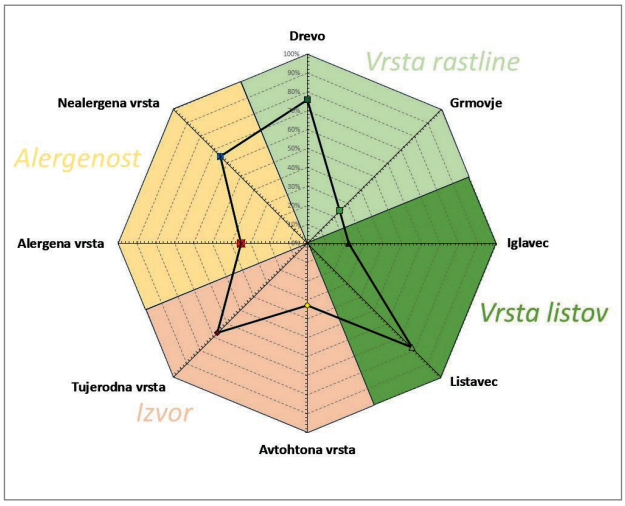


Slika 4: Porazdelitev majhnih dreves in grmičevja v Bukarešti

prikaza sloja majhnih dreves in grmičevja je razviden vzorec porazdelitve, ki se ujema z ugotovitvami analize gostote dreves (slika 4). Soseske na vzhodu, zahodu in jugu imajo največ območij, poraslih z drevesi in grmičevjem, za obrobje in mestno središče pa je značilno izrazito pomanjkanje takšnih prvin. Območja, porasla z majhnimi drevesi in grmičevjem, pogosto ležijo ob robovih večjih parkov, razpršenih po mestu. Približno 87 % jih je manjših od 0,25 ha, kar je v skladu z državnimi predpisi najnižji prag za to, da se skupina dreves lahko opredeli kot gozd. Kljub majhnosti posameznih zaplat te obsegajo samo 26 % skupne površine, poraščene z majhnimi drevesi in grmičevjem v mestu. Navedeno kaže, da v Bukarešti k skupnemu drevesnemu pokrovu pomembno prispevajo večja in bolj strnjena drevesa.

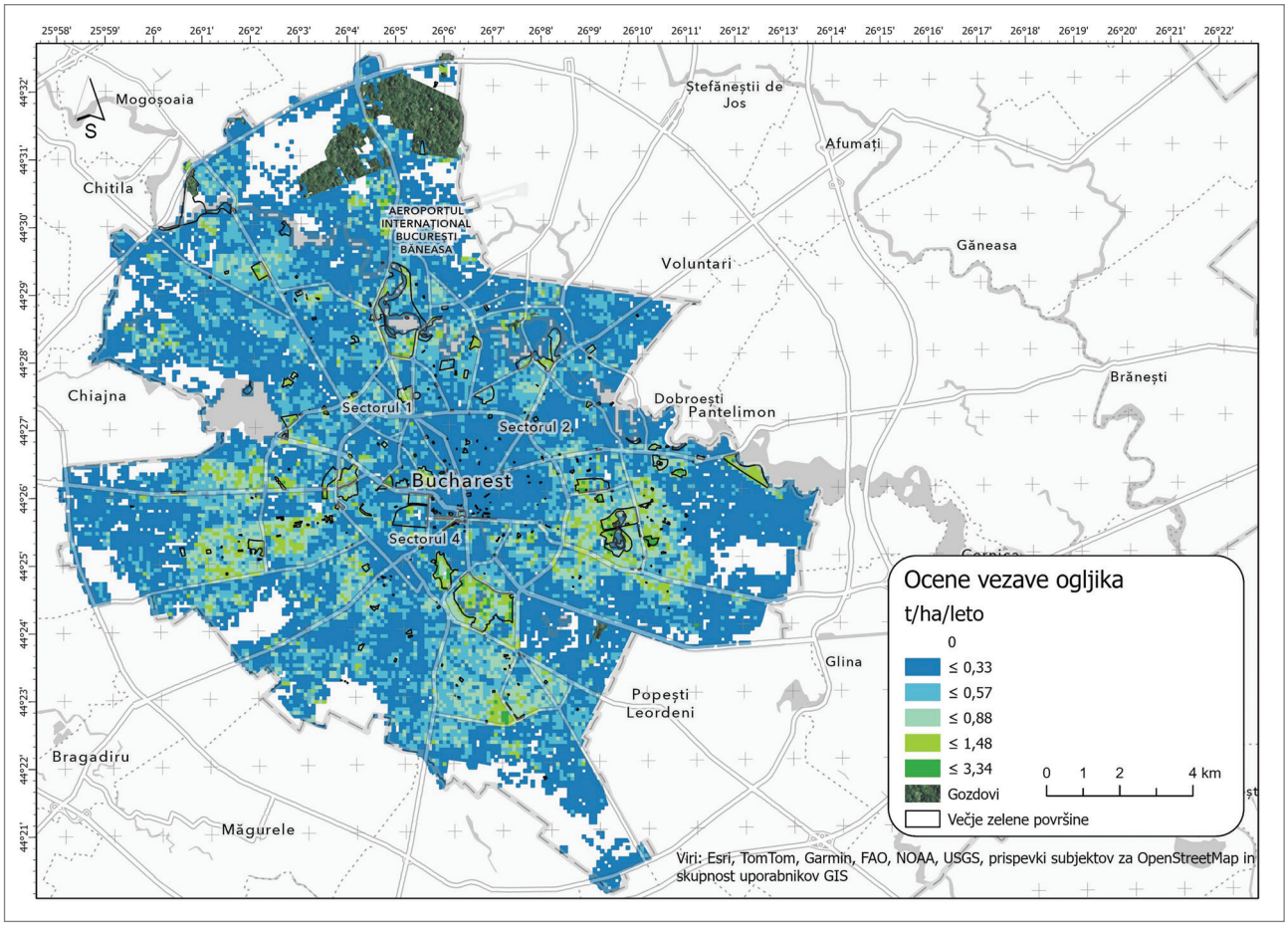
3.2 Drevesne in grmovne vrste ter njihova učinkovitost pri vezavi ogljika

V registru zelenih površin Bukarešte je skupno 1.647.517 dreves in grmovnic, razvrščenih v 219 vrst, pri čemer je vrsta zanesljivo določena za samo približno 11 % evidentiranih dreves. Kot je razvidno s slike 5, je med evidentiranimi vrstami



Slika 5: Značilnosti drevesnih in grmovnih vrst v Bukarešti

76 % drevesnih vrst in 24 % grmovnic. Prevladujejo listavci (78 %). Pomembna ugotovitev je, da je večina vrst tujerodnih (67 %), avtohtonih pa je manjši delež. Precejšen delež vrst je opredeljen kot alergen (35 %). Analiza števila evidentiranih primerkov po posameznih vrstah je pokazala, da so vse vrste z več kot 10.000 primerki drevesa. Med njimi je 38 % tujero-



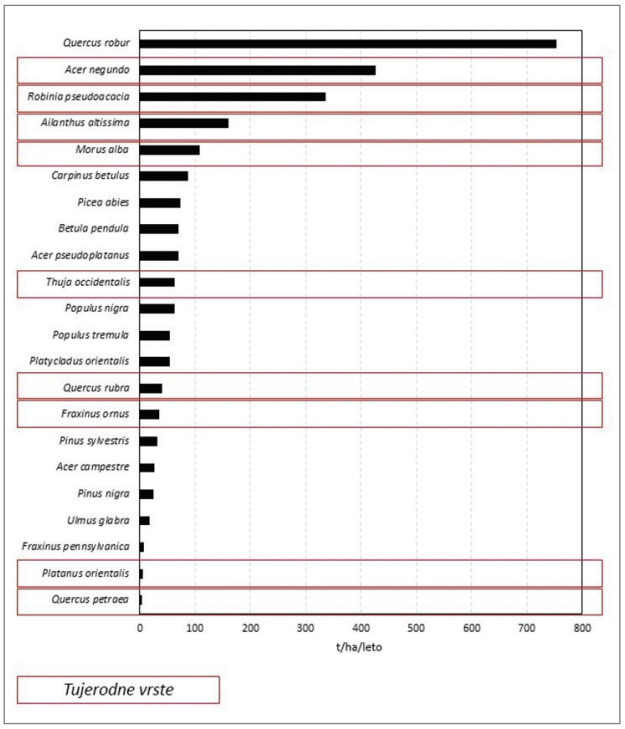
Slika 6: Vezava ogljika v drevesih (v t/ha/leto) v Bukarešti

dnih. Najbolj razširjene tujerodne vrste so ameriški javor (*Acer negundo*), navadna robinija (*Robinia pseudoacacia*), vzhodni klek (*Platycladus orientalis*), ameriški klek (*Thuja occidentalis*), ameriški jesen (*Fraxinus americana*), veliki pajesen (*Ailanthus altissima*) in španski bezeg (*Syringa vulgaris*), pri čemer je za vsako v mestu evidentiranih več kot 20.000 primerkov. Najštevilčnejša vrsta v Bukarešti je dob (*Quercus robur*) s 114.250 primerki, kar pomeni 9 % skupnega števila evidentiranih dreves in grmovnic v mestu.

Ob upoštevanju zgoraj navedene povprečne količine ogljika, ki ga veže odraslo drevo (4,29 kg/leto), se predvideva, da drevesa in grmičevje v Bukarešti letno vežejo približno 6.090 ton ogljika. Pričakovano se soseske z večjo gostoto dreves na hektar ujemajo z območji, kjer se vežejo največje količine ogljika (slika 6). Najvišja ugotovljena vrednost za posamezno zaplato velikosti 1 ha je znašala 3,34 tone vezanega ogljika v enem letu. Na podlagi bruto količine vezanega ogljika v različnih drevesnih in grmovnih vrstah so najučinkovitejše avtohtone vrste v Bukarešti navadna breza (*Betula pendula*), rdečelistna sliva (*Prunus cerasifera*), graden (*Quercus petraea*), puhasti hrast (*Quercus pubescens*), dob (*Quercus robur*), beli javor (*Acer pseudoplatanus*), poljski javor (*Acer campestre*), beli gaber (*Carpinus betulus*) in mali jesen (*Fraxinus ornus*). Vsaka od teh vrst lahko letno veže več kot 5 kg ogljika. Ob upoštevanju tako števila primerkov v Bukarešti kot količine ogljika, ki ga lahko vežejo, je opazno, da so štiri od petih najučinkovitejših drevesnih in grmovnih vrst z vidika vezave ogljika tujerodne (slika 7). Boljša učinkovitost teh tujerodnih vrst pa je bolj posledica njihove večje razširjenosti kot pa večje zmožnosti vezave ogljika na ravni posameznega drevesa.

4 Razprava

V raziskavi so bila opredeljena kritična območja v Bukarešti z vidika poraščenosti z drevesi in grmičevjem. Poleg tega je bila ocenjena zmožnost vezave ogljika pri posameznih drevesnih vrstah v mestu. Ti rezultati so lahko izhodišče za pripravo usklajenih in učinkovitih načrtov za širjenje območij v Bukarešti, poraščenih z drevesi in grmovjem. Mestna okolja so dinamični sistemi, v katerih so nepozidana zemljišča pomemben vir. V tem okviru postaja načrtovanje ali oblikovanje mestnih gozdov kot način prilagajanja podnebnim spremembam in povečanja vezave ogljika večplastni izziv. Izzivi v praksi, povezani z načrtovanjem mestne zelene infrastrukture, se večinoma



Slika 7: Drevesne in grmovne vrste, ki najbolj prispevajo k letni vezavi ogljika v Bukarešti (število primerkov, pomnoženo z bruto količino vezanega ogljika, izraženo v t/ha/leto).

nanašajo na upravljanje in vodenje, zlasti zaradi slabe vključenosti urbanega gozdarstva v urbanistične okvire. Ti izzivi so po navadi povezani z izborom vrst in zasnove zasaditve, stroški vzdrževanja in spremljanja ter preživetjem zasajenih rastlin (Suhane idr., 2024). Zadnje navedeno ni nujno povezano z izbiro drevesnih ali grmovnih vrst, prilagojenih lokalnim podnebnim razmeram, temveč zlasti s kakovostjo in količino prsti v mestu (Jim idr., 2018). Ker pomanjkanje zemljišč vpliva na oblikovanje obsežnih gozdov v velikih mestih, bi bila lahko primerna alternativa povečanje gostote dreves in grmičevja na razpoložljivih površinah.

Razporeditev dreves v Bukarešti je mogoče pojasniti z navedenimi izzivi, saj je razpoložljivost zemljišč za sajenje v mestnem središču okrnjena, pogosto ni dovolj prsti ali ta ne dosega ustrezne kakovosti. Večje gostote dreves so bile zaznane dlje od mestnega središča, zlasti v soseskah, načrtovanih in zgrajenih med komunizmom, kar se ujema z ugotovitvami o neenakomerni razporeditvi zelenih površin v velikih mestih (Tatlić idr., 2024). Kot vzhodnoevropsko mesto, v katerem so se postkomunistični načrtovalski pristopi prekrivali s centralizirano komunistično plansko paradigmo (Csomós idr., 2021), Bukarešta kaže razlike v razporeditvi območij, poraščenih z drevesi in grmovjem, ki so podobne vzorcem, prepoznanim v drugih postkomunističnih mestih. Sektorsko usmerjeni in razdrobljeni načrtovalski sistemi v kombinaciji s šibkimi mehanizmi izvrševanja zakonskih določb so ključni vzroki neenakomerne razporeditve mestne zelene infrastrukture (Vasiljević idr., 2018). Prejšnje raziskave so razporeditev mestnih območij, poraščenih z drevesi in grmičevjem, povezovale zlasti s socialnimi in gospodarskimi dejavniki, manj pa z okoljskimi ali ekološkimi. V Bukarešti je razporeditev takih zelenih območij tesno povezana z veljavnim načrtovalskim okvirom in preteklimi načrtovalskimi pristopi, drugje pa je ta razporeditev povezana z rasno segregacijo, gostoto prebivalstva, dohodki, značilnostmi stanovanjskega fonda in fizičnimi krajinskimi prvinami (Schwarz idr., 2015; Foster idr., 2024). Analize, izvedene v zahodnih družbah, podpirajo tezo, da so premožnejše soseske bolj zelene, revnejša območja in tista, na katerih živijo manjšine, pa imajo manj zelenih površin. Nasprotno pa v Bukarešti novejše soseske, v katerih praviloma živi višji srednji sloj, pogosto nimajo veliko površin, poraščenih z drevesi in grmičevjem, starejše soseske, v katerih živijo večinoma pripadniki nižjega srednjega sloja, pa so po navadi bolj zelene. Navedeno je posledica tržno usmerjenih načrtovalskih pristopov, ki so bili uvedeni v devetdesetih letih prejšnjega stoletja in so opazni še danes, v okviru katerih zemljiške parcele investitorjem prinašajo večje donose, če so pozidane. Zagotavljanje zelenih površin v takšnih soseskah se zato dojema zgolj kot zakonska obveznost, ki se pogosto omeji na najmanjšo zahtevano površino ob najmanjšem možnem finančnem vložku.

Glede na biogeografsko regijo, v kateri je Bukarešta, so bili rezultati analize drevesnih vrst v mestu pričakovani. Kljub temu še naprej ostaja precejšnja težava velika razširjenost tujerodnih vrst, med katerimi so nekatere invazivne ali bi lahko take postale. Skladno s prejšnjimi raziskavami med najpogostejše tujerodne vrste v Bukarešti spadajo ameriški javor (*Acer negundo*), veliki pajesen (*Ailanthus altissima*), navadna robinija (*Robinia pseudoacacia*) in bela murva (*Morus alba*) (Sîrbu idr., 2021; Gavrilidis idr., 2023). Večja mestna okolja so pogosto žarišča vnosa tujerodnih vrst v nacionalne ekosisteme (Kaczorowska, 2020), pri čemer Bukarešta ni izjema. Večina prevladujočih tujerodnih drevesnih vrst v mestu je bila v preteklosti namerno vnesena, zlasti iz estetskih razlogov. Po vnosu so te vrste dobro uspevale in postale prevladujoče prvine urbane krajine. Tujerodne invazivne drevesne in grmovne vrste v mestnih okoljih uspevajo zaradi toplejše in bolj suhe mikroklime ter zaradi svojih razmeroma skromnih ekoloških potreb. Kot poudarjajo izsledki prejšnjih raziskav, robinija še posebej dobro uspeva v mestnih okoljih, ker se njene ekološke potrebe dobro ujemajo z mestnimi ekološkimi razmerami (Franceschi idr., 2023). Ta vrsta je v mestih pogosto zaželena zaradi nižjih stroškov nabave in vzdrževanja ter sorazmerno nižje smrtnosti posajenih primerkov. Prejšnje raziskave mestnih drevesnih vrst so poleg tega pokazale, da sta jesen (*Fraxinus* spp.) in javor (*Acer* spp.) bolj odporna proti suši kot druge vrste (Sjöman idr., 2024), kar pomeni, da se njuna prisotnost v Bukarešti ujema s starejšimi izsledki.

Ne glede na to, ali je drevesna vrsta avtohtona ali tujerodna, je njen prispevek k vezavi ogljika nedvoumno pozitiven (Lashof in Neuberger, 2023). Ugotovitve opravljene raziskave kažejo, da se Bukarešta poleg gozda v severnem delu mesta opira še na tri druge pomembne ponore ogljika na vzhodu, zahodu in jugu. Nepovezanost teh ponorov pa omejuje njihovo skupno učinkovitost, zaradi česar mesto ne more v celoti izkoristiti njihovih regulacijskih ekosistemskih storitev. Poleg tega odsotnost povezav med temi ponori bodisi prek linearnih zelenih koridorjev bodisi manjših površin, poraslih z drevjem in grmičevjem, pomeni tveganje za njihovo postopno degradacijo in manj učinkovito zadrževanje ogljika (Hansen idr., 2022). Pretekle kažejo, da so mestni gozdovi pomemben dejavnik prilagajanja na podnebne spremembe, vendar zgolj zanašanje nanje za doseganje ogljične nevtralnosti ne zadostuje (Velasco idr., 2016). Poglobljene študije zmožnosti mestnih dreves za vezavo ogljika so v Evropi še vedno razmeroma redke, večina pa vezavo ogljika proučuje na podlagi drevesnega pokrova ali vrstne sestave z uporabo alometričnih razmerij, razvitih za ameriške drevesne vrste (Bherwani idr., 2024). Za Bukarešto je povprečna ocenjena količina vezanega ogljika v drevesih in grmičevju približno 0,26 t/ha/leto. Za primerjavo: povprečna stopnja vezave ogljika v gozdovih kitajskih mest naj bi bila približno 2 t/ha/leto (Chen, 2015), v gozdovih v Teheranu pa približno 1 t/ha/leto (Rasoolzadeh idr., 2024). Raziskava iz Teherana je pokazala, da med vrste z veliko zmožnostjo vezave ogljika spadajo robinija (*Robinia pseudoacacia*), brest (*Ulmus* spp.), jesen (*Fraxinus* spp.), bor (*Pinus* spp.) in platana (*Platanus* spp.). Podobno sta v svoji raziskavi za Bukarešto ugotovila avtorja tega članka. Analize iz ameriških mest kažejo, da je letna bruto zmogljivost dreves v Baltimoru – mestu, ki je po površini, podnebju in rastlinstvu primerljivo z Bukarešto – približno 14.800 t vezanega ogljika (≈ 0,62 t/ha/leto) (Nowak in Crane, 2002).

Izsledki v literaturi jasno potrjujejo velik pomen mestnih površin, poraslih z drevjem in grmičevjem, pri prizadevanjih za doseganje večje vezave ogljika v mestih. Zaradi vloge, ki jo ima CO_2 pri pospeševanju podnebnih sprememb, je v novejših raziskavah izpostavljen kot eden glavnih onesnaževal zraka (Hadipoor idr., 2021). Ocenjena količina vezanega CO_2 v štirih parkih v Rimu pomeni približno 3,5 % skupnih emisij toplogrednih plinov v mestu (Gratani idr., 2016), v Pekingu pa ocenjena letna količina vezanega CO_2 zajema samo približno 0,2 % skupnih emisij (Tang idr., 2016). V indijskih mestih naj bi bila količina ogljika, vezanega v drevesih, zasajenih ob cestah, enakovredna 22 % mestnih emisij CO_2 (Kiran in Kinnary, 2011). Kljub navedenim ugotovitvam ostaja nejasno, koliko so stroški in prizadevanja občin za širitev ter razvoj robustnih in funkcionalnih omrežij zelene infrastrukture upravičeni zgolj z vidika rezultatov vezave ogljika. Tudi denarno vrednotenje zmožnosti mestnih dreves za vezavo ogljika, čeprav je uporabno za oblikovanje politik in ponazoritev gospodarskega pomena, ni dovolj natančno, da bi lahko ugotovljene vrednosti obravnavali kot točen finančni podatek (Nowak in Crane, 2002; Bherwani idr., 2024). Poleg tega je rast mestnega prebivalstva povezana z naraščajočim povpraševanjem po dostopnih stanovanjih in prometni infrastrukturi. Ohranjanje nepozidanih zemljišč tako postaja čedalje zahtevnejši izziv za lokalne odločevalce, saj se družbeni pritisk stopnjuje z obeh strani: tako z vidika potrebe po zagotavljanju stanovanj kot z vidika potrebe po ustreznih mestnih zelenih površinah. Vrednosti vezanega ogljika, navedene v tem članku in prejšnjih raziskavah, se morda zdijo premalo prepričljive, da bi same po sebi spodbudile strožjo regulacijo urbanističnega načrtovanja, ki bi se osredotočala na kakovost in obseg zelene infrastrukture. Kljub temu z znanstvenega stališča ni nobenega dvoma, da bi se z izgubo mestnih zelenih površin močno poslabšala kakovost življenja v mestih.

Ključna prednost raziskave, predstavljene v tem članku, je bila razpoložljivost podatkovne baze o lokacijah dreves iz registra zelenih površin Bukarešte. Brez tega vira bi bila edina druga možnost uporaba sloja majhnih dreves in grmičevja, ki je dovolj natančen za splošne ocene. Dostop do obeh podatkovnih virov pa je omogočil medsebojno preverjanje podatkov. Ponovljivost uporabljenih metod je odvisna od dostopnosti geoprostorskih podatkov o mestnih drevesih in grmičevju. Če so taki podatki dopolnjeni z informacijami o drevesnih in grmovnih vrstah, je mogoče podobne analize brez težav ponoviti tudi v drugih mestih. Vendar register zelenih površin Bukarešte ni bil posodobljen vse od leta 2012, zato so se razmere v tem času lahko precej spremenile. Posodobljena analiza razporeditve dreves in vrstne sestave bi lahko pokazala spremembe v nekaterih delih mesta, vendar se splošni vzorci, ugotovljeni v tej raziskavi, verjetno ne bi pomembno razlikovali. Dodatna omejitev je bila, da ni podatkov o starosti dreves in vrstah na zadevnih lokacijah. Kljub temu splošni statistični podatki o drevesnih vrstah še vedno zagotavljajo dober vpogled v to, katere vrste pomembno prispevajo k vezavi ogljika v Bukarešti.

5 Sklep

Izsledki raziskave poudarjajo, da bodo za doseganje ogljične nevtralnosti na podlagi na naravi temelječih rešitev v Bukarešti potrebni precejšnja prizadevanja, strokovno podprto načrtovanje in politično preudarno odločanje. Nadaljnja uporaba dosedanjega pristopa lahko privede do rezultatov, ki so slabši od ohranjanja trenutnega stanja, kar dodatno izpostavlja nujnost strateških ukrepov, ki temeljijo na relevantnih informacijah. Raziskava je pokazala, da Bukarešta v primerjavi s podobnimi mesti zaostaja z vidika zmožnosti mestnih dreves in grmičevja za vezavo ogljika. Območja z večjo gostoto dreves in grmičevja

so razpršena po vsem mestu. Trenutno stanje je ustrezno izhodišče za nadaljnji razvoj zelene infrastrukture v mestu s poudarkom na širjenju površin, poraslih z drevjem in grmičevjem. Pri tem bi bilo treba dati prednost obrobju mesta, kjer je še vedno na voljo dovolj zemljišč za načrtovanje in oblikovanje tovrstnih prvin. Nasprotno pa bi bili v mestnem središču, kjer je razpoložljivost zemljišč omejena, koristni inovativni pristopi, kot so vertikalne ozelenitve.

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Izjava o razpoložljivosti podatkov

Podatki o pokrovnosti in rabi tal za Bukarešto in županijo Ilfov so bili pridobljeni iz podatkovnih baz Corine Land Cover (CLC) in Urban Atlas ter so ob registraciji prosto dostopni. Podatke o geolokaciji dreves je zagotovila mestna uprava Bukarešte in so na voljo na zahtevo, ni pa jih dovoljeno deliti s tretjimi osebami. Izpeljani podatki, oblikovani v tej raziskavi, kot so gostota dreves in letna količina vezanega ogljika na hektar ter število dreves in grmovnic po posameznih vrstah, so javno dostopni v repozitoriju ORF na povezavi https://osf.io/g3xva/overview (Gavrilidis, 2026); če so ti podatki uporabljeni v drugih publikacijah, je treba citirati tudi ta članek.

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Urban vitality in a medium-sized city: Insights from a spatial multi-criteria analysis

Urban vitality reflects the intensity and diversity of everyday urban activities and their spatial distribution, serving as a key indicator for planning and managing cities. In medium-sized, post-socialist cities, spatial disparities in vitality often remain underexplored due to limited data integration and analytical tools. This study examines urban vitality in Niš, one of Serbia's few medium-sized regional centres, using a spatial multi-criteria assessment that integrates socioeconomic, infrastructural, and spatial indicators. An entropy–TOPSIS multi-criteria model integrated with GIS was applied to determine the relative importance of indicators and derive a composite urban vitality index across sixty-nine settlements. The analysis reveals pronounced intra-urban differences, highlighting areas of concentrated vitality as well as zones of relative functional and social weakness. Beyond mapping vitality, the study identifies key indicators that most strongly influence urban vitality and provides insights into monitoring and enhancing vitality in similar urban contexts. The findings provide a transparent, spatially explicit framework to support evidence-based planning, targeted regeneration, and follow-up qualitative or participatory assessments in medium-sized cites.

Keywords: urban vitality, GIS, multi-criteria assessment, post-socialist urban development, Niš

1 Introduction

Urban vitality refers to the intensity and diversity of human activities in urban spaces, reflecting interactions between spatial structure, functional mix, and socioeconomic dynamics. In urban planning and urban studies, vitality is closely associated with walkability, land-use diversity, accessibility, and the presence of active public spaces (Cardoso & Meijers, 2016; Istrate et al., 2020). Recent scholarship further conceptualizes urban vitality as an emergent, dynamic phenomenon shaped by temporal activity patterns, social interaction, and community engagement (Garau & Annunziata, 2022; Osunkoya & Partanen, 2024).

Urban vitality has been studied more in large metropolitan regions, whereas medium-sized and second-tier cities have been insufficiently explored despite their crucial role in regional development and territorial cohesion (Cardoso, 2016). Unlike large cities around the world, medium-sized cities often experience depopulation (Parkinson & Meegan, 2013). They also undergo functional mono-structuring following industrial restructuring (Berroir et al., 2019) and gradual centre devitalization (Chouraqui, 2021). These transformations often call for context-specific analytical approaches able to capture intra-urban disparities rather than relying solely on aggregate city-level indicators.

European research highlights several spatial dimensions of vitality. Functional density and mixed land use have been shown to strengthen everyday urban activity (Istrate et al., 2020). Socioeconomic diversity and connectivity contribute to resilient local economies (Gao et al., 2024). Moreover, cultural initiatives (Kara et al., 2025) and culture-led regeneration programs (Tzatzadaki, 2024) are useful tools for enhancing urban identity and social cohesion, particularly in second-tier cities (Błaszczyk & Krysiński, 2023).

In post-socialist cities, institutional transformation and economic restructuring have shaped urban spatial dynamics (Cvetinović et al., 2016). Fragmented planning systems and uneven development patterns have contributed to disparities between central and peripheral areas (Stojić & Timotijević, 2024). Urban planning in Serbia often fails to address structural inequalities (Petrović, 2009), remaining detached from the specific needs of peripheral and sub-municipal zones (Vujošević et al., 2012). Research on major cities such as Belgrade, Novi Sad, and Niš identifies demographic change, migration, and infrastructural inequality as important drivers of spatial differentiation (Antonić, 2024; Šantić & Đorđević, 2023). Integrating cultural initiatives, participatory governance (Nedučin & Krklješ, 2022), and infrastructure quality (Đorđević et al., 2023) is increasingly highlighted as a pathway to maintain vibrant and inclusive urban spaces (Protić et al., 2020). Nevertheless, systematic, fine-grained spatial assessments of urban vitality at the sub-municipal level remain limited.

Methodologically, European studies increasingly combine spatial statistics (Gao et al., 2024), GIS modelling, big data (Osunkoya & Partanen, 2024), and spatial analysis (Galaktionova & Istrate, 2025) to capture both static and temporal dimensions of urban vitality. On the other hand, although multicriteria decision-making (MCDM) methods, due to their robustness, are increasingly employed to integrate heterogeneous indicator datasets (Ali et al., 2023; Ginting et al., 2017), they are less present in this domain. Such approaches can allow the identification of intra-urban variability and provide transparent support for evidence-based planning. However, they are rarely applied in medium-sized post-socialist cities, particularly in Serbia.

This study focuses on Niš, Serbia, a representative second-tier city with a compact urban core, a mixed urban–rural administrative structure, and pronounced spatial disparities. Using entropy-based weighting and the TOPSIS method coupled with GIS, the research develops a composite vitality index for a fine-grained understanding of intra-urban differences. The study offers a spatially explicit and transferable MCDM model tailored to medium-sized cities and, by identifying the indicators with the greatest differentiating capacity at the urban level, it supports evidence-based planning beyond municipal aggregates. It addresses the following research question: How can a hybrid GIS–MCDM model be effectively applied to evaluate urban vitality by assessing various levels of urban vitality at the sub-municipal level using data from publicly managed infrastructure assets, environmental resources, and social facilities?

To address this primary question, the study explores the following sub-questions: 1) To what extent can this GIS-based entropy–TOPSIS model serve as a replicable tool for evidence-based planning in other regional centres with limited data integration? 2) How is the vitality disparity spatially manifested? and 3) Which indicators carry the highest weights that can strongly impact vitality index results?

2 Literature review

Urban researchers have highlighted the spatial dimension as a main factor determining urban vitality. For instance, Cardoso and Meijers (2016) reported that urban areas experience greater daily activity when accessibility and land-use diversity, together with density, reach optimal levels. Findings from

multiple European cities show that pedestrian traffic and socioeconomic connections increase when cities have functional density combined with mixed-use development (Istrate et al., 2020). On the other hand, Gao et al. (2024) employed GIS-based spatial metrics to show that medium-sized urban areas experience higher vitality levels when their land uses show more diversity and their street networks provide better access to different areas. Furthermore, Liu et al. (2023) demonstrated that, in medium-sized contexts, fine-grained analysis of spatial environmental data is essential to uncover the "sub-municipal" realities of urban vitality. Osunkoya and Partanen (2024) combined spatial data with activity patterns by analysing mobile phone data and reported that vitality levels depend on mobility patterns and access to services. A study by Garau and Annunziata (2022) demonstrated that compact urban areas with proximity to public amenities foster both tangible and perceived vitality among their inhabitants. These findings indicate that a single infrastructure indicator cannot adequately capture vitality; instead, a multidimensional evaluation is necessary.

Considering medium-sized and second-tier cities, European spatial policy discussions have started to recognize their rising significance in their development plans. Cardoso (2016) argued that such cities play a stabilizing role in regional systems, despite lacking the global competitiveness of metropolitan centres. However, several important factors affect their vitality. Parkinson and Meegan (2013) identified demographic decline as a common trend in post-industrial second-tier cities. Berroir et al. (2019) showed how functional mono-structuring as a consequence of the industrial restructuring of cities reduces urban diversity and weakens local resilience. Chouraqui (2021) demonstrated that suburbanization, with its limited service node development, is the root cause of the decline in central areas. Studies have also reported that culture-led regeneration initiatives have potential as a community revitalization method. Kara et al. (2025) examined the impact of European Capital of Culture initiatives on urban identity and local economic dynamics. Tzatzadaki (2024) found that cultural programming can stimulate social cohesion when embedded in long-term governance frameworks. However, Błaszczyk and Krysiński (2023) warned that the outcomes from such projects depend on their specific environment, resulting in different effects across different areas. There is an evident incline in research toward larger cities; thus, there is a limited understanding of vitality in a wider spectrum of European cities.

Research on post-socialist cities recognizes three main factors that affect their urban vitality: institutional changes, privatization, and alterations to governing systems. Cvetinović et al. (2016) argued that deregulation and fragmented planning practices largely influenced uneven urban development patterns in Serbia. Stojić and Timotijević (2024) showed that peripheral settlements often experience infrastructural deficits compared to central zones. Serbian scholarship provides additional context. For instance, Antonić et al. (2024) reported that demographic changes in major Serbian cities mainly result from migration and aging. On the other hand, Šantić and Đorđević (2023) showed that infrastructure distribution creates persistent uneven development patterns between different areas. Protić et al. (2020) and Nedučin & Krklješ (2022) argued that improved accessibility to public areas positively affects their use, which leads to increased urban activities. The research conducted in Serbia primarily focuses on single aspects of urban sustainability and vibrancy, and lacks attempts at integrated vitality analysis. Due to the regional differences in post-socialist urban transformations, mapping urban vitality in Serbian cities requires a context-sensitive framework.

Urban vitality is examined using various methodologies. For instance, Osunkoya and Partanen (2024) combined traditional metrics with mobile phone data through GIS analysis to understand how urban diversity and socioeconomic features correlate with vitality. Gao et al. (2024) employed data such as nighttime light, housing prices, social media, points of interest (POIs), and NDVI data to measure various aspects of urban vibrancy using the Geodetector and geographically weighted regression models. Galaktionova and Istrate (2025) assessed street vitality by using functional density as a proxy, which was derived from OpenStreetMap (OSM) data and analysed through a spatial lag regression model. Lopes and Camanho (2013) used data envelopment analysis to understand how public green spaces contribute to urban vitality. Garau and Annunziata (2022) combined space syntax and GIS to understand how urban form components impact vitality potential.

Despite the different methodological approaches, challenges related to data alignment and resolution discrepancies persist. There is also variability in data availability, applied technology, and level of analysis. Some studies focus on a fine-grained local scale, and others consider a broader, metropolitan scale. Furthermore, the use of aggregated data sources (such as mobile phone data or POI datasets) may oversimplify contextual information.

Several significant challenges are identified in the literature reviewed, such as the multidimensional nature of urban vitality, which challenges "one size fits all" urban theories and supports context-specific frameworks for urban vitality analysis, the distinct structural challenges affecting urban vitality in medium-sized and post-socialist cities, and the dearth of studies using MCDM in this setting.

As a result, this study contributes by operationalizing a spatial MCDM-GIS model tailored to a medium-sized post-social-

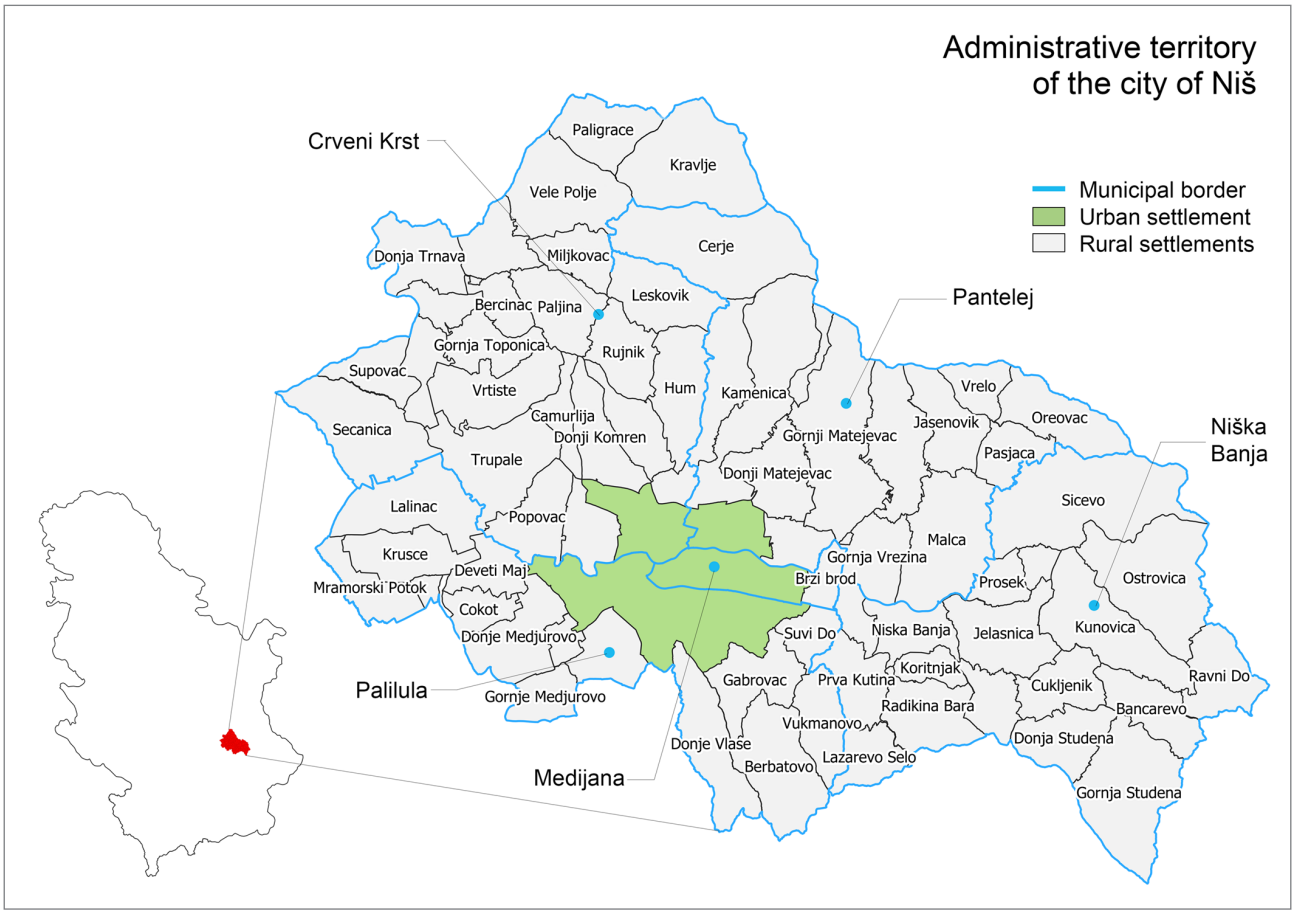

Figure 1: Study area.

ist city and by providing a transparent ranking of settlements based on publicly governed infrastructural, environmental, and social assets, expanding the scope of commonly used determinants of urban vitality (such as spatial diversity, mixed land uses, urban density, and so on).

3 Methodology

3.1 Study area

Niš was chosen as an illustrative case of a medium-sized Serbian city facing spatial disparities and functional challenges. As one of the few urban centres outside the capital region with a strong regional role, Niš serves as an administrative, economic, and educational hub for southern Serbia while showing marked differences in accessibility, land use, and socioeconomic activity between central and peripheral areas (Figure 1). Its compact urban structure, combined with areas of both decline and emerging development, makes Niš suitable for examining how different characteristics influence vitality. Since 2004, Niš has been administratively divided into five municipalities. These municipalities have diverse spatial, demographic, and functional characteristics. For instance, the municipality of Medijana, although the smallest (16 km^2), is the most densely populated, with 82,360 residents. In contrast, Niška Banja, the largest in area, is predominantly rural and features the lowest population density. Differences in urban development levels, infrastructure provision, and access to services combined with the coexistence of urban and rural lifestyles generate divergent quality-of-life outcomes. Demographic disparities further reinforce this fragmentation: some settlements have an average age as low as thirty-eight, and others as high as sixty-nine. These spatial and demographic differences necessitate detailed sub-municipal analysis. The presence of sixty-nine rural settlements within the five city municipalities emphasizes the limitations of using the municipal scale as the primary unit of urban analysis. Therefore, these settlements are considered as study units because they lack sufficient data and are frequently excluded from conventional planning processes.

3.2 Indicators

The indicators used for this study primarily focus on physical resources and important infrastructure under the municipal government. Although privately owned facilities, such as gro-

cery stores or banks, contribute to daily life and urban vitality, their presence is market-dependent and reflects commercial decisions rather than public-sector support, and so they are not included on the indicator list. The final list of indicators was developed in accordance with relevant literature and following an extensive field investigation, which included an inventory of all infrastructure elements (e.g., roads, schools, and sport facilities) and resources (e.g., watercourses, forests, and caves). The indicators are classified according to five criteria briefly outlined below.

1. Geographical location, natural potential, and environmental protection

- Proximity to the city centre indicates accessibility to diverse economic opportunities, public services, cultural amenities, and transportation infrastructure. According to Jacobs (1961), the quality of urban life depends on dense mixed-use urban environments that provide better closeness and social networks, and where everyday activities are close together. Montgomery (1998) supported this, stating that urban vitality diminishes with distance from the urban core.
- Proximity to watercourses offers ecosystem services such as provisions for agriculture, natural flood regulation, and recreational values, which MEA (2005) recognized as essential for long-term local development.
- Proximity to forests reflects potential for eco-tourism, sustainable resource use, recreation, improved microclimate, and overall well-being (Tzoulas et al., 2007).
- Protected natural areas function as part of a green infrastructure network linking environmental conservation with community well-being and supporting local livelihoods through regulated low-impact activities such as eco-tourism, speleology, or collecting herbs, allowing an economy in line with long-term ecological preservation (MEA, 2005).
- Geological resources include features such as caves, thermal springs, and spas, which support tourism, small business development, sports, and recreation (Farsani et al., 2011).

2. Infrastructure and communications

- Types of access roads from the city centre, roads within the settlement, and accessibility to public transportation are indicators of physical connectivity, economic potential, emergency response, and community integration (Litman, 2021).
- Frequency of organized public transport.
- Presence of petrol stations refers to the spatial proximity of these to agricultural and residential clusters, cutting transport costs, and ensuring farmers have the fuel they need close by. This can support infrastructure integration, economic vitality, and support for tourism and logistics.
- Presence of a post office indicates developed communication infrastructure, access to financial and logistical services, and information dissemination, which is especially important in rural areas (Castells, 2010). It is an important physical gateway for e-commerce, providing the "last mile" logistical link needed for community integration in rural or remote areas.
- Mobile network coverage serves as the fundamental digital system allowing suburban areas to develop into connected economic centres through the provision of final data transmission and communication services while also supporting the social and cultural activities that drive suburban community life.

3. Healthcare

Niš's suburban settlements are already experiencing demographic decline. Most of these settlements lack access to healthcare facilities. Thus, the following two indicators can contribute to local vitality:

- Access to primary healthcare facilities.
- Access to pharmacies.

4. Education

- Access to educational institutions: a lack of primary schools causes families to migrate toward the city. Thus, a primary school in a settlement reflects a capacity to retain residents.

5. Social development

- Number of public outdoor sports fields and recreational facilities, and sports clubs: such facilities are "bonding" spaces (Putnam, 2000), essential for creating trust and cooperation. Sports fields and sport clubs are a proxy for healthy and multigenerational demographics, and a base for social interaction and community well-being.
- Number of cultural institutions and local events refers to cultural festivals and creative hubs, mainly in the urban core of Niš, that draw the younger generation out from metropolitan edges. This creates stagnant areas of peripheral community, dull and without the social vibrancy and institutional "glue" that Florida (2002) proposed as a requirement for maintaining a productive long-term multi-generational population.
- Number of religious buildings reflects the potential for social cohesion, community inclusion, and opportunities for volunteerism and civic participation. A diversity of religious institutions may also suggest cultural tolerance and pluralism (Putnam & Campbell, 2010).

3.3 Scoring method and data sources

Class boundaries were established by considering both accepted norms and empirical evidence. We utilized the walkability thresholds established by UN-Habitat (2018) to determine distance-based measures. For indicators with established classifications, such as mobile network coverage and road categories, the corresponding institutional categories were utilized. For the remaining indicators, the complete dataset was analysed and classes that accurately reflected the distribution of values were established. For instance, if the inventory showed that the maximum number of geological resources within the settlement boundary is more than three, we assigned three classes to this indicator (see Table 1); if the maximum number of schools in all settlements is 1, we assigned binary classes. The scoring system was thus both evidence-based and aligned with current planning and regulatory frameworks. Consequently, the scoring system may accurately represent actual differences and respond to minor variations within communities while adhering to a four-point or binary rating framework. The settlement boundaries (SB) were taken into account when evaluating indicators.

The values of the four-point scale are 3 = significant potential for local development, 2 = moderate potential, 1 = weak potential, 0 = absent. Scoring is based on data collected from publicly available sources, institutional records, field visits, and planning documentation, ensuring a comprehensive and reliable data foundation (Vranić et al., 2026a).

3.4 Prioritization methodology

The objective of applying the multi-criteria method was to rank local communities according to predetermined criteria to assess their vitality. Shannon's entropy method was used to calculate the weight values of the criteria and determine the weight coefficients. The term *entropy* denotes disorder and uniformity in a data set (Shannon, 1948). The relationship between the entropy value and weight coefficient is inverse (Zakeri et al., 2025): criteria with a higher entropy value have low coefficients and vice versa (Ali et al., 2023). Criteria with a minimum difference between their values have a higher entropy value because the data are uniformly distributed and provide limited information. In contrast, criteria with a greater difference between individual values provide a variety

Table 1: Indicator values and rationale.

Indicator	Data source, method	Rating
1. Geographical location, natural potential and environmental protection		
Proximity to the city centre	Calculation of isochrones with QGIS TravelTime plugin using centre of settlement as origin point, city centre as destination point	3: < 10 min drive to city centre 2: 10–20 min 1: 20–30 min
Proximity to watercourse	Calculation of Euclidean distance from centre of settlement to closest watercourse/forest using buffer tool in QGIS	3: 5 min walk 2: 10 min 1: 15 min
Proximity to forests		
Protected natural areas	Environment Protection Institute of Serbia data applying spatial overlay	1: Protected area present within SB 0: Does not exist
Geological resources	OSM data	3: three or more geological sites are present within SB 2: two 1: one 0: none
2. Infrastructure and communication		
Types of access roads from the city centre	Public utility Co. "Directorate for Construction of the City of Niš" and OSM data, applying zonal statistics in QGIS. Due to data limitations on road quality, analysis focused only on road hierarchy.	3: The settlement is accessible via primary roads 2: via secondary roads 1: via tertiary roads
Types of roads within settlement		3: road network of mostly primary roads 2: secondary roads 1: tertiary roads

Accessibility to public transportation	Analysis of "Directorate for Public Transport of Niš and Serbian Railways data applying zonal statistics in QGIS	2: more than one type of transport available 1: one 0: none
Frequency of organized public transport*		3: high 2: medium 1: low
Presence of petrol stations	OSM and Google Earth data	1: present within SB 0: none
Presence of a post office	Post of Serbia, Google Earth, and field study data	1: present 0: none
Mobile network coverage**	GIS analysis of regulatory authority for Electronic Communications and Postal Services (RATEL) data	3: mostly good/excellent coverage 2: satisfactory to good/excellent 1: satisfactory for ≥ 80%
3. Healthcare		
Access to primary healthcare facilities	Voronoi diagram in QGIS based on health centre data	3: health centre present within SB 2: shared with one settlement 1: serves several settlements
Access to pharmacies	Voronoi diagram in QGIS based on Google Earth data and online data	3: pharmacy present within SB 2: shared with one settlement 1: serves several settlements
4. Education		
Access to educational institutions	School administration, Google Earth, and field study data	1: primary school present within SB 0: none
5. Social development		
Number of public outdoor sports fields and recreational facilities,	OSM, Google Earth, and field study data	2: two or more facilities within SB 1: one 0: none
Number of cultural institutions	Google Earth, Diocese of Niš, and field study data	1: institution present 0: none
Number of religious buildings		1: religious building is present within SB 0: none
Number of local events	Local tourist organization data	2: more than one event annually 1: one 0: none
Number of registered sports clubs	Local sports federation data	2: more than one club 1: one 0: none

*Based on the number of departures to each municipality per workday. The final number was standardized to a range of 0–1 using the min–max approach, with 0 being the least frequency and 1 the most. For uniformity of evaluation, the normalized range was divided into three frequency groups.

**The signal area for the three national operators was compared to the total area of the settlement using the Regulatory Authority for Electronic Communications and Postal Services (RATEL) classification levels: excellent (expected very good connection), good (expected good connection), and satisfactory (expected acceptable connection with interruptions). The final grade was determined by averaging the scores of all three operators based on signal dominance: 3 = combined territory of excellent/good signal exceeds satisfactory signal area, 2 = satisfactory signal area exceeds combined excellent/good signal coverage, 1 = satisfactory signal level covers more than 80% of the territory.

of information for ranking, the degree of entropy is lower, and their weight value is greater (Chen, 2020). Criteria with lower entropy can contribute to the observation of differences among local communities because they imply variability in the data and facilitate ranking. Applying this method seeks to avoid subjectivity in the ranking process. The TOPSIS method then combined the weighted indicators into a composite urban vitality index, ranking settlements by how close they are to an "ideal" high-vitality scenario and how far from the "least desirable" scenario. More information about each method can be found in the Vranić et al., (2026b).

4 Results

4.1 Indicators

The spatial distribution of indicators is presented in Figure 2. For proximity to the city centre, isochrone maps were generated to estimate travel times to the city center of Niš under optimal driving conditions by car (excluding rush hour), measured from the settlement center. Fifty per cent of settlements lie within the third zone (20–30 minutes), 47.1% in the second zone (10–20 minutes), and only two within ten minutes. Several settlements fall on isochrone boundaries. Sixty per cent are in the second zone, indicating most residents drive eighteen to twenty minutes to the city centre (Figure 2a). Residents generally walk five to fifteen minutes (400–1,200 m) to the nearest watercourse (51.4% are within 400 m, 18.6% within 400–800 m, 15.7% within 800–1,200 m, and 14.3% beyond 1,200 m; Figure 2b). Proximity to forest area considered the distance between the centre of the settlement and the closest forest; 58.6% of residents live near forests: 19% within five to ten minutes walking, 14% within fifteen minutes (800–1,200 m), and 8% within five minutes. The remaining 41.4% are over 1,200 meters away (Figure 2c). Protected areas cover 10.4% of the study area, mainly in the east. Thirteen of sixty-nine settlements are partially or fully within nature parks and reserves such as the Sićevo Gorge and Mount Suva (Figure 2d). Only seven settlements (10.1%) have geological resources within their boundaries. Some even have thermal springs and caves with national or international significance, such as Cerje and Pešturina caves (Figure 2e). Regarding types of access roads from the city centre and roads within the settlement, 10% of settlements are accessible from the city centre only via tertiary roads, 29% via secondary roads, and 61% via primary roads. Within settlements, 31% rely on tertiary roads, 33% on secondary roads, and 6% on primary roads (Figure 2f).

Approximately 80% of settlements have organized public transport, mostly buses; 11.4% also have rail service. If accessible neighbouring areas are included, rail access rises to 35.7%. Four percent of settlements lack organized transport entirely (Figure 2a). In terms of frequency of public transport, 12.9% have the highest frequency (0.69–1.0), 12.9% medium (0.31–0.53), and 74.2% low (up to 0.30), decreasing with distance from the city centre (Figure 2b). The spatial distribution of petrol stations corresponds to the expected directions of the main highways and access roads. Along these, petrol stations are present in 14.2% of settlements. Including neighbouring settlements that can be driven to in ten minutes or less, an additional 41.4% of settlements are direct users of this resource. The number of post offices decreases with distance from the centre of Niš, but coverage remains good, at 49% overall. Including settlements bordering those with post offices, the coverage increases to 95.7% of the population. There is great spatial variation in mobile network signal quality for local communities: 19.4% of settlements have very good to excellent signal coverage (≥ 2.7), with acceptable mobile access for digital services, online communication, and smart infrastructure. However, 23.6% of settlements are in the poor to very poor range (≤ 1.3), meaning that direct, good mobile signal coverage exists only 19.4% of the local settlements.

Primary schools are present in half of the settlements; 28.5% are branch schools. The remainder lack primary schools, requiring residents to attend school in nearby settlements. Voronoi diagrams showed half the settlements share a health centre with two or more others, 37.6% share with three or more, 14.3% share with only one other, and 35.7% have their own. Pharmacy coverage is slightly lower than that of healthcare facilities and diminishes with distance from the centre of Niš: 87.1% of settlements share a pharmacy with two or more others, and 64.3% with four or more settlements. Only 12.9% of settlements have their own pharmacy, and 4.3% share with one other. Regarding sports and recreational facilities, 11.4% of settlements lack facilities, 51.4% have at least one, and 37.2% have two or more. Cultural institutions are absent in 88.6% of settlements, and 11.4% have at least one. Among religious buildings and cultural institutions, Orthodox monasteries and churches dominate, although activity data are limited. Half the settlements lack religious buildings, 40% have one, and 10% have multiple. Most communities (85.7%) do not host cultural, sports, or traditional events, 5.8% hold one or two, and 8.6% host more than two. Regarding sports clubs, 35.7% of settlements lack these, 57.1% have one, and 5.7% have two or more.

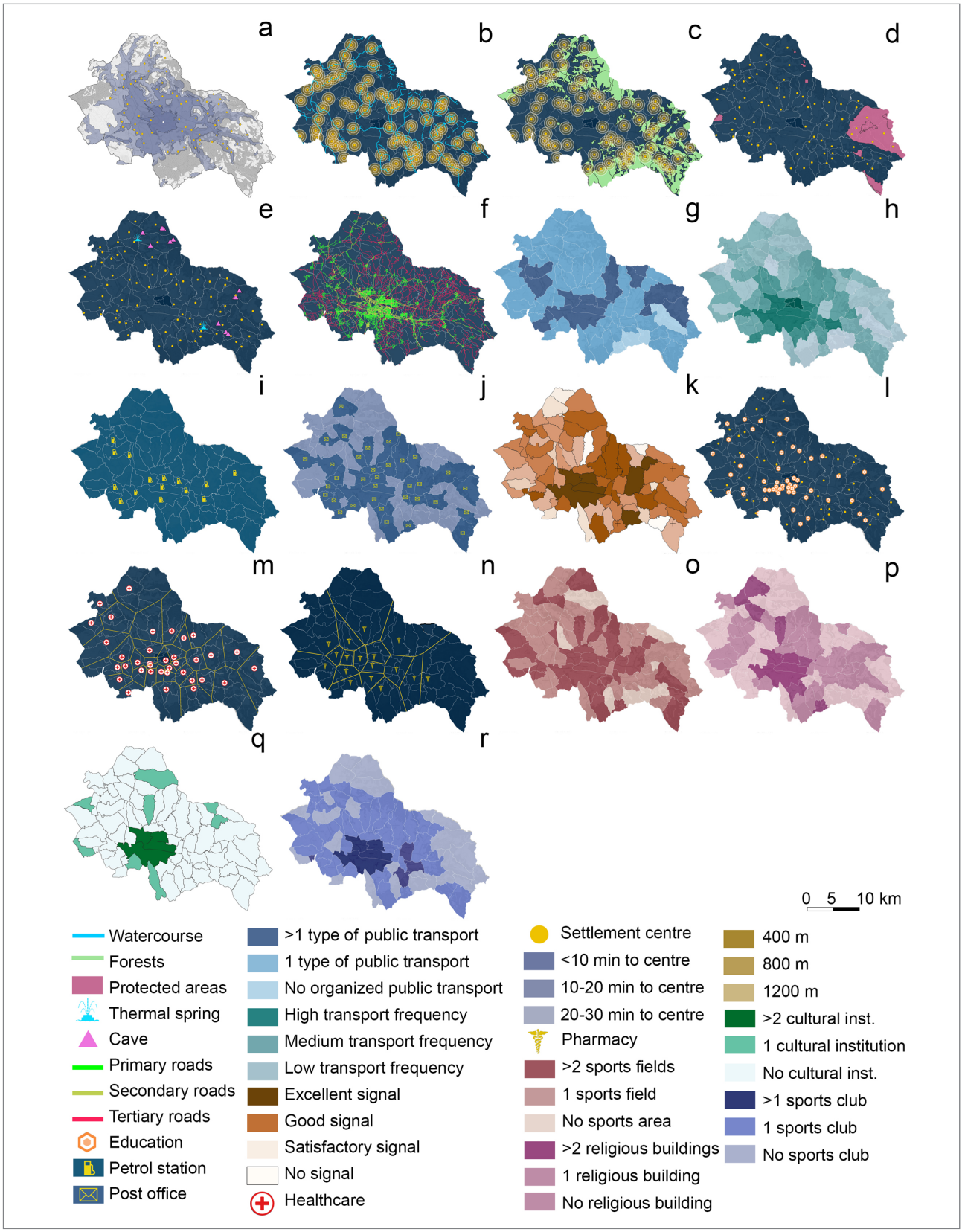

Figure 2: a) proximity to the city centre, b) proximity to watercourses, c) proximity to forests, d) protected natural areas, e) geological resources, f) types of roads within the settlement and types of roads leading there, g) accessibility to public transportation, h) frequency of organized public transport, i) presence of petrol stations, j) presence of a post office, k) mobile network coverage, l) access to educational institutions, m) primary healthcare facilities, n) access to pharmacies, o) number of public outdoor sports fields and recreational facilities, p) number of religious buildings, q) number of cultural institutions, and r) number of sports clubs.

Table 2: Objective weight coefficients by Shannon's entropy method.

Criteria	Indicator	Weight coefficient
Geographical location, natural potential and environmental protection	Proximity to the city centre	0.004
	Proximity to watercourse	0.012
	Proximity to forests	0.035
	Protected natural areas	0.096
	Geological resources	**0.136**
Infrastructure and communication	Types of access roads from the city centre	0.002
	Types of roads within the settlement	0.006
	Accessibility to public transportation	0.006
	Frequency of organized public transport	0.020
	Presence of petrol stations	**0.111**
	Presence of post office	0.048
	Mobile network coverage	0.006
Healthcare	Access to primary healthcare facilities	0.006
	Access to pharmacies	**0.101**
Education	Access to educational institutions	0.040
Social development	Number of public outdoor sports fields and recreational facilities	0.010
	Number of cultural institutions	**0.124**
	Number of religious buildings	0.042
	Number of local events	**0.139**
	Number of registered sports clubs	0.054

4.2 Weights and ranks

The applied entropy method highlights the indicators' relative importance through weight coefficients (Table 2). A higher weight coefficient means that the observed indicator has a high impact on the vitality index ranking, and a low weight coefficient mean that that the indicator has limited impact. The highest-weighted indicators are the number of events (0.139), geological resources (0.136), and cultural institutions (0.124). Along with indicators such as pharmacies (0.101) and petrol stations (0.111), these have the highest influence on the vitality ranking. Their determined entropy is lower, and the data make it possible to differentiate settlements, which is important for developing the vitality index. On the other hand, the indicators with the lowest weight, such as road hierarchy (0.002), proximity to the city centre (0.004), and primary healthcare access (0.006), were not very influential for differentiation. Their entropy is higher because the criteria values are homogenous and do not distinguish settlements. This does not imply that these indicators are irrelevant; rather, their relatively uniform distribution or limited variability across settlements reduces their ability to shape overall vitality ranking. These outcomes indicate that, although basic infrastructure is important, Niš is mainly defined in terms of culture, ecology, and community-based assets.

The TOPSIS ranking results in Table 3 show discrepancy among the settlements: Malča (C_i = 0.690) and Nikola Tesla (C_i = 0.622) lead, whereas Berčinac, Rujnik, and Manastir stand at the bottom because they differ only minimally from the most negative solution. Based on natural breaks and considering the complete vitality ratings (from 0.690 to 0.017), three vitality categories can be recognized: 1) the high-vitality tier, with only 7% of settlements that attain a score over 0.400;

Table 3: TOPSIS prioritization list.

Name	S_i+	S_i-	C_i	Rank
Bancarevo	0.019	0.006	0.233	31
Berbatovo	0.019	0.010	0.345	13
Berčinac	0.019	0.000	0.017	70
Brenica	0.019	0.004	0.187	39
Brzi Brod	0.017	0.009	0.358	12
Bubanj	0.019	0.001	0.052	63
Čamurlija	0.018	0.002	0.109	54
Cerje	0.017	0.003	0.142	47
Čokot	0.019	0.009	0.315	18
Čukljenik	0.020	0.006	0.232	33
Deveti Maj	0.017	0.004	0.179	43
Donja Studena	0.019	0.011	0.365	9
Donja Toponica	0.019	0.010	0.345	14
Donja Trnava	0.012	0.005	0.299	22
Donja Vrežina	0.018	0.003	0.146	46
Donje Medjurovo	0.018	0.005	0.217	36
Donje Vlase	0.018	0.011	0.374	8
Donji Komren	0.014	0.010	0.405	6
Donji Matejevac	0.019	0.001	0.028	67
Gabrovac	0.018	0.008	0.315	19
Gornja Studena	0.018	0.010	0.340	16
Gornja Toponica	0.016	0.001	0.049	65
Gornja Trnava	0.019	0.001	0.059	61
Gornja Vrežina	0.019	0.001	0.057	62
Gornje Medjurovo	0.019	0.007	0.271	26
Gornji Komren	0.020	0.001	0.051	64
Gornji Matejevac	0.018	0.002	0.098	55
Hum	0.015	0.011	0.415	5
Jasenovik	0.019	0.007	0.275	24
Jelašnica	0.019	0.007	0.287	23
Kamenica	0.019	0.003	0.140	48
Knez Selo	0.019	0.008	0.302	21
Koritnjak	0.019	0.007	0.270	27
Kravlje	0.019	0.007	0.262	28
Krušce	0.020	0.004	0.184	41
Kunovica	0.020	0.004	0.184	42
Lalinac	0.019	0.003	0.139	49
Lazarevo Selo	0.018	0.005	0.230	34
Leskovik	0.014	0.003	0.191	38
Malča	0.007	0.015	0.690	1
Manastir	0.019	0.000	0.023	68
Medoševac	0.014	0.008	0.363	10
Mezgraja	0.018	0.002	0.083	57
Miljkovac	0.019	0.005	0.219	35
Mramor	0.019	0.001	0.042	66
Mramorski Potok	0.017	0.002	0.118	51
Nikola Tesla	0.010	0.017	0.622	2
Niška Banja	0.009	0.006	0.384	7
Oreovac	0.016	0.002	0.112	53
Ostrovica	0.019	0.002	0.083	58
Paligrace	0.016	0.008	0.344	15
Paljina	0.019	0.002	0.093	56
Pasi Poljana	0.016	0.007	0.314	20
Pasjača	0.017	0.009	0.360	11
Popovac	0.018	0.003	0.130	50
Prosek	0.019	0.007	0.274	25
Prva Kutina	0.019	0.005	0.202	37
Radikina Bara	0.019	0.002	0.080	60
Rautovo	0.019	0.004	0.186	40
Ravni Do	0.015	0.012	0.436	4
Rujnik	0.019	0.000	0.022	69
Sečanica	0.016	0.008	0.324	17
Sičevo	0.017	0.004	0.175	44
Supovac	0.017	0.002	0.116	52
Suvi Do	0.020	0.006	0.233	30
Trupale	0.013	0.011	0.449	3
Vele Polje	0.019	0.006	0.243	29
Vrelo	0.017	0.003	0.147	45
Vrtište	0.018	0.002	0.081	59
Vukmanovo	0.019	0.006	0.233	32

2) the predominant middle tier, with 68% of settlements with values between 0.100 and 0.399; and 3) the low-vitality tier, with 25% of settlements with vitality ratings below 0.100. Niška Banja and Donje Vlase are as the closest to advancing to higher vitality status, and Čamurlija and Oreovac are the closest to dropping to lower vitality status. In the higher vitality group, Komren is at risk of becoming a member of the medium vitality group if conditions change. The spatial distribution of vitality rankings in Figure 3 reveals significant variances within the administrative boundaries of Niš, without a distinct centrality pattern, indicating that proximity to the city centre is not directly related to improved vitality.

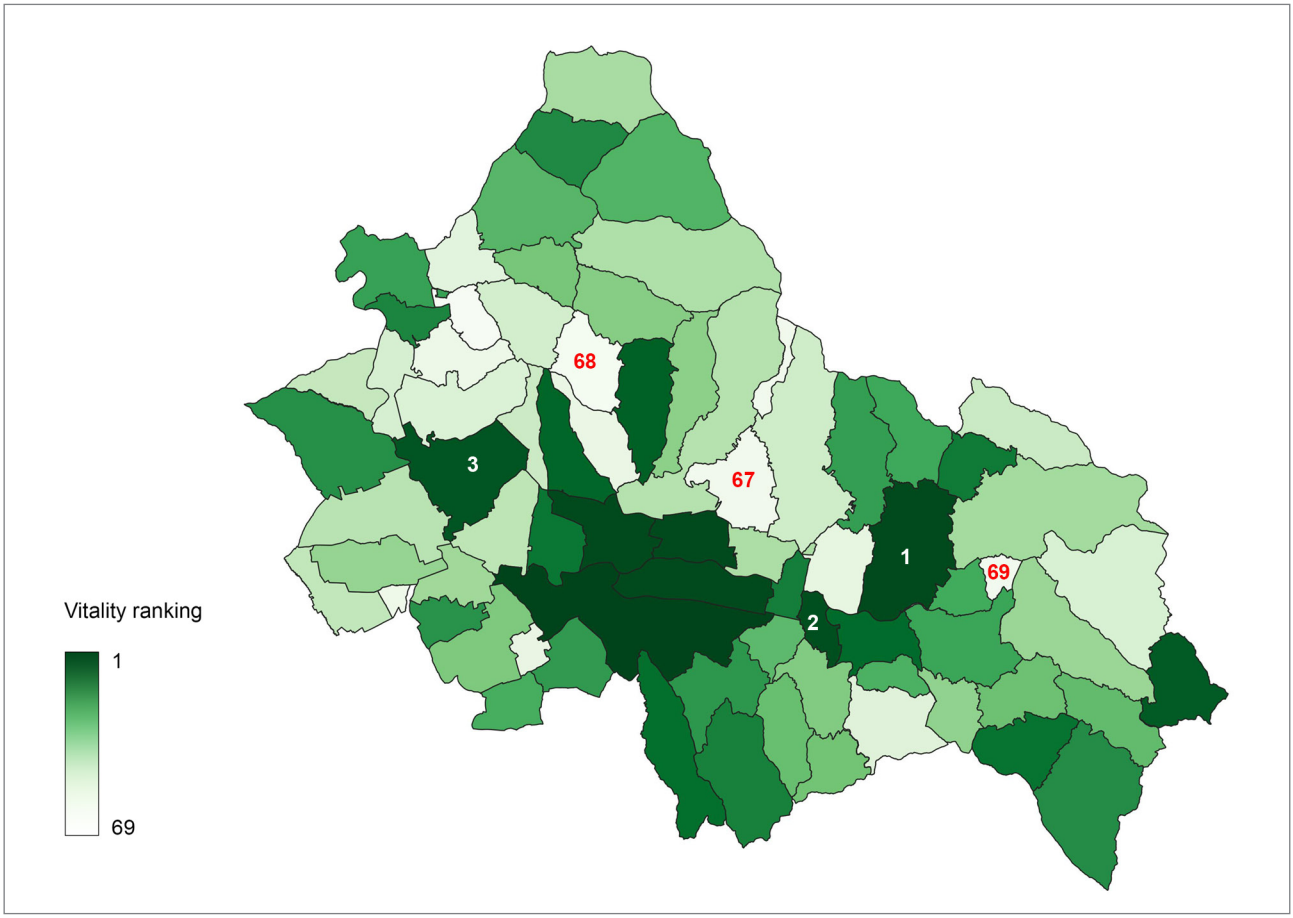

Figure 3: Visual representation of the vitality index (source: authors).

5 Discussion

5.1 Interpretation of findings

This research has developed a spatially explicit hybrid MCDM model to assess urban vitality at the sub-municipal level. It was initially tested and validated in Niš, Serbia. In line with the first research sub-question, by merging entropy-based weighting with TOPSIS methodology, a composite vitality index sought to capture disparities among five key dimensions: geography and natural assets, infrastructure and communications, healthcare, education, and social development. The model can serve as a highly replicable tool by using public indicators that can be easily mapped in any urban area. It is suitable for identification of spatial disparity with use of basic data requirements while creating a clear evidence-based foundation for planning in data-scarce post-socialist regions.

The findings demonstrate a significant gap in settlements' capacity to foster vitality, primarily in terms of accessible physical infrastructure and resources. In spatial terms, and in line with the second research sub-question, the analysis showed no connection between proximity to the city centre and vitality. Instead of a monotonic outflow from the urban centre, the lowest vitality rankings (67–69) are found in the intermediate zone between the urban core and the northern and northeastern peripheries, indicating pockets of low vitality in this zone rather than a single-channel peripheral decline. This shows that the potential vitality of the settlement is influenced more by the mix of its assets than by its distance from the urban core.

The study also shows a prominent digital and cultural gap. Although most settlements have easy access to resources and infrastructure, mobile phone signal coverage remains an issue, with around 25% of settlements having poor connections. This can limit their residents' digital integration – that is, access to associated options such as online jobs, online education, and e-commerce, which contributes not only to overall vitality but also to emergency-response options. Furthermore, nearly 90% of settlements lack cultural institutions, which are critical to the development of local social life and identity.

In addition, based on the distribution of vitality, the findings imply that planning interventions should focus on the settlements that belong to the predominant middle vitality tier, which comprise most of the research area.

5.2 Relation to previous studies

The results strengthen the multidimensionality of vitality, meaning that it must include both material and intangible services that constitute cultural and ecological resources. The disparities identified are not reflected in Niš's planning documents, which employ municipal-level statistics, masking sub-municipal reality. In this respect, the vitality index meets the need for fine-grained spatially indexed approaches to embody intra-urban heterogeneity (Liu et al., 2023). By revealing inequalities between different settlements, this index provides a clear guide for making local decisions that are more responsive to each settlement's specific needs.

In line with the third research sub-question, the results also confirm a key role of social development for vitality. Receiving relatively high weightings through the entropy method, social development indicators (such as number of events and cultural institutions) demonstrate that even modest variations can strongly influence vitality rankings. This resonates with Jacobs's (1961) and Putnam's (2000) emphasis on social cohesion and civic life as vital components of urban sustainability, and with Osunkoya and Partanen (2024), who reported that socioeconomic variables significantly correlate and influence the vitality value. Furthermore, the TOPSIS ranking points to deviation from the centrality pattern, frequently noted in post-socialist cities, which generally entails the marginalization of peripheral areas because investment increasingly focuses on urban cores, as discussed by Vujošević et al. (2012) and Petrović (2009). Therefore, the spatial arrangement observed appears to highlight the importance of relational rather than positional aspects of urban vitality.

The landscape of vitality indicators is diverse and well covered in the literature. For instance, Lopes and Camanho (2013) focused on the use of public green spaces as a measurable indicator of urban vitality. Galaktionova and Istrate (2025) suggested using "functional density" as a proxy to assess street-level vitality. Osunkoya and Partanen (2024) proposed integration of traditional metrics with big data, such as mobile phone records. Garau and Annunziata (2022) applied built-up and population density, various centrality indexes, density of POIs, and environmental quality indicators. Putnam (2000) and Putnam and Campbell (2010) highlighted social capital indicators such as civic engagement, religious participation, and community networks as a "social" side of vitality. Many of these indicators were included directly or indirectly in this study, such as proximity to geological resources as a proxy for Garau and Annunziata's environmental quality, the presence of religious buildings as a proxy for Putnam's religious participation, and mobile network coverage as a proxy for Olukoya and Partanen's phone records. However, the purpose of this study was to address a set of indicators that cover the segment of infrastructure and resources under public authority (i.e., municipal governance) and focus on rural settlements within the administrative boundaries of the city, relying on an extensive field inventory that provided an initial set of indicators for existing assets. As a result, many of the literature's proposed indicators, which are largely concerned with urban centres, were not directly applicable. Although the selected set of indicators meets the contextual analysis requirements, it also limits the scope of a more extensive investigation.

5.3 Limitations

Because this research was intentionally framed to emphasize the essential physical assets that can support vitality, one limitation is the absence of indicators that map human activity in the settlements analysed. A second limitation is the use of categorical metrics (e.g., the presence of cultural institutions or healthcare facilities), which might oversimplify the complexities of service quality, accessibility, and usage. A selected set of indicators also mapped the current state of the settlements, but they lacked a temporal component that may reflect seasonal or daily patterns of vitality. Finally, by examining the indicators that represent municipal responsibility, the researchers have purposely neglected market-driven and community-led activities that clearly contribute equally to local vibrancy.

Recognizing that a "one size fits all" framework is not attainable, the primary objective of this research was to provide a fundamental spatial baseline with field-validated indicators, offering a clear actionable map for municipal planners.

5.4 Future research

In line with the limitations identified, future research should explore more fine-grained data, such as facility capacity, quality of provision, or user satisfaction, to better capture community-level differences. Second, and in line with what Osunkoya and Partanen (2024) proposed, the results should be overlayed with big data (such as social media analysis, GPS, and location-based services, integrating real-time data on business/service openings and closures). Third, the analysis reflects a single temporal snapshot of vitality. Incorporating temporal dimensions would allow for a more comprehensive understanding of vitality rhythms. Fourth, although the entropy–TOPSIS methodology reduced subjectivity in weighting, it may inadvertently undervalue indicators with low variability but high conceptual importance (e.g., education and healthcare). A potential avenue is the use of hybrid approaches that combine objective statistical variation with expert choices. By integrating these dynamic measurements, future research can

move toward a predictive analytic framework that can show how adding a particular physical asset can affect settlement vitality.

6 Conclusion

This study presented the vitality index, a flexible tool for identifying inequities and developing spatial strategies at the sub-municipal level. However, it is important to acknowledge that the observed weightings are context specific, reflecting the data structure and variability of the local sample. This emphasizes the need to tailor vitality evaluations to unique local conditions and demonstrates that the approach may be adjusted to detect substantial variations across urban areas.

In practice, the findings and methods in this study can help enhance evidence-based decision making by contributing to the asset-based strategy in the local planning process, which takes into account the unique characteristics of each settlement. It also provides a platform for further improvements with dynamic and demographic indicators for greater insights into urban vitality.

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Data availability statement

The data used in this article can be accessed from Zenodo at https://zenodo.org/records/18670892 (Vranić et al., 2026); this article must be cited if these data are used in other publications.

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Vitalnost srednje velikih mest: izsledki večkriterijske prostorske analize

Vitalnost mest se nanaša na intenzivnost in raznovrstnost vsakdanjih dejavnosti v mestu in njihovo prostorsko porazdelitev ter je eden ključnih kazalnikov za prostorsko urejanje in upravljanje mest. Zaradi slabe povezanosti podatkov in pomanjkanja analitičnih orodij so v srednje velikih postsocialističnih mestih prostorske razlike v vitalnosti pogosto slabo raziskane. V članku je na podlagi večkriterijske prostorske analize, ki združuje družbenogospodarske, infrastrukturne in prostorske kazalnike, proučena vitalnost Niša, enega redkih srednje velikih srbskih regionalnih središč. Avtorji so z modelom večkriterijskega odločanja, ki združuje metodi entropije in TOPSIS ter je podprt z geografskim informacijskim sistemom, določili relativni pomen kazalnikov in oblikovali sestavljeni indeks vitalnosti 69 naselij. Analiza je pokazala izrazite prostorske razlike znotraj mesta, pri čemer so na eni strani izstopala območja zgoščene vitalnosti, na drugi pa funkcionalno in socialno razmeroma šibka območja. Avtorji so vitalnost mestnih območij kartirali, opredelili so ključne kazalnike, ki nanjo najmočneje vplivajo, in predstavili, kako vitalnost spremljajo in krepijo v primerljivih mestih. Izsledki zagotavljajo pregleden in jasen prostorski okvir za znanstveno utemeljeno načrtovanje, ciljno usmerjeno urbano prenovo in naknadne kvalitativne ali participativne analize v srednje velikih mestih.

Ključne besede: vitalnost mest, geografski informacijski sistem, večkriterijska analiza, razvoj postsocialističnih mest, Niš

1 Uvod

Vitalnost mest se nanaša na intenzivnost in raznovrstnost človekovih dejavnosti v mestnih prostorih, hkrati pa se v njej kažejo medsebojni vplivi prostorske strukture, mešane rabe prostora in družbenogospodarske dinamike. V urbanizmu in urbanih študijah je vitalnost tesno povezana s hodljivostjo, raznovrstno rabo zemljišč, dostopnostjo in prisotnostjo aktivnih javnih prostorov (Cardoso in Meijers, 2016; Istrate idr., 2020). V novejših znanstvenih razpravah se poleg tega vitalnost mest pojmuje kot nastajajoč, dinamičen pojav, na katerega vplivajo časovni vzorci aktivnosti, družbeni stiki in skupnostno vključevanje (Garau in Annunziata, 2022; Osunkoya in Partanen, 2024).

Raziskave vitalnosti mest se osredotočajo zlasti na velika metropolitanska območja, srednje velika mesta in mesta drugega reda pa so kljub svoji ključni vlogi v regionalnem razvoju in teritorialni koheziji razmeroma slabo raziskana (Cardoso, 2016). V nasprotju z velikimi mesti po svetu prebivalstvo v srednje velikih mestih pogosto upada (Parkinson in Meegan, 2013). Poleg tega ta po industrijskem prestrukturiranju pogosto postanejo monofunkcionalna (Berroir idr., 2019), njihova središča pa začnejo postopno izgubljati vitalnost (Chouraqui, 2021). Zaradi tovrstnih preobrazb so pogosto potrebni analitični pristopi, ki so prilagojeni posameznemu okolju in lahko zajamejo razlike med mestnimi območji, namesto da bi temeljili zgolj na skupnih kazalnikih na ravni celotnega mesta.

Evropske raziskave izpostavljajo več prostorskih razsežnosti vitalnosti. Gostota funkcij in mešana raba zemljišč dokazano krepita vsakdanje dejavnosti v mestih (Istrate idr., 2020). Družbenogospodarska raznovrstnost in povezanost prispevata k odpornim lokalnim gospodarstvom (Gao idr., 2024). Kulturne pobude (Kara idr., 2025) in programi prenove, ki se osredotočajo na kulturo (Tzatzadaki, 2024), so uporabna orodja za krepitev mestne identitete in socialne kohezije, zlasti v mestih drugega reda (Błaszczyk in Krysiński, 2023).

Prostorska dinamika postsocialističnih mest se je preoblikovala zaradi institucionalnih sprememb in gospodarskega prestrukturiranja (Cvetinović idr., 2016). Razdrobljeni načrtovalski sistemi in neenakomeren razvoj so prispevali k razlikam med središčnimi in obrobnimi območji (Stojić in Timotijević, 2024). V okviru urbanističnega načrtovanja v Srbiji se pogosto ne rešujejo strukturne neenakosti (Petrović, 2009) ter se ne upoštevajo specifične potrebe obrobnih in podobčinskih območij (Vujošević idr., 2012). V raziskavah večjih mest, kot so Beograd, Novi Sad in Niš, so bili kot pomembni dejavniki prostorskih razlik opredeljene demografske spremembe, migracije in infrastrukturne neenakosti (Antonić, 2024; Šantić in Đorđević, 2023). Vse pogosteje se poudarja tudi pomen vključevanja kulturnih pobud, participativnega upravljanja (Neducin in Krklješ, 2022) in kakovostne infrastrukture (Đorđević idr., 2023) pri ohranjanju živahnih in vključujočih mestnih prostorov (Protić idr., 2020). Kljub temu so sistematične in podrobne prostorske presoje vitalnosti mest na podobčinski ravni še vedno redke.

Z metodološkega vidika evropske raziskave čedalje pogosteje združujejo prostorsko statistiko (Gao idr., 2024), modeliranje z geografskim informacijskim sistemom (GIS), velepodatke (Osunkoya in Partanen, 2024) in prostorske analize (Galaktionova in Istrate, 2025), ki omogočajo zajem tako statičnih kot časovnih razsežnosti vitalnosti mest. Po drugi strani so metode večkriterijskega odločanja kljub svoji robustnosti in vse pogostejši uporabi pri združevanju heterogenih naborov kazalnikov (Ali idr., 2023; Ginting idr., 2017) na tem področju še vedno razmeroma redke. Navedeni pristopi omogočajo prepoznavanje razlik znotraj mest in podpirajo na dokazih temelječe načrtovanje. Kljub vsemu se tovrstni analitični okviri v srednje velikih postsocialističnih mestih, zlasti v Srbiji, le redko uporabljajo.

Članek se osredotoča na Niš, značilno mesto drugega reda s strnjenim jedrom, mešano urbano-podeželsko upravno zgradbo in izrazitimi prostorskimi razlikami. Z določanjem uteži na podlagi entropije ter uporabo metode TOPSIS in geografskega informacijskega sistema so avtorji oblikovali sestavljeni indeks vitalnosti, ki omogoča natančnejše razumevanje razlik v mestu. Raziskava zagotavlja prostorsko jasen in prenosljiv okvir večkriterijskega odločanja, prilagojen srednje velikim mestom, z opredelitvijo kazalnikov, ki lahko pokažejo največje razlike med posameznimi mestnimi območji, pa podpira na dokazih temelječe načrtovanje, ki presega skupne kazalnike na občinski ravni. Avtorji so se osredotočili na naslednje raziskovalno vprašanje: Kako je mogoče hibridni model, ki združuje geografski informacijski sistem in večkriterijsko odločanje, učinkovito uporabiti za proučevanje vitalnosti mest z analizo ravni vitalnosti na podobčinski ravni na podlagi podatkov, ki se nanašajo na javno upravljano infrastrukturo, okoljske vire in socialno infrastrukturo?

Pri tem so proučili naslednja podvprašanja: 1. Koliko je model, ki združuje metodi entropije in TOPSIS ter je podprt z geografskim informacijskim sistemom, uporaben kot orodje za na dokazih temelječe načrtovanje, ki se lahko prenese tudi v druga regionalna središča, v katerih primanjkuje ustreznih, med seboj povezanih podatkov? 2. Kako se razlike v vitalnosti kažejo v prostoru? 3. Kateri kazalniki imajo najvišje uteži in tako najmočneje vplivajo na vrednosti indeksa vitalnosti?

2 Pregled literature

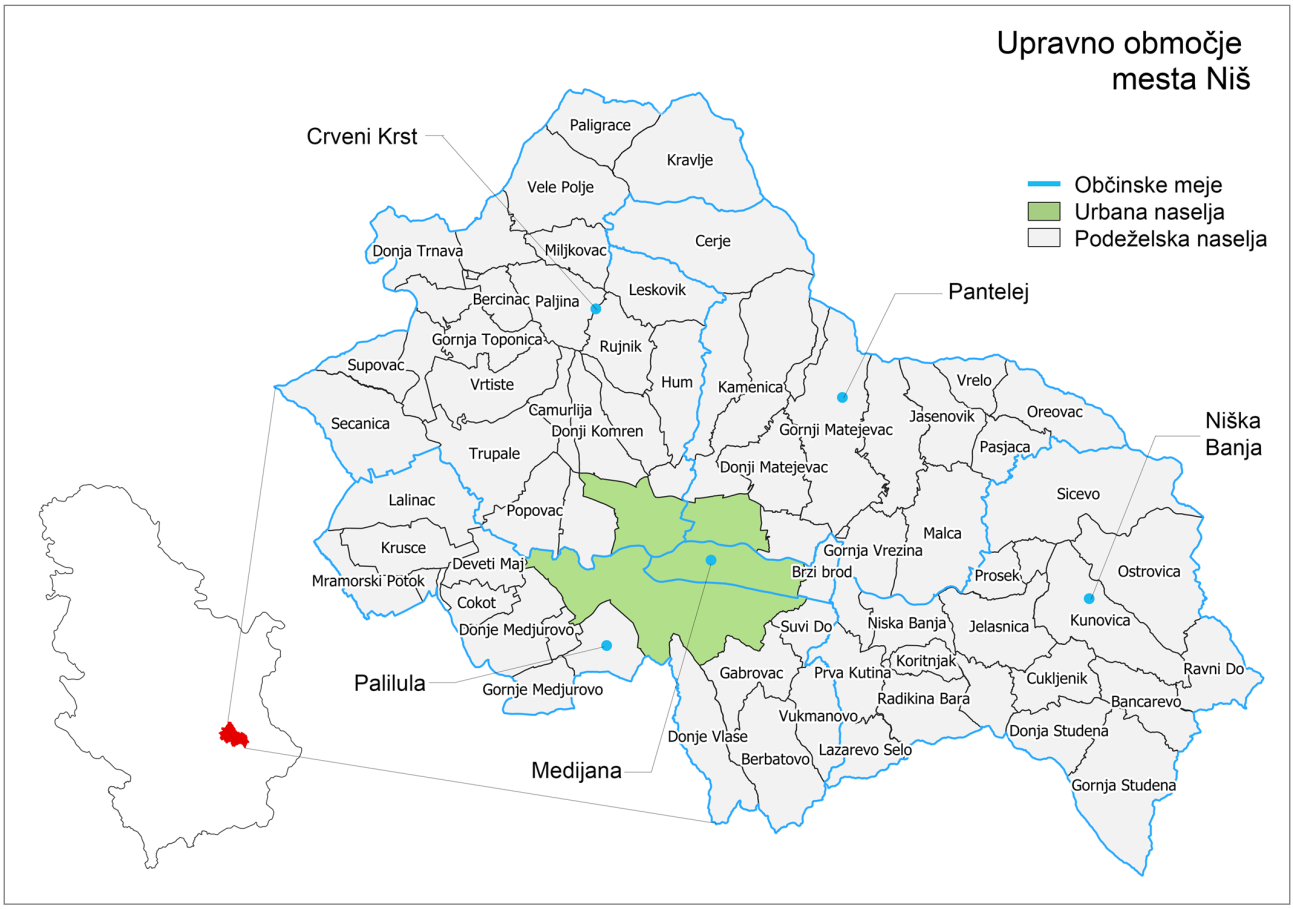
Raziskovalci poudarjajo prostorsko razsežnost kot enega glavnih dejavnikov, ki določajo vitalnost mest. Cardoso in Meijers (2016) na primer ugotavljata, da je na mestnih območjih z optimalno dostopnostjo, raznolikostjo rabe zemljišč in gostoto funkcij na dnevni ravni aktivnost večja. Ugotovitve iz več evropskih mest kažejo, da se pretok pešcev in družbenogospodarske povezave okrepijo v mestih z veliko gostoto funkcij in mešano rabo prostora (Istrate idr., 2020). Gao idr. (2024) so s prostorskimi meritvami na podlagi GIS pokazali, da srednje velika mestna območja dosegajo večjo vitalnost, če imajo bolj raznovrstno rabo zemljišč in njihova ulična omrežja zagotavljajo boljši dostop do območij. Liu idr. (2023) navajajo, da je v srednje velikih mestih za boljše razumevanje vitalnosti na podobčinski ravni nujna podrobna analiza prostorskih okoljskih podatkov. Osunkoya in Partanen (2024) sta z združitvijo prostorskih podatkov in vzorcev aktivnosti na podlagi analize podatkov mobilne telefonije ugotovili, da je vitalnost odvisna od vzorcev mobilnosti in dostopa do storitev. Garau in Annunziata (2022) sta ugotovila, da strnjena mestna območja z dobro dostopno javno infrastrukturo krepijo tako dejansko kot zaznano vitalnost med prebivalci. Navedeni izsledki kažejo, da vitalnosti ni mogoče ustrezno meriti s samo enim infrastrukturnim kazalnikom, temveč je potrebna večdimenzionalna analiza.

V evropskih razpravah s področja prostorske politike se prepoznava čedalje večji pomen srednje velikih mest in mest drugega reda v razvojnih načrtih. Cardoso (2016) navaja, da imajo zadnjenavedena mesta stabilizacijsko vlogo v regionalnih sistemih, čeprav na globalni ravni niso tako konkurenčna kot metropolitanska središča. Na njihovo vitalnost vpliva več pomembnih dejavnikov. Kot ugotavljata Parkinson in Meegan (2013), je za postsocialistična in postindustrijska mesta drugega reda pogosto značilen trend upadanja prebivalstva. Po navedbah Berroir idr. (2019) monofunkcionalnost kot posledica industrijskega prestrukturiranja zmanjšuje raznovrstnost mestnih območij in slabi lokalno odpornost. Chouraqui (2021) je kot enega ključnih vzrokov za izgubo vitalnosti mestnih središč izpostavil suburbanizacijo in z njo povezan omejen razvoj storitvenih vozlišč. Raziskave so pokazale še, da so lahko pobude za prenovo, osredotočene na kulturo, koristne za revitalizacijo skupnosti. Kara idr. (2025) so proučevali vpliv pobud v okviru evropske prestolnice kulture na mestno identiteto in lokalno gospodarsko dinamiko. Tzatzadaki (2024) ugotavlja, da lahko kulturni programi spodbujajo socialno kohezijo, če so vključeni v dolgoročne upravljavske okvire. Błaszczyk in Krysiński (2023) pa opozarjata, da so učinki tovrstnih projektov močno odvisni od okolja, v katerem se izvajajo, zato se po območjih razlikujejo. Očitno je, da se raziskave osredotočajo na večja mesta, kar omejuje razumevanje vitalnosti v širšem obsegu evropskih mest.

Raziskave postsocialističnih mest kažejo, da na vitalnost mest v glavnem vplivajo naslednji trije dejavniki: institucionalne spremembe, privatizacija in spremembe upravljavskih sistemov. Cvetinović idr. (2016) navajajo, da so deregulacija in razdrobljene načrtovalske prakse pomembno vplivale na neenakomeren razvoj mestnih območij v Srbiji. Stojić in Timotijević (2024) ugotavljata, da v obrobnih naseljih v primerjavi s središčnimi območji pogosto ni ustrezne infrastrukture. V srbski znanstveni literaturi so obravnavani dodatni vpogledi v obravnavano problematiko. Antonić idr. (2024) na primer navajajo, da so demografske spremembe v večjih srbskih mestih posledica zlasti migracij in staranja prebivalstva. Šantić in Đorđević (2023) ugotavljata, da neenakomerna razporeditev infrastrukture vpliva na razlike v razvoju posameznih območij. Protić idr. (2020) in Nedučin in Krklješ (2022) navajajo, da boljša dostopnost javnih prostorov pozitivno vpliva na njihovo rabo, kar pomeni več aktivnosti v mestu. Raziskave v Srbiji se večinoma osredotočajo na posamezne vidike trajnostnosti in živahnosti mest ter redko vključujejo celovite analize vitalnosti. Zaradi regionalnih razlik v preobrazbi postsocialističnih mest je za kartiranje njihove vitalnosti v Srbiji potreben analitični okvir, prilagojen posameznemu mestu.

Vitalnost mest se proučuje z več metodami. Osunkoya in Partanen (2024) sta na primer analizirali tradicionalne kazalnike in podatke mobilne telefonije v okolju GIS, da bi ugotovili, kako so prostorska raznovrstnost in družbenogospodarske značilnosti povezane z vitalnostjo. Gao idr. (2024) so na podlagi podatkov o nočni osvetljenosti, cen nepremičnin, objav na družbenih omrežjih, mestnih zanimivostih in vegetacijskega indeksa NDVI ter modelov Geodetector in geografsko utežene regresije merili vidike vitalnosti mestnih območij. Galaktionova in Istrate (2025) sta vitalnost ulic proučevali na podlagi gostote funkcij kot merila, ki sta ga izpeljali iz podatkov orodja OpenStreetMap (OSM) in analizirali z modelom regresije s prostorskim zamikom. Lopes in Camanho (2013) sta z analizo ovojnice podatkov proučevala, kako javne zelene površine prispevajo k vitalnosti mest, Garau in Annunziata (2022) pa sta s kombinacijo metode prostorske sintakse in GIS analizirala vpliv prvin grajenega okolja na vitalnost mestnih območij.

Kljub raznovrstnim metodološkim pristopom se pri raziskavah še vedno pojavljajo izzivi, povezani z usklajevanjem podatkov in razlikami v prostorski ločljivosti. Zaznati je mogoče tudi razlike v razpoložljivosti podatkov, uporabljenih tehnologijah in ravneh analize. Nekatere raziskave se osredotočajo na lokalno raven, druge pa na širšo, metropolitansko raven. Poleg tega



Slika 1: Proučevano območje

se lahko z uporabo združenih podatkovnih virov (npr. podatkov mobilne telefonije ali podatkov o mestnih zanimivostih) informacije o posameznem območju pretirano poenostavijo.

Iz pregleda literature je razvidnih več pomembnih izzivov, kot so večdimenzionalna narava vitalnosti mest, ki presega univerzalne urbane teorije in zahteva analitične okvire, prilagojene posameznemu mestnemu okolju, specifični strukturni izzivi, ki vplivajo na vitalnost srednje velikih in postsocialističnih mest, in pomanjkanje raziskav v teh mestih, ki bi vključevale metode večkriterijskega odločanja.

V tem okviru članek prispeva k razvoju proučevanega področja z operacionalizacijo prostorskega modela, ki združuje večkriterijsko odločanje in GIS ter je prilagojen srednje velikim postsocialističnim mestom, in s preglednim razvrščanjem naselij na podlagi javno upravljanih infrastrukturnih, okoljskih in družbenih virov. S tem razširja nabor kazalnikov, s katerimi se običajno meri vitalnost mest (npr. prostorska raznovrstnost, mešana raba zemljišč in gostota poselitve).

3 Metodologija

3.1 Proučevano območje

Avtorji so za proučevanje vitalnosti izbrali Niš, ker je značilen primer srednje velikega srbskega mesta, ki se spopada s prostorskimi razlikami in funkcionalnimi izzivi. Kot eno redkih urbanih središč zunaj območja prestolnice z izrazito regionalno vlogo je Niš upravno, gospodarsko in izobraževalno središče južne Srbije, za katero so hkrati značilne izrazite razlike med osrednjimi in obrobnimi območji, ki se kažejo v prostorski dostopnosti, rabi zemljišč in družbenogospodarski aktivnosti (slika 1). Zaradi strnjene urbane gradnje s propadajočimi območji na eni strani in območji novogradenj na drugi je mesto primerno za proučevanje vpliva značilnosti na vitalnost mestnih območij. Od leta 2004 je upravno razdeljeno na pet mestnih občin, ki se med seboj razlikujejo po prostorskih, demografskih in funkcionalnih značilnostih. Občina Medijana je na primer najmanjša (16 km^2) in z 82.360 prebivalci najgosteje poseljena, Niška Banja pa je po površini največja, pretežno ruralna in najredkeje naseljena. Razlike v stopnji urbanističnega razvoja,

opremljenosti z infrastrukturo in dostopnosti storitev, skupaj s soobstojem mestnega in podeželskega življenjskega sloga, vplivajo tudi na razlike v kakovosti življenja prebivalcev. Demografske razlike še dodatno povečujejo to neenakost: v nekaterih naseljih je povprečna starost prebivalcev le 38 let, v drugih pa 69 let. Zaradi navedenih prostorskih in demografskih razlik je potrebna podrobna analiza na podobčinski ravni. Neprimernost uporabe občinske ravni kot osnovne enote prostorske analize utemeljuje tudi dejstvo, da je v petih mestnih občinah kar 69 podeželskih naselij. Avtorji so jih vključili v raziskavo, saj zanje primanjkuje ustreznih podatkov, hkrati pa so pogosto izključena iz običajnih načrtovalskih procesov.

3.2 Kazalniki

Kazalniki, uporabljeni v tej raziskavi, se nanašajo zlasti na fizične vire in pomembno infrastrukturo, ki jih upravljajo občinske oblasti. Čeprav zasebni objekti, kot so trgovine z živili ali banke, pomembno prispevajo k vsakdanjemu življenju v mestih in njihovi vitalnosti, je njihova prisotnost odvisna od tržnih razmer in poslovnih odločitev, ne pa od podpore javnega sektorja, zato v nabor kazalnikov niso bili vključeni. Končni seznam kazalnikov je bil oblikovan na podlagi relevantne literature in obsežne terenske raziskave, ki je vključevala popis vse infrastrukture (npr. cest, šol in športnih objektov) in naravnih virov (npr. vodotokov, gozdov in jam). Kazalniki so bili razvrščeni glede na pet kriterijev, ki so na kratko predstavljeni v nadaljevanju.

1. Geografska lega, naravni viri in varstvo okolja
   - Oddaljenost od mestnega središča: vpliva na stopnjo dostopnosti raznovrstnih gospodarskih priložnosti, javnih storitev, kulturnih objektov in prometne infrastrukture. Kot je poudarila že Jane Jacobs (1961), je kakovost življenja v mestu odvisna od gosto poseljenih sosesk z mešano rabo prostora, v katerih vsakdanje aktivnosti potekajo blizu druga druge in so socialne mreže bolje razvite. Navedeno potrjujejo tudi izsledki Johna Montgomeryja (1998), ki je ugotovil, da se vitalnost območij zmanjšuje z oddaljenostjo od mestnega jedra.
   - Bližina vodotokov: zagotavlja ekosistemske storitve, kot so kmetijska pridelava, naravno uravnavanje poplav in rekreacija, ki so bile v okviru mednarodne raziskave MEA (2005) prepoznane kot ključne za dolgoročni lokalni razvoj.
   - Bližina gozdov: kazalnik se nanaša na možnosti za ekoturizem, trajnostno rabo virov, rekreacijo, izboljšanje mikroklime in splošno dobro počutje prebivalcev (Tzoulas idr., 2007).
   - Zavarovana naravna območja: so del omrežja zelene infrastrukture, ki povezuje varstvo okolja in dobro počutje skupnosti ter podpira lokalno gospodarstvo z reguliranimi dejavnostmi z majhnim vplivom na okolje, kot so ekoturizem, jamarstvo in zeliščarstvo, skladno s cilji dolgoročnega ohranjanja okolja (MEA, 2005).
   - Geološki viri: prvine, kot so jame, termalni izviri in zdravilišča, podpirajo razvoj turizma, malih podjetij, športa in rekreacije (Farsani idr., 2011).

2. Infrastruktura in komunikacije
   - Vrsta povezovalnih cest iz mestnega središča, kakovost cest v naseljih in dostopnost javnega prevoza: to so kazalniki prostorske povezanosti, gospodarskega potenciala, odzivnosti v izrednih razmerah in vključenosti v skupnost (Litman, 2021).
   - Pogostost linij organiziranega javnega prevoza.
   - Prisotnost bencinskih servisov: kazalnik se nanaša na majhno oddaljenost teh objektov od kmetijskih in stanovanjskih območij, kar zmanjšuje prevozne stroške in kmetom zagotavlja hiter dostop do goriva. Navedeno prispeva k infrastrukturni povezanosti, gospodarski vitalnosti ter razvoju turizma in logistike.
   - Prisotnost pošte: to kaže na razvito komunikacijsko infrastrukturo ter zagotavlja dostop do finančnih in logističnih storitev ter širjenje informacij, kar je še zlasti pomembno na podeželskih območjih (Castells, 2010). Hkrati zagotavlja pomembno fizično točko za e-trgovino, saj je zadnji člen v logistični verigi, potreben za vključevanje v skupnost na podeželskih ali odmaknjenih območjih.
   - Pokritost z mobilnim omrežjem: zagotavlja temeljni digitalni sistem, ki primestnim območjem omogoča, da se s prenosom končnih podatkov in komunikacijskimi storitvami razvijejo v povezana gospodarska središča, hkrati pa podpira tudi družabne in kulturne dejavnosti, ki so gonilo skupnostnega življenja v predmestjih.

3. Zdravstvena oskrba

Primestna naselja v Nišu se že spopadajo z odseljevanjem prebivalcev in večina jih nima ustreznega dostopa do zdravstvenih storitev. K vitalnosti lokalnega okolja lahko pomembno prispevata ta kazalnika:
   - dostop do primarnega zdravstvenega varstva,
   - dostop do lekarn.

4. Izobraževanje
   - Dostop do izobraževalnih ustanov: zaradi pomanjkanja osnovnih šol se družine preseljujejo bližje mestnemu središču. Če ima naselje osnovno šolo, je torej sposobno zadržati prebivalce.

5. Družbeni razvoj
   - Število zunanjih javnih športnih igrišč, rekreacijskih objektov in športnih klubov: tovrstni prostori delujejo kot prostori povezovanja (Putnam, 2000), ki so ključni za

vzpostavljanje zaupanja in sodelovanja. Športna igrišča in klubi so poleg tega znak zdravega prebivalstva različne starosti ter temelj za družabne stike in dobro počutje skupnosti.

- Število kulturnih ustanov in lokalnih prireditev: to se nanaša na festivale in ustvarjalna središča, zlasti v urbanem jedru Niša, ki privabljajo mlajše generacije z obrobnih območij. Navedeno povzroča stagnacijo skupnosti na mestnem obrobju, ki so zato puste ter brez živahnega družabnega življenja in institucionalnega »lepila«, ki jo Florida (2002) prepoznava kot pogoj za dolgoročno produktivno prebivalstvo, sestavljeno iz več generacij.
- Število verskih objektov: kazalnik se nanaša na zmožnost okolja, da spodbuja socialno kohezijo in vključevanje skupnosti, ter priložnosti za prostovoljstvo in državljansko udejstvovanje. Raznovrstnost verskih ustanov lahko odraža tudi kulturno strpnost in pluralizem (Putnam in Campbell, 2010).

3.3 Metoda ocenjevanja in podatkovni viri

Meje razredov so bile določene na podlagi kombinacije uveljavljenih normativov in empiričnih izsledkov. Pri kazalnikih, ki temeljijo na razdalji, so bili uporabljeni pragovi hodljivosti, ki jih določa Program ZN za naselja (UN-Habitat, 2018). Pri kazalnikih z že uveljavljenimi klasifikacijami, kot sta pokritost z mobilnim omrežjem in kategorije cest, so bile uporabljene ustrezne institucionalne kategorije. Pri preostalih kazalnikih je bil analiziran celoten nabor podatkov, nato pa so bili oblikovani razredi, ki pravilno odražajo porazdelitev vrednosti. Če se je na primer izkazalo, da je največje število geoloških virov znotraj meja posameznega naselja večje kot tri, so bili za ta kazalnik določeni trije razredi (glej preglednico 1), če pa je bilo največje število šol v vseh naseljih ena, je bila uporabljena binarna klasifikacija. Sistem točkovanja je tako temeljil na empiričnih podatkih, hkrati pa je bil usklajen z veljavnimi načrtovalskimi in regulativnimi okviri. S tovrstnim sistemom se lahko pravilno prikažejo dejanske razlike in zaznajo manjša odstopanja v skupnostih, pri čemer se uporabi štiristopenjski ali binarni ocenjevalni okvir. Pri ocenjevanju kazalnikov so bile upoštevane meje posameznih naselij (MN).

Uporabljene so bile naslednje vrednosti na štiristopenjski lestvici: 3 = pomemben potencial za lokalni razvoj, 2 = zmeren potencial, 1 = šibek potencial, 0 = brez potenciala. Točkovanje je temeljilo na podatkih iz javno dostopnih virov, institucionalnih evidenc, terenskih raziskav in prostorskih aktov, s čimer so avtorji zagotovili celovito in zanesljivo podatkovno osnovo (Vranić idr., 2026).

Preglednica 1: Vrednosti kazalnikov in razlaga metode ocenjevanja

Kazalnik	Podatkovni vir, metoda	Točkovanje
1. Geografska lega, naravni viri in varstvo okolja		
Oddaljenost od mestnega središča	Izohrone in vtičnik QGIS TravelTime, pri čemer je bilo kot izhodišče potovanja uporabljeno središče naselja, kot končna destinacija pa je bilo uporabljeno mestno središče.	3: < 10 min vožnje do središča 2: 10–20 min 1: 20–30 min
Bližina vodotokov	Evklidska oddaljenost središča naselja od najbližjega vodotoka/gozda, izračunana z orodjem Buffer v okolju QGIS.	3: 5 min hoje 2: 10 min 1: 15 min
Bližina gozdov		
Zavarovana naravna območja	Podatki srbskega okoljevarstvenega inštituta in uporaba prostorskega prekrivanja.	1: zavarovano območje v MN 0: ni zavarovanega območja
Geološki viri	Podatki iz orodja OSM.	3: trije geološki pojavi ali več znotraj MN 2: dva 1: eden 0: nobeden
2. Infrastruktura in komunikacije		
Vrste povezovalnih cest iz mestnega središča	Podatki javnega komunalnega podjetja Direktorata za gradnjo mesta Niš in podatki iz orodja OSM, uporaba orodja Zonal Statistics v QGIS, podatki o kakovosti cest pa niso bili na voljo.	3: ceste 1. kategorije (avtoceste) 2: ceste 2. kategorije (regionalne ceste) 1: ceste 3. kategorije (lokalne ceste)
Vrste cest v naselju		3: v naselju prevladujejo ceste 1. kategorije 2: ceste 2. kategorije 1: ceste 3. kategorije

Kazalnik	Podatkovni vir, metoda	Točkovanje
Dostopnost javnega prevoza	Podatki o javnem prevozu Direktorata za javni prevoz mesta Niš in Srbskih železnic, uporaba orodja Zonal Statistics v QGIS.	2: znotraj MN na voljo več kot ena vrsta prevoza 1: ena 0: nobena
Pogostost linij organiziranega javnega prevoza*		3: velika 2: srednja 1: majhna
Prisotnost bencinskih servisov	Podatki iz orodij OSM in Google Earth.	1: so znotraj MN 0: jih ni
Prisotnost pošte	Podatki Pošte Srbije, orodja Google Earth in terenskih raziskav.	1: je znotraj MN 0: je ni
Pokritost z mobilnim omrežjem**	Analiza podatkov regulativnega organa za elektronske komunikacije in poštne storitve RATEL v programu GIS.	3: večinoma dobra/odlična pokritost 2: zadovoljiva do dobra/odlična pokritost 1: zadovoljiva pokritost v 80 odstotkih ali več
3. Zdravstvena oskrba		
Dostop do primarnega zdravstvenega varstva	Izdelava Voronojevega diagrama v QGIS na podlagi podatkov o zdravstvenih domovih.	3: zdravstveni dom je znotraj MN 2: zdravstveni dom pokriva dve naselji 1: zdravstveni dom pokriva več naselij
Dostop do lekarn	Izdelava Voronojevega diagrama v QGIS na podlagi podatkov orodja Google Earth in spletnih podatkov.	3: lekarna je znotraj MN 2: lekarna pokriva dve naselji 1: lekarna pokriva več naselij
4. Izobraževanje		
Dostop do izobraževalnih ustanov	Podatki mestne šolske uprave, orodja Google Earth in terenskih raziskav.	1: osnovna šola je znotraj MN 0: je ni
5. Družbeni razvoj		
Število zunanjih športnih igrišč in rekreacijskih objektov	Podatki orodij OSM in Google Earth ter terenskih raziskav.	2: dva ali več objektov znotraj MN 1: en objekt 0: ni objektov
Število kulturnih ustanov	Podatki orodja Google Earth, nadškofije Niš in terenskih raziskav.	1: ustanova je znotraj MN 0: je ni
Število verskih objektov		1: verski objekt je znotraj MN 0: ga ni
Število lokalnih prireditev	Podatki lokalne turistične organizacije.	2: več kot ena prireditev letno 1: ena prireditev 0: ni prireditev
Število registriranih športnih klubov	Podatki lokalne športne zveze.	2: več kot en klub 1: en klub 0: ni klubov

* Pogostost linij javnega prevoza temelji na številu odhodov v vsako občino na delovni dan. Končno število je bilo z metodo min-max pretvorjeno v razpon od 0 do 1, pri čemer 0 pomeni najmanjšo, 1 pa največjo pogostost. Zaradi enotnosti ocenjevanja je bil normalizirani razpon razdeljen v tri skupine pogostosti.

** Površina signala treh državnih operaterjev je bila primerjana s celotno površino posameznega naselja na podlagi naslednjih treh klasifikacijskih ravni organizacije RATEL: odličen signal (pričakovana zelo dobra povezava), dober signal (pričakovana dobra povezava) in zadovoljiv signal (pričakovana sprejemljiva povezava z občasnimi prekinitvami). Končna ocena je bila določena kot povprečje točk vseh treh operaterjev glede na prevladujočo raven signala: 3 = skupna površina z odličnim/dobrim signalom je večja od površine z zadovoljivim signalom, 2 = površina z zadovoljivim signalom je večja od skupne površine z odličnim/dobrim signalom, 1 = več kot 80 % površine naselja je pokrite z zadovoljivim signalom.

3.4 Metodologija razvrščanja naselij

Cilj uporabe metode večkriterijskega odločanja je bil razvrstiti lokalne skupnosti glede na vnaprej določene kriterije, da se oceni njihova vitalnost. Za izračun uteži kriterijev in določitev koeficientov uteži je bila uporabljena metoda Shannonove entropije. Izraz *entropija* pomeni neurejenost v nizu podatkov (Shannon, 1948). Razmerje med vrednostjo entropije in koeficientom uteži je obratno sorazmerno (Zakeri idr., 2025): kriteriji z višjo stopnjo entropije imajo nižje koeficiente in obratno (Ali idr., 2023). Kriteriji z minimalnimi razlikami med vrednostmi imajo večjo entropijo, saj so podatki enakomerno porazdeljeni in vsebujejo manj informacij. Nasprotno pa kriteriji z večjimi razlikami med posameznimi vrednostmi zagotavljajo več informacij za razvrščanje, stopnja entropije je v tem primeru nižja, vrednost uteži pa večja (Chen, 2020). Kriteriji z nižjo stopnjo entropije lahko prispevajo k zaznavanju razlik med lokalnimi skupnostmi, saj nakazujejo variabilnost podatkov in omogočajo učinkovitejše razvrščanje. Uporaba te metode je namenjena zmanjševanju subjektivnosti v postopku razvrščanja. Z metodo TOPSIS so bili nato uteženi kazalniki združeni v sestavljeni indeks vitalnosti, pri čemer so bila naselja razvrščena glede na to, kako blizu so idealnemu scenariju visoke stopnje vitalnosti in kako daleč so od najmanj želenega scenarija. Več informacij o posamezni metodi je na voljo v prilogi.

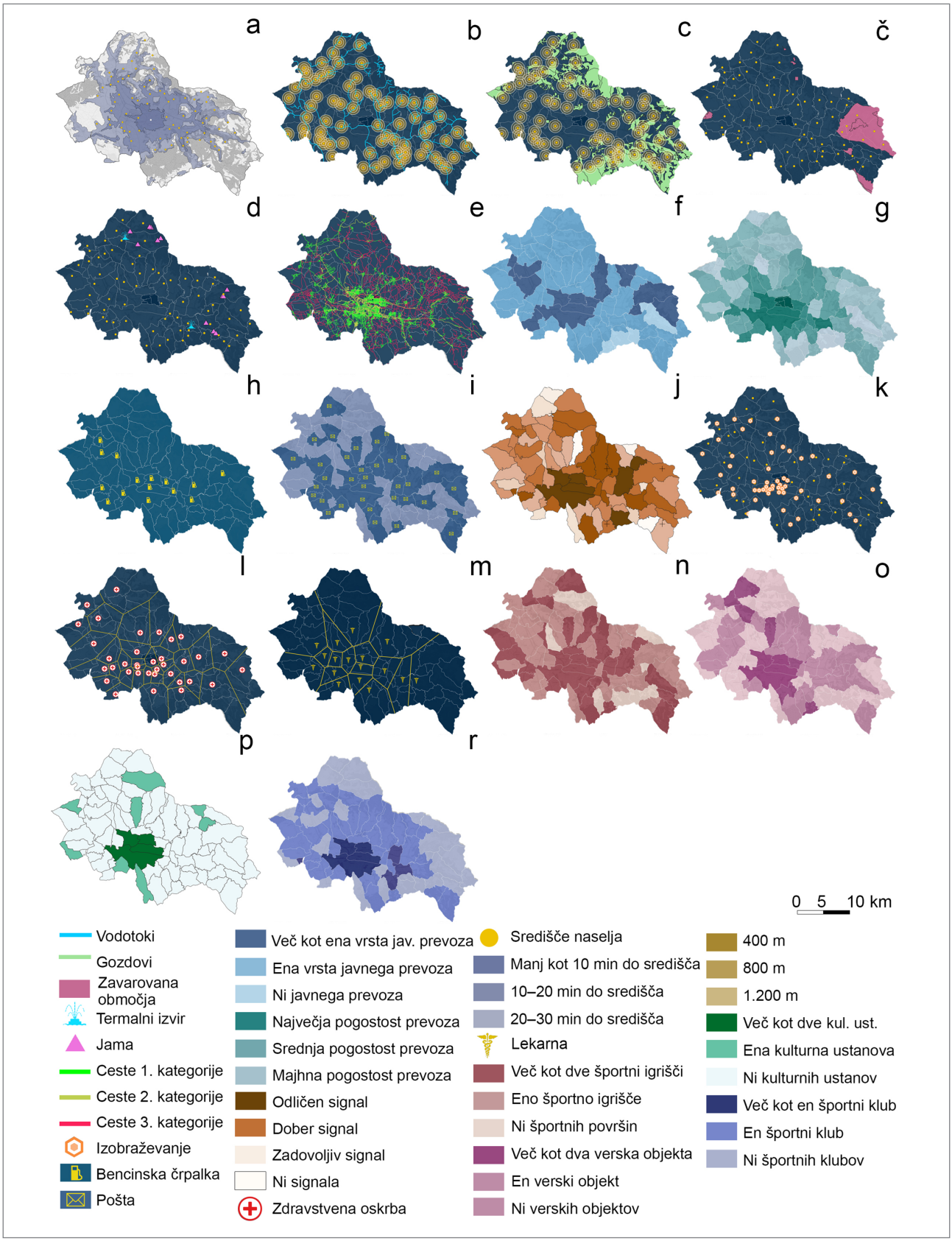
4 Rezultati

4.1 Kazalniki

Prostorska porazdelitev kazalnikov je prikazana na sliki 2. Za kazalnik oddaljenosti od mestnega središča so bile izdelane karte z izohronami, s katerimi so bili ocenjeni potovalni časi v optimalnih razmerah vožnje z avtomobilom (brez prometnih konic). Petdeset odstotkov naselij je v tretjem pasu (20–30 minut od središča), 47,1 % v drugem pasu (10–20 minut), le dve pa sta od središča oddaljeni manj kot 10 minut. Več naselij leži na meji dveh izohron. Šestdeset odstotkov jih spada v drugi pas, kar pomeni, da večina prebivalcev do mestnega središča potrebuje od 18 do 20 minut vožnje (slika 2a). Prebivalci praviloma potrebujejo od 5 do 15 minut hoje (400–1.200 m) do najbližje vodne površine. 51,4 % jih je od nje oddaljenih do 400 m, 18,6 % med 400 in 800 m, 15,7 % med 800 in 1.200 m, 14,3 % pa več kot 1.200 m (slika 2b). Bližina gozdnih površin je bila določena kot razdalja med središčem naselja in najbližjim gozdom. 58,6 % prebivalcev živi blizu gozdov: 19 % jih je 5 do 10 minut hoje stran, 14 % do 15 minut (800–1.200 m), 8 % pa do najbližjega gozda potrebuje 5 minut. Preostalih 41,4 % jih je od gozda oddaljenih več kot 1.200 m (slika 2c). Zavarovana območja pokrivajo 10,4 % proučevanega območja, večinoma v njegovem vzhodnem delu. 13 od 69 naselij delno ali v celoti leži znotraj naravnih parkov in rezervatov, kot sta Sićevačka klisura in Suva planina (slika 2č). Geološke vire ima znotraj svojih meja le sedem naselij (10,1 %). Nekatera med njimi imajo celo termalne izvire in jame državnega ali mednarodnega pomena, kot sta Cerjanska pećina in Pešturina (slika 2d). Glede vrst povezovalnih cest iz mestnega središča in cest znotraj naselij je 10 % naselij dostopnih po lokalnih cestah (3. kategorije), 29 % po regionalnih cestah (2. kategorije) in 61 % po avtocestah (1. kategorije). V naseljih prevladujejo regionalne ceste (33 %), sledijo lokalne ceste (31 %), najmanj pa je avtocest in hitrih cest (6 %) (slika 2e).

Približno 80 % naselij ima organiziran javni prevoz, večinoma avtobusni, 11,4 % jih ima tudi železniško povezavo. Če upoštevamo še dostopna sosednja območja, se delež naselij z dostopom do železnice poveča na 35,7 %. Štirje odstotki naselij so brez kakršnega koli organiziranega javnega prevoza (slika 2a). Glede pogostosti linij javnega prevoza ima 12,9 % naselij največjo (0,69–1,0), 12,9 % srednjo (0,31–0,53) in 74,2 % majhno (do 0,30) pogostost, pri čemer se ta zmanjšuje z oddaljenostjo od mestnega središča (slika 2b). Prostorska porazdelitev bencinskih črpalk se ujema s smerjo glavnih avtocest in povezovalnih cest. Ob teh je bencinska črpalka v 14,2 % naselij. Če se upoštevajo še sosednja naselja, do katerih je mogoče priti z avtomobilom v 10 minutah ali manj, to storitev neposredno uporablja dodatnih 41,4 % naselij. Število poštnih uradov se z oddaljenostjo od središča Niša zmanjšuje, vendar pokritost ostaja razmeroma dobra (49 %). Če se upoštevajo še naselja, ki mejijo na tista s poštnim uradom, je s poštnimi storitvami pokritega 95,7 % prebivalstva. Kakovost signala mobilnega omrežja se med lokalnimi skupnostmi močno razlikuje: 19,4 % naselij ima zelo dober do odličen signal (≥ 2,7), kar omogoča zadovoljiv dostop do digitalnih storitev, spletne komunikacije in pametne infrastrukture. Nasprotno pa ima 23,6 % naselij slab do zelo slab signal (≤ 1,3), kar pomeni, da je neposreden, dober mobilni signal zagotovljen le v 19,4 % naselij.

Osnovna šola je v polovici proučevanih naselij, od teh je v 28,5 % naselij podružnična šola. V preostalih naseljih ni osnovne šole, zato jo morajo učenci obiskovati v bližnjih naseljih. Voronojevi diagrami so pokazali, da si polovica naselij deli zdravstveni dom z dvema ali več drugimi naselji, 37,6 % s tremi ali več, 14,3 % z enim, 35,7 % pa ima lasten zdravstveni dom. Pokritost z lekarnami je nekoliko manjša kot pokritost z zdravstvenimi storitvami in se zmanjšuje z oddaljenostjo od središča Niša: 87,1 % naselij si lekarno deli z dvema ali več drugimi naselji, 64,3 % pa s štirimi naselji ali več. Samo 12,9 % naselij ima lastno lekarno, 4,3 % pa si jo deli še z enim naseljem. Športnih in rekreacijskih površin v 11,4 % naselij ni, v 51,4 % naselij je vsaj ena, v 37,2 % naselij pa sta dve ali več. V 88,6 % naselij ni kulturnih ustanov, v 11,4 % naselij pa je



Slika 2: a) oddaljenost od mestnega središča, b) bližina vodotokov, c) bližina gozdov, č) zavarovana naravna območja, d) geološki viri, e) vrste povezovalnih cest iz mestnega središča in vrste cest, ki tja peljejo, f) dostopnost javnega prevoza, g) pogostost linij organiziranega javnega prevoza, h) prisotnost bencinskih servisov, i) prisotnost pošte, j) pokritost z mobilnim omrežjem, k) dostop do izobraževalnih ustanov, l) dostop do primarnega zdravstvenega varstva, m) dostop do lekarn, n) število zunanjih javnih športnih igrišč in rekreacijskih objektov, o) število verskih objektov, p) število kulturnih ustanov in r) število športnih klubov

Preglednica 2: Objektivni koeficienti uteži, izračunani s Shannonovo metodo entropije

Kriterij	Kazalnik	Koeficient uteži
Geografska lega, naravni viri in varstvo okolja	Oddaljenost od mestnega središča	0,004
	Bližina vodotokov	0,012
	Bližina gozdov	0,035
	Zavarovana naravna območja	0,096
	Geološki viri	**0,136**
Infrastruktura in komunikacije	Vrste povezovalnih cest iz mestnega središča	0,002
	Vrste cest v naselju	0,006
	Dostopnost javnega prevoza	0,006
	Pogostost linij organiziranega javnega prevoza	0,020
	Prisotnost bencinskih servisov	**0,111**
	Prisotnost pošte	0,048
	Pokritost z mobilnim omrežjem	0,006
Zdravstvena oskrba	Dostop do primarnega zdravstvenega varstva	0,006
	Dostop do lekarn	**0,101**
Izobraževanje	Dostop do izobraževalnih ustanov	0,040
Družbeni razvoj	Število zunanjih javnih športnih igrišč in rekreacijskih objektov	0,010
	Število kulturnih ustanov	**0,124**
	Število verskih objektov	0,042
	Število lokalnih prireditev	**0,139**
	Število športnih klubov	0,054

vsaj ena. Med verskimi objekti in kulturnimi ustanovami prevladujejo pravoslavni samostani in cerkve, vendar je podatkov o njihovi dejanski dejavnosti malo. V polovici naselij ni verskih objektov, v 40 % naselij je eden, v 10 % naselij pa jih je več. Večina skupnosti (85,7 %) ne organizira kulturnih, športnih ali tradicionalnih prireditev, 5,8 % jih organizira eno ali dve, 8,6 % pa več kot dve. V 35,7 % naselij ni športnih klubov, v 57,1 % naselij je eden, v 5,7 % naselij pa sta dva ali več.

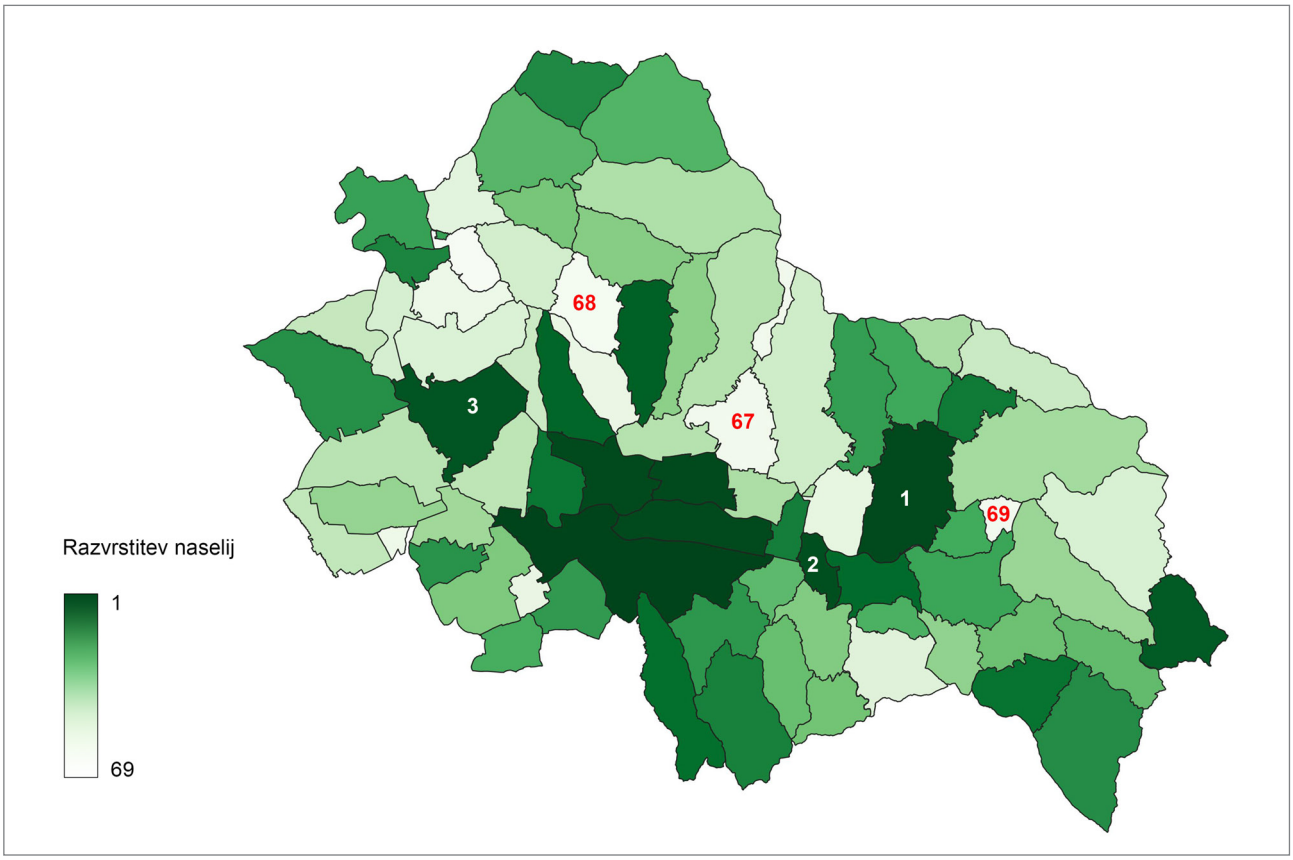
4.2 Uteži in razvrstitev naselij

Z metodo entropije so avtorji določili relativno pomembnost posameznih kazalnikov na podlagi koeficientov uteži (preglednica 2). Višji koeficient pomeni, da ima kazalnik velik vpliv na razvrstitev naselij po vitalnosti, nižji koeficient pa pomeni manjši vpliv. Kazalniki z najvišjimi utežmi vključujejo število prireditev (0,139), geološke vire (0,136) in kulturne ustanove (0,124). Skupaj s kazalniki, kot sta lekarna (0,101) in bencinska črpalka (0,111), imajo ti največji vpliv na končno razvrstitev po vitalnosti. Njihova izračunana entropija je nižja, podatki pa omogočajo razlikovanje med naselji, kar je ključno za oblikovanje indeksa vitalnosti. Nasprotno imajo kazalniki z najnižjo utežjo, kot so vrste cest (0,002), oddaljenost od mestnega središča (0,004) in dostop do primarnega zdravstvenega varstva (0,006), razmeroma majhen vpliv na razlikovanje med naselji. Njihova entropija je višja, ker so vrednosti kriterijev homogene in ne omogočajo razlikovanja med naselji. To ne pomeni, da ti kazalniki niso pomembni, gre bolj za to, da njihova razmeroma enakomerna porazdelitev ali omejena variabilnost med naselji zmanjšuje njihov vpliv na skupno razvrstitev naselij po vitalnosti. Navedeni rezultati kažejo, da čeprav je osnovna infrastruktura pomembna, vitalnost Niša večinoma določajo kulturni, okoljski in skupnostno usmerjeni dejavniki.

Preglednica 3: Razvrstitev naselij po metodi TOPSIS

Naselje	S_i+	S_i-	C_i	Rang
Bancarevo	0,019	0,006	0,233	31
Berbatovo	0,019	0,010	0,345	13
Berčinac	0,019	0,000	0,017	70
Brenica	0,019	0,004	0,187	39
Brzi Brod	0,017	0,009	0,358	12
Bubanj	0,019	0,001	0,052	63
Čamurlija	0,018	0,002	0,109	54
Cerje	0,017	0,003	0,142	47
Čokot	0,019	0,009	0,315	18
Čukljenik	0,020	0,006	0,232	33
Deveti Maj	0,017	0,004	0,179	43
Donja Studena	0,019	0,011	0,365	9
Donja Toponica	0,019	0,010	0,345	14
Donja Trnava	0,012	0,005	0,299	22
Donja Vrežina	0,018	0,003	0,146	46
Donje Medjurovo	0,018	0,005	0,217	36
Donje Vlase	0,018	0,011	0,374	8
Donji Komren	0,014	0,010	0,405	6
Donji Matejevac	0,019	0,001	0,028	67
Gabrovac	0,018	0,008	0,315	19
Gornja Studena	0,018	0,010	0,340	16
Gornja Toponica	0,016	0,001	0,049	65
Gornja Trnava	0,019	0,001	0,059	61
Gornja Vrežina	0,019	0,001	0,057	62
Gornje Medjurovo	0,019	0,007	0,271	26
Gornji Komren	0,020	0,001	0,051	64
Gornji Matejevac	0,018	0,002	0,098	55
Hum	0,015	0,011	0,415	5
Jasenovik	0,019	0,007	0,275	24
Jelašnica	0,019	0,007	0,287	23
Kamenica	0,019	0,003	0,140	48
Knez Selo	0,019	0,008	0,302	21
Koritnjak	0,019	0,007	0,270	27
Kravlje	0,019	0,007	0,262	28
Krušce	0,020	0,004	0,184	41
Kunovica	0,020	0,004	0,184	42
Lalinac	0,019	0,003	0,139	49
Lazarevo Selo	0,018	0,005	0,230	34
Leskovik	0,014	0,003	0,191	38
Malča	0,007	0,015	0,690	1
Manastir	0,019	0,000	0,023	68
Medoševac	0,014	0,008	0,363	10
Mezgraja	0,018	0,002	0,083	57
Miljkovac	0,019	0,005	0,219	35
Mramor	0,019	0,001	0,042	66
Mramorski Potok	0,017	0,002	0,118	51
Nikola Tesla	0,010	0,017	0,622	2
Niška Banja	0,009	0,006	0,384	7
Oreovac	0,016	0,002	0,112	53
Ostrovica	0,019	0,002	0,083	58
Paligrace	0,016	0,008	0,344	15
Paljina	0,019	0,002	0,093	56
Pasi Poljana	0,016	0,007	0,314	20
Pasjača	0,017	0,009	0,360	11
Popovac	0,018	0,003	0,130	50
Prosek	0,019	0,007	0,274	25
Prva Kutina	0,019	0,005	0,202	37
Radikina Bara	0,019	0,002	0,080	60
Rautovo	0,019	0,004	0,186	40
Ravni Do	0,015	0,012	0,436	4
Rujnik	0,019	0,000	0,022	69
Sečanica	0,016	0,008	0,324	17
Sičevo	0,017	0,004	0,175	44
Supovac	0,017	0,002	0,116	52
Suvi Do	0,020	0,006	0,233	30
Trupale	0,013	0,011	0,449	3
Vele Polje	0,019	0,006	0,243	29
Vrelo	0,017	0,003	0,147	45
Vrtište	0,018	0,002	0,081	59
Vukmanovo	0,019	0,006	0,233	32

Rezultati razvrščanja po metodi TOPSIS v preglednici 3 kažejo izrazita neskladja med naselji: Malča (C_i = 0,690) in Nikola Tesla (C_i = 0,622) zasedata vodilni mesti, Berčinac, Rujnik in Manastir pa se uvrščajo na dno lestvice, saj se le minimalno razlikujejo od najbolj negativne rešitve. Na podlagi metode naravnih mej in ob upoštevanju celotnega razpona vrednosti indeksa vitalnosti (od 0,690 do 0,017) je mogoče opredeliti tri stopnje vitalnosti: visoko stopnjo z vrednostjo nad 0,400 (7 % naselij), prevladujočo srednjo stopnjo z vrednostmi med 0,100 in 0,399 (68 % naselij) in nizko stopnjo z vrednostjo pod 0,100 (25 % naselij). Niška Banja in Donje Vlase sta najbližje napredovanju v skupino naselij z višjo stopnjo vitalnosti, Čamurlija in Oreovac pa sta najbližje nazadovanju v nižjo skupino. V skupini z visoko stopnjo vitalnosti obstaja pri Komrenu tveganje, da bi ob spremembi razmer nazadoval na srednjo stopnjo vitalnosti. Iz prostorske porazdelitve vitalnosti na sliki 3 so razvidne izrazite razlike znotraj upravnih meja Niša, pri čemer bližina mestnega središča ni neposredno povezana z večjo vitalnostjo.



Slika 3: Prostorski prikaz indeksa vitalnosti (vir: avtorji)

5 Razprava

5.1 Razlaga izsledkov

Avtorji so oblikovali prostorsko eksplicitni hibridni model večkriterijskega odločanja za vrednotenje vitalnosti mest na podobčinski ravni, ki so ga najprej preizkusili in validirali na primeru Niša v Srbiji. V skladu s prvim raziskovalnim podvprašanjem so z združitvijo uteževanja na podlagi entropije in metode TOPSIS oblikovali sestavljeni indeks vitalnosti, da bi proučili razlike med petimi ključnimi vidiki: geografsko lego in naravnimi viri, infrastrukturo in komunikacijami, zdravstveno oskrbo, izobraževanjem in družbenim razvojem. Preizkušeni model se lahko zlahka prenese v druga okolja, saj temelji na javno dostopnih kazalnikih, ki jih je mogoče kartirati v katerem koli mestnem prostoru. Primeren je za prepoznavanje prostorskih neenakosti ob uporabi osnovnih podatkovnih virov ter za vzpostavitev jasne, znanstveno utemeljene podlage za urejanje prostora v postsocialističnih regijah, v katerih primanjkuje podatkov.

Izsledki so pokazali izrazite razlike v zmožnosti naselij, da spodbujajo vitalnost, zlasti z vidika dostopnosti infrastrukture in virov. V prostorskem smislu in skladno z drugim raziskovalnim podvprašanjem je analiza pokazala, da bližina mestnega središča ni povezana s stopnjo vitalnosti. Namesto monotonega upadanja vitalnosti od mestnega središča navzven je bila najnižja stopnja vitalnosti (67.–69. mesto) ugotovljena v vmesnem pasu med mestnim središčem ter severnim in severovzhodnim obrobjem Niša. To kaže na žarišča nizke vitalnosti znotraj tega pasu, ne na enosmerno upadanje proti obrobju. Na vitalnost naselja torej bolj vpliva kombinacija njegovih virov kot pa oddaljenost od mestnega središča.

Raziskava je pokazala tudi izrazite digitalne in kulturne razlike. Čeprav ima večina naselij razmeroma dober dostop do virov in infrastrukture, ostaja pokritost z mobilnim omrežjem problematična – približno 25 % naselij ima slabo povezavo. To lahko omejuje digitalno vključenost prebivalcev, tj. dostop do možnosti, kot so delo na daljavo, spletno izobraževanje in e-trgovina, kar vpliva ne le na splošno vitalnost, temveč tudi na odzivnost v izrednih razmerah. Poleg tega v skoraj 90 % naselij ni kulturnih ustanov, ki so ključne za razvoj lokalnega družabnega življenja in identitete.

Glede na prostorsko porazdelitev vitalnosti bi se morali načrtovalski posegi osredotočati zlasti na naselja s srednjo stopnjo vitalnosti, ki obsegajo večino proučevanega območja.

5.2 Povezava s prejšnjimi raziskavami

Izsledki potrjujejo večdimenzionalnost vitalnosti mest, ki mora vključevati tako materialne kot nematerialne storitve in danosti, ki tvorijo kulturne in ekološke vire. Ugotovljene razlike niso razvidne iz prostorskih aktov mesta Niš, ki temeljijo na občinskih statističnih podatkih in tako zakrivajo podobčinske značilnosti. V tem smislu indeks vitalnosti zadovoljuje potrebo po podrobnih prostorsko indeksiranih pristopih, ki upoštevajo razlike v mestih (Liu idr., 2023). Z razkrivanjem neenakosti med naselji daje podlago za sprejemanje lokalnih odločitev, ki so bolj prilagojene potrebam vsakega naselja.

V skladu s tretjim raziskovalnim podvprašanjem izsledki potrjujejo tudi ključno vlogo družbenega razvoja pri zagotavljanju vitalnosti. Kazalniki družbenega razvoja (npr. število prireditev in kulturnih ustanov) so zaradi razmeroma visokih uteži, določenih po metodi entropije, pokazali, da lahko že manjše razlike pomembno vplivajo na stopnjo vitalnosti. To se ujema z ugotovitvami Jane Jacobs (1961) in Roberta D. Putnama (2000), ki sta poudarila pomen socialne kohezije in državljanskega udejstvovanja kot bistvenih sestavin trajnosti mest, ter z raziskavo, v kateri sta Osunkoya in Partanen (2024) ugotovili, da so družbenogospodarske spremenljivke pomembno povezane s stopnjo vitalnosti ali nanjo pomembno vplivajo. Razvrstitev naselij po metodi TOPSIS poleg tega kaže odstopanje od vzorca središčnosti, ki je pogost v postsocialističnih mestih in običajno pomeni marginalizacijo obrobnih območij zaradi čedalje večje koncentracije naložb v mestnih središčih (gl. Vujošević idr., 2012; Petrović, 2009). Ugotovljena prostorska porazdelitev tako poudarja zlasti pomen medsebojnih razmerij med posameznimi kazalniki, ne pa njihovega rangiranja.

Nabor kazalnikov vitalnosti je v literaturi raznovrsten in dobro obravnavan. Lopes in Camanho (2013) sta se na primer osredotočila na uporabo javnih zelenih površin kot merljivega kazalnika vitalnosti mest. Galaktionova in Istrate (2025) sta predlagali uporabo funkcionalne gostote za vrednotenje vitalnosti ulic. Osunkoya in Partanen (2024) sta predlagali povezovanje tradicionalnih mer z velepodatki, kot so podatki mobilne telefonije. Garau in Annunziata (2022) sta proučevala gostoto pozidave in prebivalstva, razne indekse središčnosti, gostoto mestnih zanimivosti in kazalnike okoljske kakovosti. Putnam (2000) ter Putnam in Campbell (2010) so izpostavili kazalnike socialnega kapitala, kot so državljansko udejstvovanje, udeležba v verskih aktivnostih in skupnostna omrežja, kot družbeno razsežnost vitalnosti. Mnogi od teh kazalnikov so bili neposredno ali posredno vključeni v raziskavo, predstavljeno v tem članku – na primer bližina geoloških virov, ki je primerljiva s kazalnikom okoljske kakovosti v raziskavi, ki sta jo izvedla Garau in Annunziata (2022), prisotnost verskih objektov, primerljiva s kazalnikom udeležbe v verskih aktivnostih pri Putnamu (2000), ali pokritost z mobilnim omrežjem, primerljiva z mobilnimi podatki v raziskavi Osunkoye in Partanen (2024). Namen predstavljene raziskave je bil proučiti nabor kazalnikov, ki se nanašajo na infrastrukturo in vire pod javno oziroma občinsko upravo ter na podeželska naselja znotraj upravnih meja mesta, pri čemer so avtorji izvedli obsežen terenski popis infrastrukture in virov, s katerim so pridobili izhodiščni nabor kazalnikov. Posledično številni kazalniki, predlagani v literaturi, ki se večinoma osredotočajo na mestna središča, niso bili neposredno uporabni. Čeprav izbrani nabor kazalnikov ustreza zahtevam kontekstualne analize, hkrati omejuje izvedbo širše raziskave.

5.3 Omejitve

Ker je bila raziskava namenoma zasnovana tako, da poudari temeljne fizične dejavnike, ki lahko spodbujajo vitalnost, je ena od njenih omejitev odsotnost kazalnikov, ki se nanašajo na človeško aktivnost v analiziranih naseljih. Druga omejitev je uporaba kategoričnih mer (npr. prisotnosti kulturnih ustanov ali zdravstvenih storitev), ki lahko pretirano poenostavijo celovito naravo kakovosti, dostopnosti in rabe storitev. Izbrani nabor kazalnikov prikazuje trenutno stanje v naseljih, vendar ne vključuje časovne razsežnosti, ki bi lahko pokazala sezonske ali dnevne vzorce vitalnosti. Ne nazadnje so avtorji z osredotočanjem na kazalnike, ki se nanašajo na prvine v pristojnosti občin, tudi zavestno zanemarili tržno pogojene in skupnostno usmerjene aktivnosti, ki prav tako pomembno prispevajo k vitalnosti lokalnega okolja.

Avtorji so se zavedali, da ni mogoče ustvariti univerzalnega modela, ki bi bil primeren za vsa okolja, zato je bil njihov glavni cilj oblikovati temeljno prostorsko izhodišče s kazalniki, preverjenimi na terenu, in občinskim načrtovalcem ponuditi jasno operativno podlago za odločanje.

5.4 Prihodnje raziskave

V skladu z ugotovljenimi omejitvami bi morali biti v prihodnje raziskave vključeni podrobnejši podatki, na primer zmogljivost objektov, kakovost storitev ali zadovoljstvo uporabnikov, na podlagi katerih bi lahko bolje proučili razlike na ravni skupnosti. Drugič, skladno s predlogi Osunkoye in Partanen (2024) bi bilo smiselno rezultate nadgraditi z velepodatki (npr. podatki analize družbenih omrežij, podatki GPS in podatki o lokalnih storitvah, vključno s posodobljenimi podatki o ustanovitvi in zaprtju podjetij). Tretjič, v analizo bi bilo treba vključiti časovno razsežnost, kar bi omogočilo celovitejše razumevanje sprememb vitalnosti. Četrtič, čeprav se s pristopom, ki združuje entropijo in metodo TOPSIS, zmanjša subjektivnost pri določanju uteži, se lahko nenamerno prenizko ovrednotijo ka-

zalniki z majhno spremenljivostjo, a velikim konceptualnim pomenom (npr. izobraževanje in zdravstvo). Ena od možnih rešitev je uporaba hibridnih pristopov, ki združujejo objektivne statistične razlike in mnenja strokovnjakov. Z vključevanjem navedenih dinamičnih meritev bi se prihodnje raziskave lahko usmerile k uporabi napovednega analitičnega okvira, ki bi pokazal, kako dodajanje posameznih fizičnih virov vpliva na vitalnost naselij.

6 Sklep

Avtorji so v članku predstavili indeks vitalnosti kot prilagodljivo orodje za prepoznavanje neenakosti in oblikovanje prostorskih strategij na podobčinski ravni. Pri tem je treba poudariti, da se izračunane uteži nanašajo na specifično obravnavano okolje ter odražajo strukturo podatkov in razlike na lokalni ravni. To potrjuje potrebo po prilagajanju analiz vitalnosti posameznim lokalnim razmeram in kaže, da je pristop mogoče prilagoditi tako, da omogoča odkrivanje pomembnih razlik med mestnimi območji.

V praksi lahko izsledki in metodološki pristop predstavljene raziskave prispevajo h krepitvi na dokazih temelječega odločanja, saj so lahko podlaga za lokalne načrtovalske strategije, ki temeljijo na virih in upoštevajo edinstvene značilnosti posameznega naselja. Hkrati so lahko izhodišče za nadaljnje izboljšave na podlagi vključevanja dinamičnih in demografskih kazalnikov, ki omogočajo boljši vpogled v vitalnost mest.

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Reuse trends in abandoned military land in Ljubljana, Prague, and Pula: An overview through the lens of the commons

Managing former military land has been a challenging task, especially due to its status as a publicly owned asset. This has arisen bottom-up using commoning approaches to satisfy people's needs. This article explores such approaches by analysing three former military barracks in central and eastern Europe: Karlo Rojc barracks, currently Rojc Community Centre (Pula, Croatia); Kasárna Karlín (Prague, Czech Republic); and Fourth of July barracks, today called Metelkova Mesto (Ljubljana, Slovenia). This article examines the conversion of these abandoned spaces to civilian use by approaching them through the lens of Ostrom's eight design principles for successful common-pool resource institutions. By comparing the case studies through these principles, this article demonstrates how the cases are based on features that can make them proper commons, as well as potential risks related to the profit-oriented approach conducted by technocratic or growth-oriented coalitions.

Keywords: urban governance, commoning, urban regeneration

1 Introduction

The conversion of redundant military land into an urban commons is currently a relatively unexplored theme in central and eastern Europe (CEE), but it has arisen as a response to the tendency of CEE to emulate western profit-seeking in contemporary urban spaces (Taubenböck et al., 2019) related to contested negotiations for the future use of abandoned spaces (O'Callaghan & Di Feliciantonio, 2021). An example of such dynamics is how to deal with former military land. Military withdrawal did not occur simply due to geopolitics related to the Cold War, but also because military land became an opportunity for potential speculation at the intersection of capital accumulation and environmental exploitation (Krcho, 2013; Hercik et al., 2014; Glintić, 2015; Jevremović et al., 2021; Peric & Miljus, 2021; Bársony, 2022). This goes along with counterapproaches to this kind of orientation in the built environment, such as informal placemaking practices that have occurred since the pivotal case of Christiania (Thörn et al., 2011) and affecting dozens of disused barracks in Italy (Camerin, 2024). Not only have community-driven actions taken place, but top-down planning decisions have also changed regarding the potential creation of commons in very specific cases (Camerin, 2021). However, contemporary scholarship is scant on these specific dynamics and has mostly focused on western countries, with analysis in CEE countries still insufficient. Nevertheless, the cases of Ljubljana's Metelkova Mesto (MM), Pula's Rojc Community Centre (RCC), and Prague's Kasárna Karlín (KK) have increasingly attracted the interest of scholars in the last decade (see Ntounis & Kanellopoulou, 2017; Tomašević, 2018; Rodríguez-Barcón & Sousa, 2021). These cases are considered and analysed as culture-led revitalization initiatives (Ivanc & Petrovic, 2025) capable of generating new economic income. Despite growing interest in such cases, they have been poorly approached in terms of commons, and previous studies need re-examination to account for current dynamics. This article builds on attempts to apply the theory of the commons (Saunders, 2014) to a specific kind of public land, former military assets, by applying Ostrom's definition of the commons. Here, abandoned military land as a commons comprises abandoned space whose reuse is triggered by alternative models of social organization developed by nongovernmental and civic actors (i.e., commoner, mostly in the form of NGOs developing activities related to art and culture, business, children and youth, the environment, psychosocial work, mental health, sports, and recreation, as well as special subgroups such as refugees and war veterans). In particular, such actors try to self-govern these assets through the institutions they create in an attempt to go beyond the market–state dichotomy (Brando et al., 2019). The study thus empirically focuses on nongovernmental and civic activities to reuse these three abandoned barracks based on Ostrom's eight design principles for sustainable community-based commons management. The relationship and interactions between commoners and public authorities is examined from this point of view to determine whether these activities generate wealth for local citizens, as opposed to being controlled by private interests, and to establish the extent to which each case study can be regarded as a commons (Wily, 2011).

2 Ostrom's design principles and abandoned military land as a successful commons

As Moroni (2025) recently pointed out, academics from various disciplines, ranging from economics to sociology, widely recognize the ambivalence of the concept of the commons. Ostrom's seminal work on an institutional model of analysis is the basic reference point for this study, with specific attention to the eight design principles for the sustainability of commons governance (Ostrom, 1990: 90, 1993). These principles are essential for successful common-pool resource (CPR) institutions because they would prevent overuse and be transferred from one generation of resource appropriators to the next. CPRs are resources with characteristics of subtractability and difficult excludability, such as pastures and the internet, that may be owned by national or local governments, by communal groups, or by private individuals or corporations, or that may be used as open-access resources by whoever can gain access (Dolšak & Ostrom, 2003: 4). The definition of a CPR's boundaries and the identification of people authorized to use it "can be thought of as a first step in organizing for collective action. So long as the boundaries of the resources and/or the specification of individuals who can use the resource remain uncertain, no one knows what is being managed or for whom" (Ostrom, 1990: 91).

These principles can be used to examine the management of former military barracks intended as a commons, although it is widely recognised that Ostrom's research has various limitations. First, Choe and Yun (2017: 117) argued that, by approaching excludability and subtractability as physical or technical attributes, Ostrom's CPR notion "has a number of limitations. Excludability and subtractability are attributes constructed by society, not a physical or technical attribute. Ostrom overlooked this aspect." Second, according to Block and Jankovic (2016: 290–291), Ostrom's research has been largely misunderstood because she "did not discover any new form of governance beyond private property and government control. Rather, she discussed some interesting variations in contractual regulation and enforcement of private property rights." Third, more than thirty years after her 1990 book *Governing the Commons*, the current approach to commons

has shifted from the basic argumentation on this concept. According to Ostrom (1990), commons are resources jointly appropriated by a group of partners that have an exclusive right to them and can exclude all other individuals and groups from access to and use of them. In contrast, Moroni (2025: 178–180) recently stated that the contemporary conceptualization of commons indicates that they are resources that everyone should have access to and they thus belong to the people as a matter of life necessity, positing that no individual or group should possess an exclusive right to these items. This character implies the opposite of ownership: consequently, commons fall outside any market logic (Rodotà, 2012; Mattei & Mancall, 2019).

Bearing in mind these aspects, previous scholarship on military land has mainly come from the domain of urban studies. However, this has insufficiently addressed military assets in terms of the commons. In fact, growing explorations of people-centred approaches to abandoned military land underscore that successful reuse can be achieved when the activities in these places and their socioeconomic influence in urban environments result in a brand or a mix of functions producing certain benefits that allows them to be tolerated by local governments (Rodríguez-Barcón & Sousa, 2021). Such a statement alone is not enough to fill the research gap, and so applying Ostrom's approach is useful because she recognized that not all commons were successful and that many CPRs collapsed. The eight design principles can thus help identify universal patterns to explain the necessary rules for successful commons, and for examining the institutions that developed the commons in the case studies and how they work. Ostrom (1990: 52) explained that there are three levels of rules: "operational" (principles 1 to 5), "collective-choice" (principle 6), and "constitutional-choice" (principles 7 and 8). Operational rules directly impact the daily decisions made by appropriators or commoners regarding the withdrawal of resource units, monitoring actions, the information required, and assigning rewards and sanctions for different outcomes. Collective-choice rules exert an indirect influence on operational rules and are employed by appropriators, officials, or external authorities when formulating operational rules for resource management. Constitutional-choice rules determine who is eligible and define the parameters for the design of these rules. These three rules are useful for this research because they deal with the ways communities of users manage share resources together (e.g., in terms of access, alienation, exclusion, and withdrawal). Consequently, taken together, these rules show whether and how communities of users can sustainably and fairly self-govern resources such as former military barracks, which can have major policy implications (e.g., democratization of an abandoned public area conceived as a public resource, thus potentially avoiding privatization, commercialization, and restricted public access).

3 Methods and case studies

3.1 Methodology

The case study choices derived from two-step research (Figure 1).

The first phase (September 2024 to August 2025) consisted of a systematic screening of peer-reviewed publications (Annex 1). The aim was to map the ways in which military land reuse occurred in CEE once the Cold War ended, the reuse typologies effectively carried out, and the possible lessons that can be learned from these to understand whether there has been a commons-centred approach. This step was performed by searching for relevant publications in various engines in English (Web of Science, Scopus, and Google Scholar) with various strings of keywords (i.e., 'commons' OR 'urban commons' AND 'military barracks' OR 'military land' and 'Central Eastern Europe' OR 'name of the country') in the title, abstract, and keywords fields. The search resulted in forty-five publications from a large variety of disciplines (mostly architecture and planning intertwined with aspects such as heritage and landscape) dealing with abandoned defence sites. Only four publications written in English were connected in some way to military land and commons in CEE, especially barracks (Ntounis & Kanellopoulou, 2017; Tomašević, 2018; Rodríguez-Barcón & Sousa, 2021; Ivanc & Petrovic, 2025). A search of literature translated into English in national and local newspapers was also performed in Google based on the aforementioned criteria. This step helped reveal that three barracks located in three major cities were addressed in line with a possible definition of the commons.

The second phase (September 2025 to March 2026) focused on two main tasks. First, qualitative information was collected on the case studies by reviewing planning documents, projects, and media related to each site. Second, fieldwork was carried out at RCC, MM, and KK in September, October, and November 2025, respectively, with a prior visit to each of them between October 2018 and January 2019. The fieldwork included visiting the case studies and performing twenty semi-structured interviews for each site to reach "meaning saturation" (i.e., the point at which the depth and themes are fully explored; Hennink et al., 2017). This led to understanding the perceptions about the management and use of each site by four different groups of actors (five interviewees for each category, all over eighteen years old, and English speakers), who were selected according to the following criteria:

- Commoners: by writing emails to the organizations in the former military barracks today, with initial contact established in the 2018–2019 fieldwork;

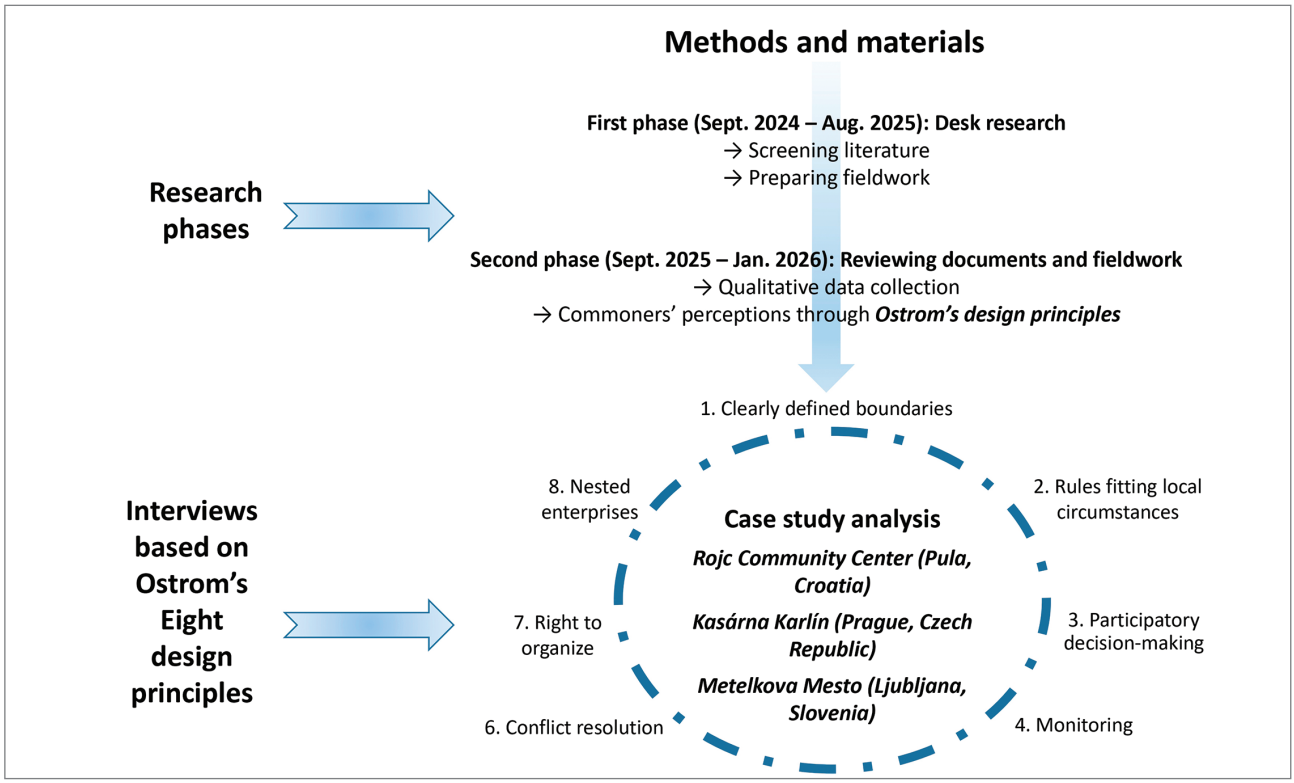

Figure 1: Research methodology. Source: authors.

- Users of and visitors to the barracks: by directly interviewing them during the 2025 fieldwork;
- Local residents: by walking in the barracks' surroundings and asking if people were available for an interview;
- Local public authorities' spokespersons: by writing emails or making telephone calls to local spatial planning bodies and/or city council planning departments because they are the most appropriate administrative level for managing former military sites. Previous contacts were made during the 2018–2019 fieldwork.

The aim was to understand the opinions of various local actors and thus obtain a broader perspective on the perception of the reuse management process from those that most understand the logic of the commons (commoners) and others to complement the categorized information with more insights based on their various roles and positions in the local arena (public authorities, users of the activities performed at each site, and people living in the city).

The interviews consisted of ten questions on the perceptions following Ostrom's eight design principles (see Annex 2):

- Principle 1. Clearly defined boundaries of the commons.
- Principle 2. The governance rules are to be adopted in accordance with the prevailing local context. Clearly, a single universally applicable approach to governing commons is not achievable.
- Principle 3. Participatory decision-making should be established so that the people that draft the rules fully follow them.
- Principle 4. Monitoring. Once a set of regulations has been established, it is the responsibility of communities to devise effective enforcement mechanisms.
- Principle 5. Graduated sanctions should be imposed for those that abuse the commons.
- Principle 6. Smooth conflict resolution.
- Principle 7. Granting legal status to commons should facilitate the establishment of organizational frameworks.
- Principle 8. The optimal functioning of commons should be facilitated by integrating them within more extensive networks.

Each interview was conducted in indoor spaces, recorded by the interviewer, and accompanied by a short informal interaction with the respondent with the aim of clarifying the answers, with a total interview time generally lasting fifteen to twenty-five minutes. Ethical considerations in handling the interviewees were addressed in compliance with the European Union's General Data Protection Regulation.

3.2 Presentation of the case studies

Table 1 and Figure 2 present the main features of the case studies: area, number of buildings, when built, abandonment, reuse, listed heritage, and governance issues (i.e., ownership and top-down / bottom-up approaches).

Table 1: Case study main data.

Case study data	Rojc Community Centre	Kasárna Karlín	Metelkova Mesto
Area (m^2)	16,739 (+29,000 open space)	8,400	12,500
Number of buildings	1	2	6
When built	1882–1911	1840s	1870s
Year abandoned	1991	2008	1991
Period of reuse	From 1999	From 2017	From 1993
Listed heritage	All buildings	All buildings	—
Ownership (year)	City council (2007)	Ministry of Justice (2016) City council (2024)	City council (2008)
Top-down / bottom-up	Bottom-up	Top-down	Bottom-up

Source: Authors.

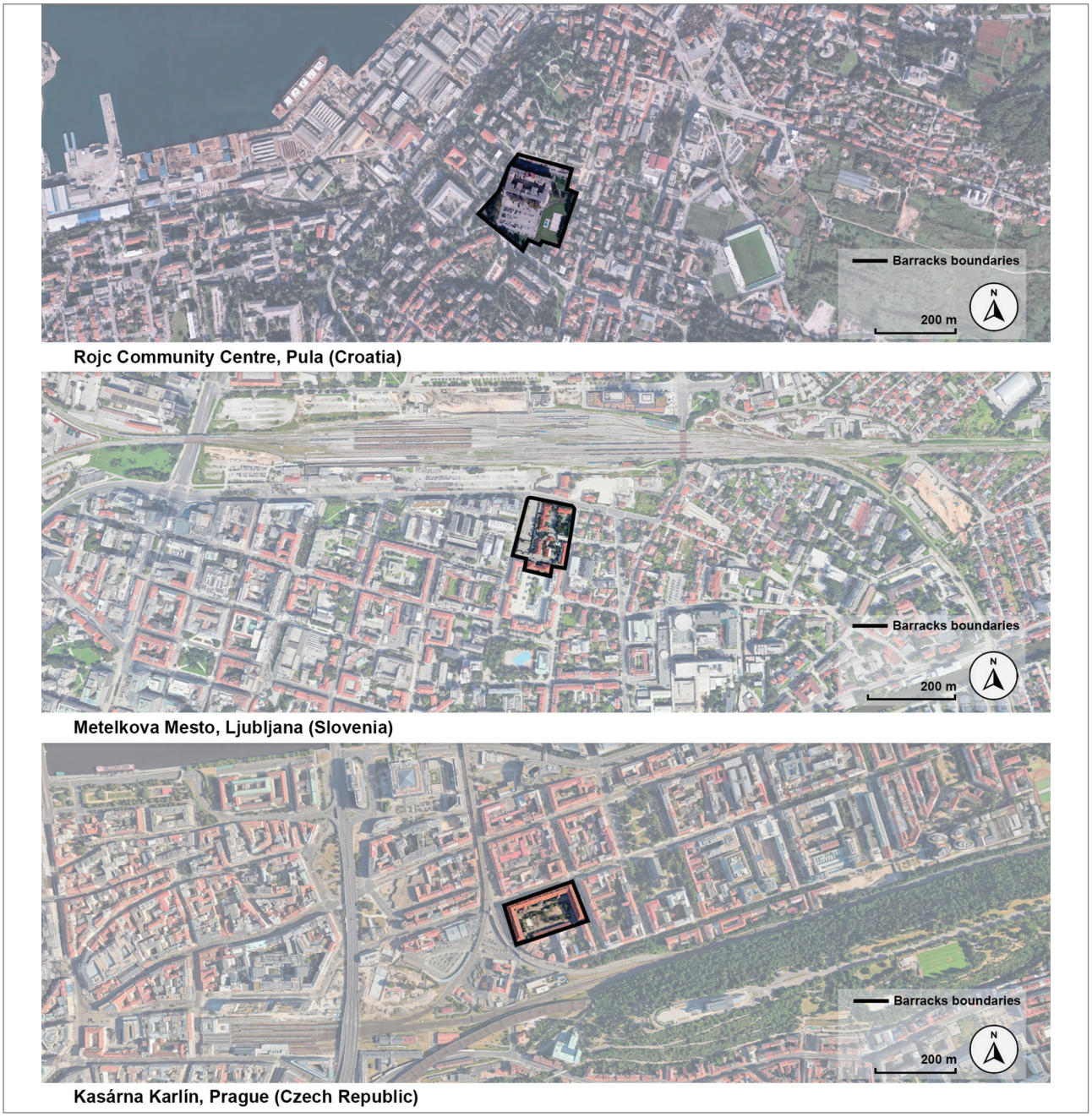

Figure 2: Surroundings of the three case studies (source: authors, based on Google Maps).

The sites analysed here have clearly differentiated characteristics, development trajectories, and lifespans although they are contested spaces. On the one hand, the Pula and Ljubljana cases show the implementation of informal urban uses that challenge hegemonic control over urban development and disrupt established growth-driven agendas. On the other hand, the Prague case shows a typical culture-led regeneration driven by the non-profit sector that generated real-estate market interest for its privatization. Whereas RCC and MM started with squatting, KK began as a top-down decision by the state to promote temporary cultural reuses entrusted to private business. All three cases operate as informal (Ljubljana and Pula) and formal (Prague) cultural centres, hosting events and gatherings for local associations devoted to various activities (e.g., arts, dance, music, and theatre). These initiatives have survived in part because of unusual manoeuvres by the actors involved, whether at the state (Ministry of Defence) or local level (city council and district authority). They have also survived attempts to be reconverted into new, more profitable uses (a large shopping centre in the case of MM and a multi-functional space for KK), which were halted due to squatting (RCC and MM) and by recent support from citizens (KK).

3.2.1 Karlo Rojc barracks, currently Rojc Community Centre (Pula, Croatia)

After the military withdrew from the Karlo Rojc barracks in 1991, the building hosted around six hundred war refugees and several humanitarian organizations until 1997. Successively, local NGOs (especially cultural, youth, and environmental organizations) started an informal occupation of the site, prompting the city of Pula to allocate spaces to over thirty NGOs in 1998. These organizations self-financed renovations and developed a rudimentary governance structure known as the Council of Rojc. By 2007, over one hundred NGOs were housed there, although tensions arose over the municipal company Castrum's opaque financial management. A 2008 protest resulted in the establishment of the RCC coordination body, with the aim of co-managing the relationship between users and the municipality. To further institutionalize the commoners' representation, the Rojc Associations Alliance (RAA) was launched in 2012 and elected nineteen user representatives to participate in shared governance. Since then, user organizations have pushed for greater financial transparency and improved management. Their advocacy has secured significant outcomes, such as requiring telecommunications companies to pay fair rent for antennas on the building, generating €35,000 annually for reinvestment. Today, RCC is an example of a hybrid governance model, combining municipal ownership with user-led co-management (Figure 3).

3.2.2 Kasárna Karlín (Prague, Czech Republic)

After the military withdrew in 2008, the KK site was largely underused until 2017, when the new owner, the Ministry of Justice, granted a temporary lease to the local cultural asso-

Figure 3: Rojc Community Centre (source: authors).

Figure 4: Kasárna Karlín (source: authors).

ciation Pražské Centrum (Prague Centre). The association transformed KK into a cultural centre, hosting a wide range of events and facilities – including a cinema, gallery, concert hall, and café – while maintaining the barracks in near-original condition (Figure 4). Operating as a nonprofit entity, the organization reinvested revenues in salaries, renovations, and equipment. The ministry's initial plan to transform the site into a courthouse was superseded by alternative proposals by 2020. These proposals included the development of student housing, administrative offices, and an innovation hub. In 2024, ownership was transferred to the city of Prague, which launched strategic planning for regeneration and potential rezoning (mixed-use redevelopment combining cultural, educational, and commercial functions) at the same time as tensions between the city authorities, local residents, and Pražské Centrum. In June 2024, the Prague 8 district authority shut down the cultural association's activities based on apparent building regulation violations and noise complaints by local residents. Critics contested the decision, pointing to the timing of the closure after years of tolerated operation. Although its courtyard provisionally reopened in 2025, KK's long-term future remains uncertain. Contemporary local discourse underscores this within the overarching discord between grassroots cultural initiatives, urban redevelopment strategies, and governance structures privileging public–private partnerships in Prague's brownfield regeneration since the early 2000s (Pixová, 2013).

3.2.3 Fourth of July barracks, today Metelkova Mesto (Ljubljana, Slovenia)

Following Slovenian independence in 1991, the southern area of the Fourth of July barracks was assigned to the Ministry of Culture to become a prominent museum, and the northern section transitioned into a focal point for alternative (sub)cultural production. NGOs (especially from the realm of culture, research, and civil society) initially sought to convert the site into a creative laboratory. However, the government-led demolition ordered in 1993 resulted in two hundred artists squatting in the area. Despite eviction attempts, the site was consolidated in 1995 as the Autonomous Cultural Centre Metelkova Mesto (AKC), which was mainly self-financed through cultural events, clubs, studios, and accommodation (i.e., Celica Hostel). The 2008 property transfer to the city council involved pledging protection for the occupants. Nonetheless, the relationship with AKC has remained fraught with complexities, marked by disputes over ownership, zoning, and autonomy. Although the local administration has boosted the Metelkova neighbourhood's cultural and tourism value, AKC has firmly resisted such trends to maintain its independence. Conflicts have escalated in relation to frictions such as attempts to sell Celica Hostel in 2017 and the 2021 spatial plan guidelines to reduce the space devoted to AKC. Political shifts in 2022 temporarily alleviated eviction threats, but recurrent police

Figure 5: Metelkova Mesto (source: authors).

interventions, drug-related incidents, and urban development pressures have sustained tensions. In 2025, new risks emerged with a proposal to build a medical facility encroaching on the Gala Hala club, a concert venue that can accommodate 350 people. Notwithstanding the persistent external pressures and the fragile relationship with public bodies, AKC continues to assert its cultural and political significance and autonomy across Ljubljana (Figure 5).

4 Results

This section relates the research findings by highlighting the most relevant aspects connected to Ostrom's eight design principles for each case study based on the outcome of the interviews along with the literature review.

4.1 Clearly defined boundaries

RCC boundaries are controlled to prevent access by unauthorized individuals or outside opening hours apart from the 108 different renting organizations. Building access (from 7 am to midnight) and control are well established, with a 24-hour doorman on watch at openings devoted to art gallery visits or organized activities such as talks, conferences, and workshops.

KK's physical boundaries are also clearly defined, and access is possible through the main gate at Křižík Street (*Křižíkova ulice*) no. 12, with opening hours (10 am to 11 pm) for visitors. However, there are no restrictions on users beyond opening hours. After the 2024 property transfer to the city council, KK has been leased rent-free to Pražské Centrum (2025), which independently manages the programming in the open spaces. The interior spaces currently remain inaccessible, although open-air activities (e.g., cinema screenings and concerts) with controlled access upon payment of an entrance fee are permitted. Apart from opening hours, access is restricted to Pražské Centrum and staff hired for maintenance work.

MM also sets boundaries for its entrance, but there are no fixed hours for accessing the premises. Access is possible either through an entrance on Metelko Street (*Metelkova ulica*), regulated by a manually operated parking barrier controlled by an MM activist group member, or from the Celica Hostel, located in the former prison building of the barracks close to the entrance.

4.2 Rules fitting local circumstances

RCC adopts constitutional and operational rules (Tomašević, 2018: 87–88). The Decision on the Use of Office Space in the RCC defines roles because it is devoted to regulating administrative matters of renting the space, such as the duration of the contract and obligations to invest in and renovate the rented spaces, and services such as electricity and water consumption. The document House Rules contains the operational rules, which are proposed by the RCC coordination body to the city council, and it defines what is permitted in the daily use

of the complex, including for visitors. For instance, the city council must give special permission for an event to be open to the general public past midnight.

In the case of MM, the community managing the site is occupying it on the fringes of legality. The renters are in ongoing dialogue with the current owner (i.e., the city council), which even finances various activities (Culture.Si, 2025). The management rules are informal and unspoken, and there is no report of an official document regarding unacceptable behaviours or attitudes. Despite this, the lively nightlife at MM is often claimed to result in noise and vandalism, as well as drug and alcohol consumption.

KK has a large variety of rules, especially in terms of management and waste recycling. In addition, there are quasi-mandatory recommendations, such as the requirement that food and drink be consumed at the bars (except for children and people with medical conditions whose needs are not met by the menus); this is aimed at boosting revenues, which, in turn, contribute to funding activities (Pražské Centrum, 2025). Additional regulations safeguard peace and quiet for local residents to prevent potential conflicts that may arise from activities taking place within the outdoor courtyard. (Kasárna Karlín, 2024).

4.3 Participatory decision-making

The three sites have low prominence in participatory decision-making, which is typical of other self-managed centres across Europe; this is similar (but on a smaller scale) to the Free Town of Christiania. The strong ideological activities and values promoted by the occupants invite visitors, whether or not they share these ethics, to respect the associations' members in all cases.

In 2011, a participatory process involving consultations with all user organizations preliminarily approved the RCC rules. Afterward, the three members of the RAA belonging to the coordination body proposed the RCC rules to the local administration for their final approval (Jakovčić et al., 2013). However, because the city council's expenditure funds the site maintenance, at approximately €200,000 annually, the participatory process outcome may not be fully respected if considered necessary by the local authority.

In the case of MM, only informal talks take place between the commoners and the city council, but there is no participatory process for drafting documents or making decisions.

Pražské Centrum establishes the rules for KK, and there is no participatory process involving local residents or collaborating organizations. Some of these rules follow environmental sustainability concerns, and others respond to complaints from residents about noise. Currently, the KK rules are part of the temporary operational plan launched after the partial reopening in 2025, and Pražské Centrum (2025) continues to insist on taking back the use of the indoor spaces that are still closed.

4.4 Monitoring

RCC implements various monitoring mechanisms. First, Pula's city council, advised by the RCC coordination body, ensures that all the organizations are up to date with their obligations under the lease agreement. Second, the security team and the doorman monitor daily use of the site and ensure the rules are followed. Third, the RCC coordination body controls the financial situation and proper use of funding, and three members of the RCC association alliance that belong to the coordination body monitor any changes to the rules (Tomašević, 2018: 90).

MM has rejected authority and formal instructions, and its cooperation with public bodies is minimal, without any external monitoring of its activities and decisions. The occupants have implemented a horizontal approach to governing their internal affairs, promoting democratic values and the participation of all its members. In addition, they eschew involvement in larger-scale decision-making with other stakeholders, a strategy employed to preserve their autonomy. This derives from the fact that MM is driven by a political struggle that is intricately linked to urban social movements that draw inspiration from right-to-the-city movements to confront neoliberalism, emerging right-wing authoritarianism, gentrification, and repressive government measures.

After the reopening in May 2025, as part of intricate negotiations with the local authorities, KK increased security, especially by hiring an outside company to enforce compliance with the rules on daily operations and mainly affecting visitors (Pražské Centrum, 2025). The goal is to prevent conflicts or undesirable behaviour that may cause discomfort for local residents, with potential threats for Pražské Centrum to develop its activities.

4.5 Graduated sanctions

RCC punishes inappropriate use of the site's facilities in line with the lease requirements. If an organization is two months in arrears for utility costs (e.g., for electricity), the service is suspended, although it can be restored immediately after payment. If there is a four-month delay, the rental contract is immediately terminated by a unilateral decision, and the

organization is banned from future rental. Other sanctions regard the daily use of the spaces. The penalties consist of formal warnings issued by Pula's city council. When three warnings are issued, the contract is revoked and the organization is forbidden from future rental.

In contrast, KK and MM have no gradual penalties in their internal regulations, nor is there any record of sanctions. At MM, the police do not intervene except in cases of illegal activity. In such cases, Slovenian criminal law applies. At KK, visitors to or collaborators with the association that fail to comply with the regulations are asked to immediately cease any activity that violates the regulations. In the event of repeated violations, the police are notified to intervene, applying the penalties specified under Czech criminal law. KK also bans entrance to those causing conflict.

4.6 Conflict resolution

At RCC, the doorkeeper is responsible for reporting conflicts or disagreements and for referring them to the RCC coordination body, which is responsible for mediating conflict resolution. However, Tomašević (2018: 90–91) states that there have been cases in which this procedure was not followed. Certain violations have been directly reported to the coordination body's members appointed by the RAA, although this body is not responsible for resolving conflicts.

In the case of MM, no formal conflict resolution mechanisms exist, nor is there any entity responsible for mediating conflicts, and so they may be resolved through informal means, thereby avoiding the necessity of calling the police. Complaints involving visitors, squatters, and local residents have been filed with the city council and the police since 2018, and the site is experiencing an increase in drug-related activities despite AKC's involvement in anti-drug campaigns. The local authorities have blamed AKC, and AKC has called on the local authorities and the police to deal with criminal activities and maintain order.

At KK, Pražské Centrum's staff, volunteers, and the security company are involved in resolving conflicts between visitors or stopping problematic behaviour, but no entity is responsible for mediation and conflict resolution. Similar to RCC, if a person causing a problem is willing to remedy it, informal resolution can occur without involving the police.

4.7 Right to organize

At AKC, what is at stake is the struggle of AKC with the city council–led cultural events in an attempt to sustain urban artistic spaces to achieve a non-institutionalized and informal right to self-organization, resulting in strong empowerment and almost total independence. Multiple factors can explain this situation. First, AKC is resistant to formalizing its legitimacy while halting eviction attempts, paralyzing demolition proposals, and rejecting rehousing offers. Second, there is the possibility of self-financing through ticket sales for cultural events and through bars. Third, MM's international reputation has led it to acquire strong organizational rights. Consequently, disrupting its authority would damage the local authorities' reputation if they forcible shut down MM, and so they prefer to find a way to market and promote it as a cultural and tourist venue (Culture.Si, 2025). Nevertheless, this right is strictly connected to the influence of local urban and cultural policies, as well as the city council's interests, and so the local authorities usually do not intervene in cases of irregularities and legal discrepancies, nor do they attempt to develop more lucrative uses.

The RCC coordination body is composed of three members each from the RCC association alliance and Pula's city council, which clearly shows limited recognition of its organizational rights by the local authorities. Specifically, these members of the coordination body are volunteers that, without any benefit, assume great responsibility in terms of co-governance (Tomašević, 2018: 94), whereby the city council holds decision-making power, and so it is the approving body. This is because the organizations located at RCC do not have sufficient funding to achieve greater independence.

In the case of KK, the management of the space is completely controlled by the local authorities. This was demonstrated by its closure in June 2024, ordered by the Prague 8 district government, under the pretext of illegal use of internal space that was neither approved for Pražské Centrum to use nor structurally approved for its purposes. In fact, only the outdoor courtyard is currently operational; it reopened in May 2025 following negotiations between the cultural association, the city council, and the Prague 8 district government, which called into question the management offered by the public actors (ČTK, 2024).

4.8 Nested enterprise

MM is a typical example of how a network of local cultural NGOs located at the site, along with an established relationship with international NGOs, have worked together to support a large variety of activities evolving over time (Popa et al., 2025). Originally, the Network for Metelkova consisted of more than two hundred NGOs led by the Movement for Culture of Peace and Non-Violence and the ŠKUC Association (Culture.Si, 2025). The ŠKUC Association was created to promote nonprofit artistic activities and is one of the most important cultural organizations in Ljubljana (Culture.Si, 2026).

In contrast, at RCC no other institutions from other Croatian cities or abroad are involved in managing and promoting events in the former barracks, which is a task performed by Pula's city council and the RAA. RCC is not part of a wider network of organizations, although there was an opportunity to be included within international networks of other former military sites located around Pula, especially following EU-funded projects such as the 2024–2026 FORTIC project led by Pula's city council (Urošević & Afrić Rakitovac, 2025). The same is true for KK. Here, no entities or organizations are involved other than Pražské Centrum and the local authorities (i.e., the Prague 8 district government and Prague's city council).

5 Discussion

The application of Ostrom's approach to the case studies is a special attempt to comprehend squatting (in the cases of RCC and MM) and cultural enterprises (for KK) with regard to management capacity and the relationship with public authorities to ensure their continued presence in these former military barracks. Moreover, this analysis highlights the challenges related to this relationship for sustaining the occupants' activities and the current threats to their existence. Applying Ostrom's design principles indicate to what degree the three former military barracks can be characterized as commons.

At RCC, although collective-choice rules (principle 6) and operational rules (principles 1 to 5) are currently operative, constitutional-choice rules (principles 7 and 8) are poorly implemented. The site's management has still not evolved into a commons. To achieve this, the involvement of other institutions in site management and/or entering into a wider network dealing with disused military land are two possibilities because the city of Pula seems to be active in this sense (Mrđen, 2017). In terms of participatory decision-making (principle 3), decisions are made by the site owner, the city council, which does not respect the outcomes of the current participatory process mechanism at RCC. This aspect is reflected in terms of an insufficient right to organize (principle 7) among the occupants because all the funds come from the city council. It is evident that RCC does not show the conventional characteristics of a commons, primarily due to its distinctive governance structure, which is characterized by a collaborative management approach involving both the local government and the community of users. This unique governance framework can best be characterized as a public–civic partnership (Hopman et al., 2021).

MM shows less implementation of the three rules than RCC. The site still has a strong squatting character as a self-organized autonomous centre but with insufficient collective-choice rules. MM continues to refrain from involvement in city council–led cultural activities, notwithstanding the evident challenges concerning safety, the absence of licences for bars and alcohol sales, and tax evasion (Rodríguez-Barcón & Sousa, 2021: 634). These irregularities are still being tolerated, primarily due to the indirect benefits that MM produces as a tourist attraction. This suggests that the cultural brand of this self-managed community has an indirect influence on the local revalorization process through culture-led initiatives.

KK seems to be the case that least corresponds to a commons. The findings indicate that the cultural activities performed at KK scarcely match the commons approach because this experience principally derives from a top-down approach to the governance of this area. The commoners show less power in relation to the other two case studies because the lease of the spaces depended on the Ministry of Justice from 2017 to 2024 and has depended on the city council since 2025. The establishment of Pražské Centrum has encountered delays, despite the initial offer of a three-year lease without charge. This was followed by the property transfer to the city council, which effectively halted the association-led activities. Consequently, Pražské Centrum was unable to exercise influence over the planning schemes and realign the city council's priorities to transform the area into a new multi-functional centre.

Four aspects deserve attention in the attempt to compare the case studies. First, these sites demonstrate the struggles of the social actors at the intersection of intricate power mechanisms and relations of public actors (van der Leer, 2026). These former barracks highlight how temporary use agreements and governance negotiations reflect broader tensions between local government development priorities and community-led cultural initiatives. Rather than simply documenting events, this study shows the fragility of collaborative governance when economic interests begin to dominate decision-making about cultural spaces. Second, the three sites face institutional constraints and uncertainties despite their status, reputation, and identity. Although their reuse is working autonomously without authorization, they have cultural heritage status, and they are former brownfields converted for new civil uses with great potential for public and green spaces, this is not a guarantee that will protect them from potential future development or profit-oriented investment. The attempt to build alternative and heterotopic places as social assets out of abandoned spaces or places in a state of transition can be a guiding axis for their existence, but it is still a process at risk. Third, and related to the previous point, the continuation of the current reuses is subject to potential future challenges and even changes resulting from the city council's decision-making on carrying out more profitable functions. The case most at risk appears to

be KK. Its reliance on negotiated legitimacy through formal agreements indicates a more fragile form of occupancy, which is dependent on institutional decisions rather than strategic leverage. Notwithstanding its involvement in collaborative governance structures, Pražské Centrum found itself in a position where it was unable to influence zoning decisions after the city's realignment of its future development planning priorities. In contrast to the bottom-up initiatives of RCC and MM, KK was legitimized through legal codification and not by the occupants' actions to maintain their presence, although their cultural activities are widely recognized as relevant within the city. Eventually, whether it involves squatting or temporary cultural use, the three cases show that their cities lacked adequate spaces for alternative culture, especially for young people and subgroups. In all three cases, a place for workshops and performances, and a home for musicians, activists, and artists was found, although the illegal takeover of derelict military sites created a stir in Ljubljana and Pula. The Prague case is different due to the initial willingness to create an agreement with Pražské Centrum that eventually legitimized its presence. Despite this, the difference between the cases in Ljubljana and Pula versus Prague is that in the first two the site users hold the power and willingness to promote bottom-up initiatives in which they position themselves in a superior level of the governance structure (Niranjan, 2015).

Applying Ostrom's design principles also presents limitations. As pointed out by her critics, reliance on the agency of individuals in a micro-level context and incapacity to recognize the broader political and economic context in which commons are embedded are two factors that undermine the application of her principles. Hence, subsequent research should use an extended geographical scope to reach at least the neighbourhood level. This approach should facilitate a more comprehensive understanding of broader trends and the manner in which historical activities have been influenced and channelled by local urban and cultural policies over time. Further research can also adopt different sampling strategy, including how to select the interviewees and the selection criteria, with coding to numerically assess actors' perception about site management and reuse. Eventually, the cases analysed can be approached as pilot projects, testbeds, or living labs to foster innovative institutional capacity in other cases, including abroad (Mazzucato, 2016). This can occur by following ambitious guidelines from international organizations such as the United Nations and the European Union with their different paths forward to achieve a more equal, sustainable, and resilient society (e.g., through their Sustainable Development Goals, Urban and Common Agendas, and Green Deal).

6 Conclusion

The theme analysed in this article is topical due to intense urban transformation of (sub)cultural spaces in contemporary cities, a phenomenon attributable to multiple effects of the cultural and socioeconomic restructuring of societies. The partial application of Ostrom's design principles is informative about the three cases for the following reasons. The findings suggest that these sites cannot be fully interpreted as proper commons. The nongovernmental and civic actors involved provide alternative models of social organization to various degrees, thus moving beyond reliance on public–private cooperation, but they do not self-govern the sites through ad-hoc institutions (when created). Moreover, the case study analysis demonstrates the insufficient role of clearly defined local communities in managing resources due to a variety of reasons (e.g., in terms of collectively agreed rules and punitive sanctions for those that break them; Albareda & Sison, 2020).

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CRediT authorship contribution statement

Roles played by authors to research outputs: Federico Camerin (FC) 50% and Arturo Vicente Ruiz (AVR) 50%. Conceptualization: FC; Data curation: AVR; Formal analysis: FC; Funding acquisition: FC; Investigation: FC and AVR (equal); Methodology: FC and AVR (equal); Project administration: FC; Resources: AVR; Software: AVR; Supervision: FC; Validation: AVR; Visualisation: AVR; Writing – original draft: FC and AVR (equal); Writing – review and editing: FC and AVR (equal).

Data availability statement

The dataset supporting the findings of this study is publicly available in the University of Valladolid's institutional repository UVaDOC: Annex 1 for the systematic literature review: https://uvadoc.uva.es/handle/10324/84037; Annex 2 for the interview content: https://uvadoc.uva.es/handle/10324/84039.

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Trendi ponovne uporabe opuščenih vojaških zemljišč v Ljubljani, Pragi in Pulju: pregled z vidika skupnih virov

Upravljanje nekdanjih vojaških zemljišč je zahtevna naloga, zlasti zaradi njihovega statusa sredstev v javni lasti. V nekaterih primerih so se oblikovala od spodaj navzgor z uporabo pristopov ustvarjanja skupnega dobra za zadovoljevanje potreb ljudi. Članek raziskuje take pristope z analizo treh nekdanjih vojašnic v Srednji in Vzhodni Evropi: vojašnice Karlo Rojc, danes Družbeni center Rojc (Pulj, Hrvaška), vojašnice Kasárna Karlín (Praga, Češka) in vojašnice 4. julij, danes imenovane Metelkova mesto (Ljubljana, Slovenija). Prispevek proučuje preobrazbo teh opuščenih prostorov v prostore v civilni rabi, kot jih je opredelila Elinor Ostrom v svojih osmih načelih za oblikovanje uspešnih institucij za vire v skupni rabi. S primerjavo študij primerov na podlagi teh načel članek pokaže, kako primeri temeljijo na značilnostih, ki jih lahko približajo pravim sredstvom skupnih virov, in tudi na potencialnih tveganjih, povezanih z dobičkonosno usmerjenim pristopom, ki ga izvajajo tehnokratske koalicije ali koalicije, usmerjene v rast.

Ključne besede: urbano upravljanje, ustvarjanje skupnega dobra, urbana regeneracija

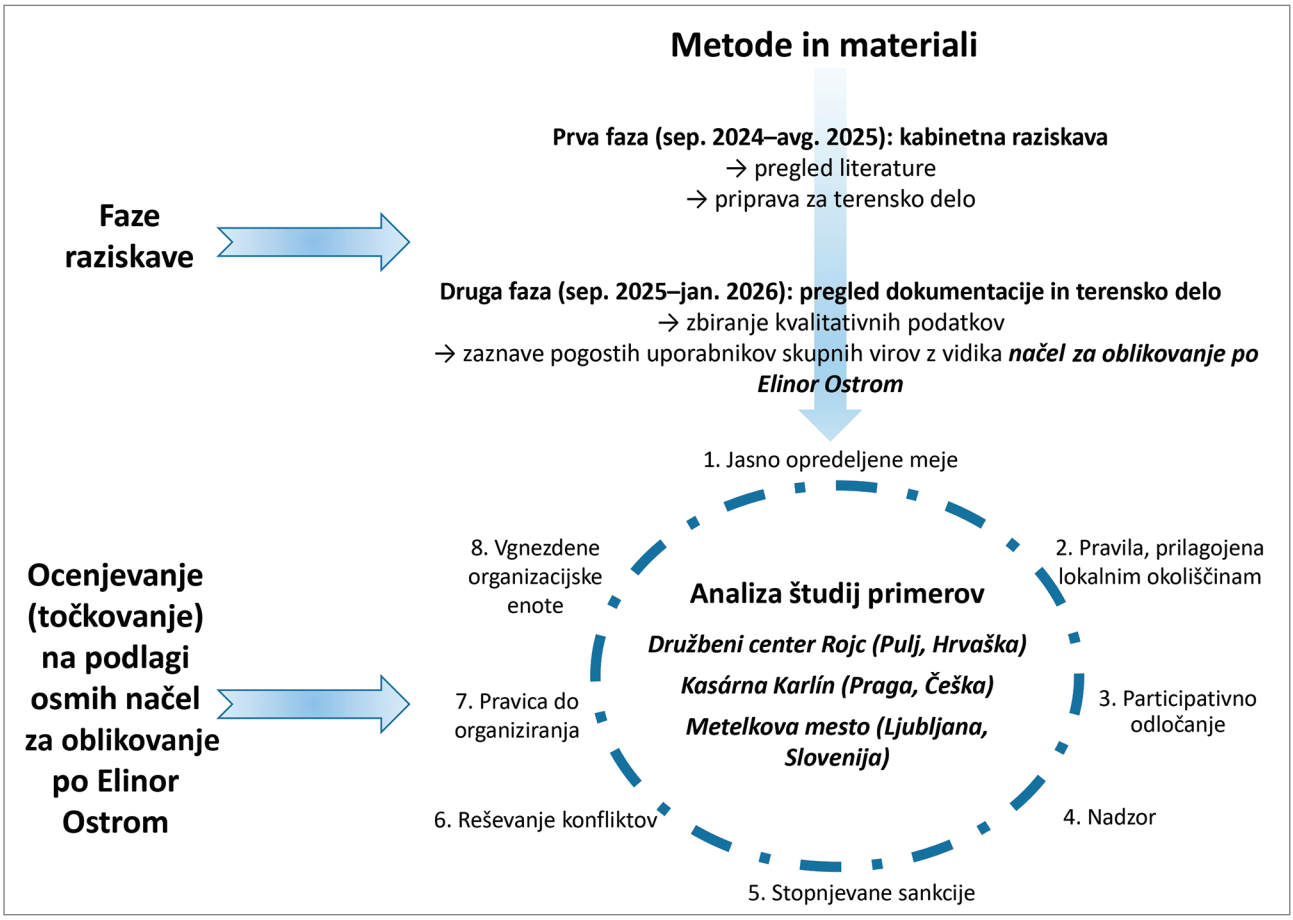
1 Uvod

Preobrazba odvečnih vojaških zemljišč v urbano skupno dobro je trenutno razmeroma neraziskana tema v Srednji in Vzhodni Evropi (regija CEE), vendar se je pojavila kot odziv na težnjo regije CEE, da v sodobnih urbanih prostorih posnema iskanje dobička na Zahodu (Taubenböck idr., 2019), povezano s spornimi pogajanji o prihodnji rabi opuščenih prostorov (O'Callaghan in Di Feliciantonio, 2021). Primer take dinamike je vprašanje ravnanja z nekdanjimi vojaškimi zemljišči. Vojaški umik se ni zgodil zgolj zaradi geopolitike, povezane s hladno vojno, temveč tudi zato, ker so vojaška zemljišča postala priložnost za potencialne špekulacije na presečišču akumulacije kapitala in okoljskega izkoriščanja (Krcho, 2013; Hercik idr., 2014; Glintić, 2015; Jevremović idr., 2021; Peric in Miljus, 2021; Bársony, 2022). To spremljajo nasprotni pristopi k taki usmeritvi v grajenem okolju, na primer neformalne prakse ustvarjanja prostora, ki so se pojavile od prelomnega primera Christianie (Thörn idr., 2011) in zadevajo desetine opuščenih vojašnic v Italiji (Camerin, 2024). Ne le da so potekali skupnostno vodeni ukrepi, temveč so se v nekaterih primerih spremenile tudi odločitve načrtovanja od zgoraj navzdol glede potencialnega ustvarjanja skupnih virov (Camerin, 2021). Vendar je sodobna znanstvena literatura o teh dinamikah skopa in se je večinoma osredinjala na zahodne države, pri čemer analiza držav CEE še vedno ni zadostna. Kljub temu so primeri ljubljanskega Metelkova mesta (MM), puljskega Družbenega centra Rojc (DCR) in praške Kasárne Karlín (KK) v zadnjem desetletju vse bolj pritegnili zanimanje raziskovalcev (glej Ntounis in Kanellopoulou, 2017; Tomašević, 2018; Rodríguez-Barcón in Sousa, 2021). Ti primeri se obravnavajo in analizirajo kot pobude za revitalizacijo, vodeno s kulturo (Ivanc in Petrovic, 2025), zmožne ustvarjati nove finančne prihodke. Kljub naraščajočemu zanimanju za take primere so bili ti z vidika skupnih virov slabo obravnavani, prejšnje študije pa je treba ponovno proučiti, da bi se upoštevale sedanje dinamike. Članek nadgrajuje poskuse uporabe teorije skupnih virov (Saunders, 2014) na posebni vrsti javnega zemljišča (nekdanja vojaška sredstva) z uporabo opredelitve skupnih virov po Elinor Ostrom. Tu opuščeno vojaško zemljišče kot skupni vir obsega opuščeni prostor, ponovna uporaba katerega je sprožena z alternativnimi modeli družbene organizacije, ki jih razvijajo nevladni in civilni akterji (tj. uporabniki skupnih virov, večinoma v obliki nevladnih organizacij, ki razvijajo dejavnosti, povezane z umetnostjo in kulturo, poslovanjem, otroki in mladino, okoljem, psihosocialnim delom, duševnim zdravjem, športom in rekreacijo ter tudi s posebnimi podskupinami, kot so begunci in vojni veterani). Ti akterji si zlasti prizadevajo samoupravljati te vire prek institucij, ki jih ustvarjajo, v poskusu preseganja dihotomije med trgom in državo (Brando idr., 2019). Študija se tako empirično osredinja na nevladne in civilne dejavnosti ponovne uporabe treh opuščenih vojašnic na podlagi osmih načel za oblikovanje po Elinor Ostrom za trajnostno skupnostno upravljanje skupnih virov. S tega vidika se proučujejo razmerje in interakcije med uporabniki skupnega vira in javnimi oblastmi, da bi ugotovili, ali te dejavnosti ustvarjajo bogastvo za lokalne prebivalce, namesto da bi jih nadzorovali zasebni interesi, in določili, koliko je mogoče posamezno študijo primera obravnavati kot skupni vir (Wily, 2011).

2 Načela za oblikovanje po Elinor Ostrom in opuščeno vojaško zemljišče kot uspešen skupni vir

Kot je pred kratkim poudaril Moroni (2025), akademiki iz različnih disciplin, od ekonomije do sociologije, široko prepoznavajo ambivalentnost koncepta skupnega vira. Temeljno delo Elinor Ostrom o institucionalnem modelu analize je osnovno izhodišče te študije, posebna pozornost pa je namenjena osmim načelom za oblikovanje za trajnost upravljanja skupnih virov (Ostrom, 1990: 90, 1993). Ta načela so bistvena za uspešne institucije, ki upravljajo skupne vire, ker naj bi preprečevala čezmerno rabo in se prenašala z ene generacije prilaščevalcev virov na naslednjo. Skupni viri so viri z značilnostmi odštevnosti in težavne izključljivosti, kot so pašniki in splet, ki so lahko v lasti nacionalnih ali lokalnih vlad, skupnostnih skupin ali zasebnikov oziroma korporacij ali jih kot vire odprtega dostopa uporablja kdor koli, ki si lahko pridobi dostop (Dolšak in Ostrom, 2003: 4). Opredelitev meja skupnih virov in določitev oseb, pooblaščenih za njihovo uporabo, »se lahko razume[ta] kot prvi korak pri organiziranju kolektivnega delovanja. Dokler meje virov in/ali določanje posameznikov, ki lahko uporabljajo vir, ostajajo negotove, nihče ne ve, kaj se upravlja ali za koga« (Ostrom, 1990: 91).

Ta načela je mogoče uporabiti pri proučevanju upravljanja nekdanjega kompleksa vojašnic, zasnovanega kot skupno dobro, čeprav je splošno znano, da imajo raziskave Elinor Ostrom različne omejitve. Prvič, Choe in Yun (2017: 117) sta trdila, da ima pojmovanje skupnih virov po Elinor Ostrom »številne omejitve«, ker izključljivost in odvzemljivost obravnava kot fizična ali tehnična atributa. »Izključljivost in odvzemljivost sta družbeno konstruirana atributa, ne fizična ali tehnična. Elinor Ostrom je ta vidik spregledala.« Drugič, po mnenju Blocka in Jankovica (2016: 290–291) so bile raziskave Elinor Ostrom večinoma napačno razumljene, ker »ni odkrila nobene nove oblike upravljanja onkraj zasebne lastnine in državnega nadzora. Namesto tega je obravnavala nekatere zanimive variacije v pogodbeni regulaciji in uveljavljanju pravic zasebne lastnine«. Tretjič, več kot trideset let po izidu njene knjige Governing the Commons iz leta 1990 se je sedanji pristop k skupnim virom



Slika 1: Raziskovalna metodologija (vir: avtorja).

odmaknil od temeljne argumentacije o tem konceptu. Po Elinor Ostrom (1990) tvorijo skupne vire viri, ki si jih skupno prisvaja skupina partnerjev, ki imajo do njih izključno pravico ter lahko vsem drugim posameznikom in skupinam preprečijo dostop do njih in njihovo uporabo. Nasprotno pa je Moroni (2025: 178–180) pred kratkim navedel, da sodobna konceptualizacija skupnih virov kaže, da gre za vire, do katerih bi moral imeti dostop vsakdo, zato bi morali pripadati ljudem kot življenjska nujnost, pri čemer temelji na predpostavki, da do teh dobrin nihče, ne posameznik ne skupina, ne bi smel imeti izključne pravice. Ta značilnost je nasprotje lastništva: posledično so skupni viri izvzeti iz vsakršne tržne logike (Rodotà, 2012; Mattei in Mancall, 2019).

Ob upoštevanju teh vidikov je prejšnja znanstvena literatura o vojaških zemljiščih izhajala predvsem s področja urbanih študij. Vendar je vojaška sredstva z vidika skupnih virov obravnavala nezadostno. Pravzaprav se v vse številnejših raziskavah pristopov k opuščenim vojaškim zemljiščem, ki se osredinjajo na ljudi, poudarja, da je uspešno ponovno uporabo mogoče doseči, kadar dejavnosti v teh krajih in njihov družbenogospodarski vpliv v urbanih okoljih privedejo do blagovne znamke ali spleta funkcij, ki ustvarja določene koristi, zaradi katerih jih lokalne vlade dopuščajo (Rodríguez-Barcón in Sousa, 2021). Taka trditev ne zadostuje za zapolnitev raziskovalne vrzeli, zato je uporaba pristopa Elinor Ostrom koristna, ker je prepoznala, da niso bili vsi skupni viri uspešni in da so se številni skupni viri sesuli. Osem načel za oblikovanje lahko tako pomaga prepoznati univerzalne vzorce za razlago potrebnih pravil za uspešne skupne vire ter proučevanje institucij, ki so v študijah primerov razvile skupne vire, in njihovega delovanja. Elinor Ostrom (1990: 52) deli pravila na tri ravni: na »operativna« (načela od 1 do 5), »pravila kolektivne izbire« (načelo 6) in »pravila ustavne izbire« (načeli 7 in 8). Operativna pravila neposredno vplivajo na vsakodnevne odločitve, ki jih prilaščevalci ali uporabniki skupnih virov sprejemajo glede odvzema enot vira, nadzornih dejanj, zahtevanih informacij ter dodeljevanja nagrad in sankcij za različne izide. Pravila kolektivne izbire posredno vplivajo na operativna pravila in jih prilaščevalci, uradniki ali zunanje oblasti uporabljajo pri oblikovanju operativnih pravil za upravljanje virov. Pravila ustavne izbire določajo, kdo je upravičen, in opredeljujejo merila za oblikovanje teh pravil. Ta tri pravila so koristna za to raziskavo, ker obravnavajo načine, na katere skupnosti uporabnikov skupaj upravljajo skupne vire (npr. z vidika dostopa, odtujitve, izključitve in odvzema). Posledično ta pravila skupaj pokažejo, ali lahko skupnosti uporabnikov trajnostno in pravično samoupravljajo vire, kot so nekdanje vojašnice, ter na kakšen način,

kar ima lahko pomembne posledice za politike (npr. demokratizacija opuščenega javnega območja, zasnovanega kot javni vir, s čimer se potencialno preprečijo privatizacija, komercializacija in omejen javni dostop).

3 Metode in študije primerov

3.1 Metodologija

Izbor študij primerov je izhajal iz dvostopenjske raziskave (slika 1).

Prva faza (od septembra 2024 do avgusta 2025) je obsegala sistematični pregled recenziranih publikacij (priloga 1). Namen je bil kartirati načine ponovne uporabe, na katere so se po koncu hladne vojne uporabljala vojaška zemljišča v regiji CEE, tipologije ponovne uporabe, ki so bile dejansko izvedene, in morebitna spoznanja, ki jih je mogoče iz njih izpeljati, da bi razumeli, ali je obstajal pristop, osredinjen na skupne vire. Ta korak je bil izveden z iskanjem relevantnih publikacij v različnih iskalnikih v angleščini (Web of Science, Scopus in Google Scholar) z različnimi nizi ključnih besed (tj. »commons« ALI »urban commons« IN »military barracks« ALI »military land« in »Central Eastern Europe« ALI »ime države«) v naslovih, povzetkih in ključnih besedah. Iskanje je prineslo petinštirideset publikacij z zelo različnih področij (večinoma arhitekture in načrtovanja, prepletenih z vidiki, kot sta dediščina in krajina), ki obravnavajo opuščene obrambne lokacije. Samo štiri publikacije, napisane v angleščini, so bile kakor koli povezane z vojaškimi zemljišči in skupnimi viri v regiji CEE, zlasti z vojašnicami (Ntounis in Kanellopoulou, 2017; Tomašević, 2018; Rodríguez-Barcón in Sousa, 2021; Ivanc in Petrovic, 2025). Na podlagi navedenih meril je bilo v Googlu izvedeno tudi iskanje literature, prevedene v angleščino, v nacionalnih in lokalnih časopisih. Ta korak je pomagal razkriti, da so bile tri vojašnice v treh večjih mestih obravnavane v skladu z mogočo opredelitvijo skupnih virov.

Druga faza (od septembra 2025 do marca 2026) se je osredinjala na dve glavni nalogi. Prvič, zbrane so bile kvalitativne informacije o študijah primerov s pregledom prostorskih dokumentov, projektov in medijev, povezanih s posamezno lokacijo. Drugič, terensko delo je bilo izvedeno v DCR, MM in KK septembra, oktobra oziroma novembra 2025, pred tem pa je bil vsaka od lokacij obiskana med oktobrom 2018 in januarjem 2019. Terensko delo je vključevalo obisk študij primerov in izvedbo dvajsetih polstrukturiranih intervjujev za vsako lokacijo, da bi dosegli »pomensko zasičenost« (tj. točko, na kateri so globina in teme popolnoma raziskani; Hennink idr., 2017). To je omogočilo razumevanje zaznav o upravljanju in uporabi posamezne lokacije pri štirih različnih skupinah akterjev (po pet intervjuvancev za vsako kategorijo, vsi starejši od osemnajst let in angleško govoreči), ki so bili izbrani po teh merilih:

- uporabniki skupnih virov: s pošiljanjem e-sporočil organizacijam, ki so danes v nekdanjih vojašnicah, pri čemer je bil začetni stik vzpostavljen med terenskim delom med letoma 2018 in 2019;
- uporabniki in obiskovalci vojašnic: z neposrednim intervjuvanjem med terenskim delom leta 2025;
- lokalni prebivalci: s hojo po okolici vojašnic in spraševanjem ljudi, ali so na voljo za intervju;
- predstavniki lokalnih javnih oblasti: s pošiljanjem e-sporočil ali telefonskimi klici lokalnim organom za prostorsko načrtovanje in/ali oddelkom mestnega sveta za načrtovanje, ker so najprimernejša upravna raven za upravljanje nekdanjih vojaških območij. Predhodni stiki so bili vzpostavljeni med terenskim delom med letoma 2018 in 2019.

Namen je bil razumeti mnenja različnih lokalnih akterjev in tako pridobiti širši vidik o zaznavi procesa upravljanja ponovne uporabe od tistih, ki najbolje razumejo logiko skupnih virov (uporabniki skupnih virov), ter drugih, da bi kategorizirane informacije dopolnili z dodatnimi uvidi na podlagi njihovih različnih vlog in položajev v lokalni areni (javne oblasti, uporabniki dejavnosti, ki se izvajajo na posamezni lokaciji, in ljudje, ki živijo v mestu).

Intervjuji so obsegali deset vprašanj o zaznavah po osmih načelih za oblikovanje po Elinor Ostrom (glej prilogo 2):

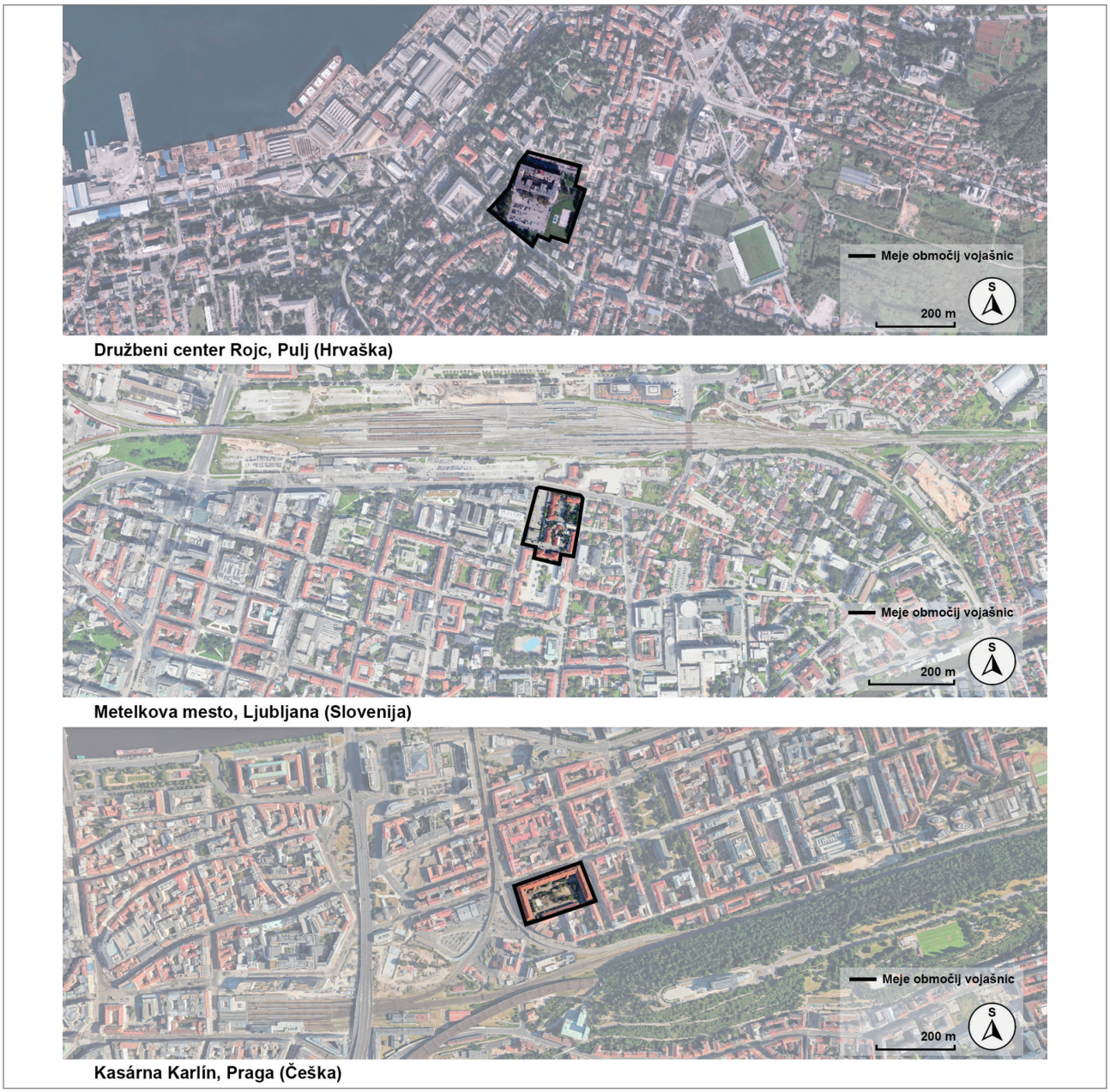
- Načelo 1: Jasno opredeljene meje skupnih virov.
- Načelo 2: Pravila upravljanja je treba sprejeti v skladu s prevladujočim lokalnim kontekstom. Jasno je, da samo en univerzalno uporaben pristop k upravljanju skupnih virov ni dosegljiv.
- Načelo 3: Vzpostaviti je treba participativno odločanje, da bodo ljudje, ki oblikujejo pravila, ta v celoti upoštevali.
- Načelo 4: Nadzor. Ko je vzpostavljen sklop predpisov, so skupnosti odgovorne za oblikovanje učinkovitih mehanizmov izvrševanja.
- Načelo 5: Za tiste, ki zlorabljajo skupne vire, je treba uvesti stopnjevane sankcije.
- Načelo 6: Nemoteno reševanje konfliktov.
- Načelo 7: Podelitev pravnega statusa skupnim virom bi morala olajšati vzpostavitev organizacijskih okvirov.
- Načelo 8: Optimalno delovanje skupnih virov bi bilo treba olajšati z njihovim vključevanjem v obsežnejša omrežja.

Vsak intervju je bil izveden v notranjih prostorih, posnel ga je izvajalec intervjuja, spremljala pa ga je kratka neformalna interakcija s sogovornikom za pojasnitev odgovorov. Skupni čas intervjuja je običajno trajal od petnajst do petindvajset minut.

Preglednica 1: Glavni podatki o študijah primerov

Podatki študije primera	Družbeni center Rojc	Kasárna Karlín	Metelkova mesto
Površina (m^2)	16.739 (+ 29.000 odprtega prostora)	8.400	12.500
Število stavb	1	2	6
Čas gradnje	1882–1911	1840	1870
Leto opustitve	1991	2008	1991
Obdobje ponovne uporabe	1999–	2017–	1993–
Spomeniško zaščitena dediščina	Vse stavbe	Vse stavbe	—
Lastništvo (leto)	Mestni svet (2007)	Ministrstvo za pravosodje (2016) Mestni svet (2024)	Mestni svet (2008)
Od zgoraj navzdol/od spodaj navzgor	Od spodaj navzgor	Od zgoraj navzdol	Od spodaj navzgor

Vir: avtorja.



Slika 2: Okolica treh študij primerov (vir: avtorja na podlagi Google Maps).

Slika 3: Družbeni center Rojc (vir: avtorja).

Etična vprašanja pri obravnavi intervjuvancev so bila rešena v skladu s Splošno uredbo o varstvu podatkov Evropske unije.

3.2 Predstavitev študij primerov

Preglednica 1 in slika 2 predstavljata glavne značilnosti študij primerov: površino, število stavb, čas gradnje, opustitev, ponovno uporabo, status spomeniške zaščite in vprašanja upravljanja (tj. lastništvo in pristopi od zgoraj navzdol/od spodaj navzgor).

Tukaj analizirane lokacije imajo jasno diferencirane značilnosti, razvojne poti in življenjske dobe, čeprav gre za sporne prostore. Po eni strani primera Pulja in Ljubljane kažeta izvajanje neformalnih urbanih rab, ki izzivajo hegemoni nadzor nad urbanim razvojem in prekinjajo uveljavljene agende, ki jih usmerja rast. Praški primer po drugi strani kaže tipično regeneracijo, ki jo usmerja kultura, poganja neprofitni sektor in ki je vzbudila zanimanje nepremičninskega trga za privatizacijo. Medtem ko sta se DCR in MM začela z zasedbo, se je KK začela kot odločitev države od zgoraj navzdol, da spodbuja začasne kulturne ponovne uporabe, zaupane zasebnemu podjetju. Vsi trije primeri delujejo kot neformalni (Ljubljana in Pulj) in formalni (Praga) kulturni centri, ki gostijo dogodke in srečanja lokalnih združenj, posvečene različnim dejavnostim (npr. umetnosti, plesu, glasbi in gledališču). Te pobude so delno preživele zaradi nenavadnih manevrov vpletenih akterjev na državni ravni (ministrstvo za obrambo) ali lokalni (mestni svet in okrožna oblast). Preživele so tudi poskuse preoblikovanja v nove, donosnejše rabe (velik nakupovalni center v primeru MM in večnamenski prostor za KK), ki so bili ustavljeni zaradi zasedbe (DCR in MM) in nedavne podpore prebivalcev (KK).

3.2.1 Vojašnica Karlo Rojc, danes Družbeni center Rojc (Pulj, Hrvaška)

Po umiku vojske iz vojašnice Karlo Rojc leta 1991 je stavba do leta 1997 gostila približno šeststo vojnih beguncev in več humanitarnih organizacij. Nato so lokalne nevladne organizacije (zlasti kulturne, mladinske in okoljske) začele neformalno zasedati lokacijo, kar je mesto Pulj spodbudilo, da je leta 1998 dodelilo prostore več kot tridesetim nevladnim organizacijam. Te organizacije so same financirale prenove in razvile rudimentarno strukturo upravljanja, znano kot Svet Rojca. Do leta 2007 je tam delovalo več kot sto nevladnih organizacij, čeprav so se pojavile napetosti zaradi nepreglednega finančnega upravljanja občinskega podjetja Castrum. Protest leta 2008 je privedel do ustanovitve koordinacijskega telesa DCR zaradi soupravljanja razmerja med uporabniki in občino. Da bi se predstavništvo uporabnikov skupnih virov dodatno institucionaliziralo, je bila leta 2012 ustanovljena Zveza društev Rojc (Savez udruga Rojca ali SUR), ki je izvolila devetnajst predstavnikov uporabnikov za sodelovanje v deljenem upravljanju. Od takrat si uporabniške organizacije prizadevajo za večjo finančno preglednost in izboljšano upravljanje. Njihovo zagovorništvo je prineslo pomembne rezultate, na primer zahtevo, da telekomunikacijska podjetja plačujejo pošteno najemnino za antene na stavbi, kar letno ustvari 35.000 EUR za ponovno vlaganje. Danes je DCR

Slika 4: Kasárna Karlín (vir: avtorja).

primer hibridnega modela upravljanja, ki združuje občinsko lastništvo s soupravljanjem, ki ga vodijo uporabniki (slika 3).

3.2.2 Kasárna Karlín (Praga, Češka republika)

Po umiku vojske leta 2008 se je območje KK večinoma premalo uporabljalo do leta 2017, ko je ministrstvo za pravosodje kot novi lastnik lokalnemu kulturnemu združenju Pražské Centrum (Praški center) odobril začasni najem. Združenje je KK preoblikovalo v kulturno središče, ki gosti širok nabor dogodkov in objektov, vključno s kinom, galerijo, koncertno dvorano in kavarno, pri čemer je vojašnico ohranilo v skoraj izvirnem stanju (slika 4). Organizacija je delovala kot neprofitni subjekt ter prihodke ponovno vlagala v plače, prenove in opremo. Prvotni načrt ministrstva, da lokacijo preoblikuje v sodišče, so do leta 2020 nadomestili alternativni predlogi. Ti so vključevali razvoj študentskih stanovanj, upravnih pisarn in inovacijskega vozlišča. Leta 2024 je bilo lastništvo preneseno na mesto Praga, ki je začelo strateško načrtovanje regeneracije in potencialne spremembe namenske rabe (prenova z mešano rabo, ki združuje kulturne, izobraževalne in komercialne funkcije), hkrati pa so se pojavile napetosti med mestnimi oblastmi, lokalnimi prebivalci in združenjem Pražské Centrum. Junija 2024 je okrožna oblast Praga 8 zaprla dejavnosti kulturnega združenja na podlagi domnevnih kršitev gradbenih predpisov in pritožb lokalnih prebivalcev zaradi hrupa. Kritiki so odločitev izpodbijali in opozorili na čas zaprtja po letih dopustnega delovanja. Čeprav je bilo dvorišče vojašnice leta 2025 začasno ponovno odprto, ostaja dolgoročna prihodnost KK negotova. Sodobni lokalni diskurz to poudarja v okviru splošnega neskladja med kulturnimi pobudami od spodaj, strategijami urbane prenove in strukturami upravljanja, ki od začetka 21. stoletja dajejo prednost javno-zasebnim partnerstvom pri regeneraciji praških degradiranih območij (Pixová, 2013).

3.2.3 Vojašnica 4. julija, danes Metelkova mesto (Ljubljana, Slovenija)

Po osamosvojitvi Slovenije leta 1991 je bilo južno območje vojašnice 4. julija dodeljeno ministrstvu za kulturo, da bi postalo pomemben muzej, severni del pa se je preoblikoval v žarišče alternativne (sub)kulturne produkcije. Nevladne organizacije (zlasti s področja kulture, raziskovanja in civilne družbe) so si sprva prizadevale lokacijo spremeniti v ustvarjalni laboratorij. Vendar je rušenje, ki ga je leta 1993 odredila in vodila vlada, privedlo do zasedbe območja s strani dvesto umetnikov. Kljub poskusom izselitve se je lokacija leta 1995 utrdila kot Avtonomni kulturni center Metelkova mesto (AKC), ki se je večinoma samofinanciral prek kulturnih dogodkov, klubov, ateljejev in nastanitev (tj. Hostel Celica). Prenos lastništva na mestni svet leta 2008 je vključeval zavezo za zaščito uporabnikov. Kljub temu je odnos z AKC ostal prežet s kompleksnostmi, zaznamovanimi s spori glede lastništva, namenske rabe in avtonomije. Čeprav je lokalna uprava okrepila kulturno in turistično vrednost soseske Metelkova, se je AKC takim trendom odločno upiral, da bi ohranil svojo neodvisnost. Konflikti so se stopnjevali v povezavi s trenji, kot so poskusi prodaje Hostla Celica leta 2017 in smernice prostorskega načrta iz leta 2021

Slika 5: Metelkova mesto (vir: avtorja).

za zmanjšanje prostora, namenjenega AKC. Politični premiki leta 2022 so začasno ublažili grožnje po izselitvi, vendar so ponavljajoče se policijske intervencije, incidenti, povezani z drogami, in pritiski urbanega razvoja ohranjali napetosti. Leta 2025 so se pojavila nova tveganja s predlogom za gradnjo zdravstvene ustanove, ki bi posegla v klub Gala Hala, koncertno prizorišče, ki lahko sprejme 350 ljudi. Ne glede na vztrajne zunanje pritiske in krhek odnos z javnimi organi AKC še naprej uveljavlja svoj kulturni in politični pomen ter avtonomijo v Ljubljani (slika 5).

4 Rezultati

To poglavje predstavlja raziskovalne ugotovitve. Poudarjeni so najpomembnejši vidiki, povezani z osmimi načeli za oblikovanje po Elinor Ostrom za vsako študijo primera, ter ugotovitve, pridobljene z intervjuji in pregledom literature.

4.1 Jasno opredeljene meje

Meje DCR so nadzorovane za preprečitev dostopa nepooblaščenim posameznikom ali zunaj odpiralnega časa, razen za 108 različnih organizacij najemnic. Dostop do stavbe (od 7. ure do polnoči) in nadzor sta dobro vzpostavljena s 24-urnim vratarjem na straži ob odprtjih, namenjenih obiskom umetniške galerije ali organiziranim dejavnostim, kot so pogovori, konference in delavnice.

Fizične meje KK so prav tako jasno opredeljene, dostop pa je mogoč skozi glavna vrata na ulici Křižíkova (Křižíkova ulice) 12 med odpiralnim časom za obiskovalce (od 10. do 23. ure). Vendar za uporabnike zunaj odpiralnega časa ni omejitev. Po prenosu lastništva na mestni svet leta 2024 je bila vojašnica KK brezplačno oddana v najem združenju Pražské Centrum (2025), ki samostojno upravlja oblikovanje programov na prostem. Notranji prostori trenutno še vedno niso dostopni, čeprav so dejavnosti na prostem (npr. filmske projekcije in koncerti) dovoljene z nadzorovanim dostopom ob plačilu vstopnine. Zunaj odpiralnega časa je dostop omejen na Pražské Centrum in osebje, najeto za vzdrževalna dela.

MM prav tako določa meje za svoj vhod, vendar ni natančno določenega časa za dostop do območja. Dostop je mogoč skozi vhod na Metelkovi ulici, ki ga ureja ročno upravljana parkirna zapornica pod nadzorom člana aktivistične skupine MM, ali iz Hostla Celica, ki je v nekdanji zaporniški stavbi vojašnice v bližini vhoda.

4.2 Pravila, prilagojena lokalnim okoliščinam

DCR sprejema ustavna in operativna pravila (Tomašević, 2018: 87–88). Sklep o uporabi pisarniških prostorov v DCR opredeljuje vloge, ker je namenjen urejanju administrativnih zadev najema prostora, kot so trajanje pogodbe, obveznosti vlaganja v najete prostore in njihove prenove ter storitve, kot sta poraba elektrike in vode. Dokument Hišni red vsebuje

operativna pravila, ki jih koordinacijsko telo DCR predlaga mestnemu svetu, in določa, kaj je dovoljeno pri vsakodnevni uporabi kompleksa, tudi obiskovalcem. Mestni svet mora na primer dati posebno dovoljenje, da je dogodek po polnoči odprt širši javnosti.

V primeru MM skupnost, ki upravlja lokacijo, to zaseda na robu zakonitosti. Najemniki so v stalnem dialogu s sedanjim lastnikom (tj. mestnim svetom), ki celo financira različne dejavnosti (Culture.Si, 2025). Pravila upravljanja so neformalna in neizrečena, poročil o uradnem dokumentu glede nesprejemljivega vedenja ali stališč pa ni. Kljub temu se pogosto trdi, da živahno nočno življenje v MM povzroča hrup in vandalizem ter uživanje drog in alkohola.

KK ima veliko različnih pravil, zlasti glede upravljanja in recikliranja odpadkov. Poleg tega obstajajo skoraj obvezna priporočila, kot je zahteva, da se hrana in pijača uživata v lokalih (razen za otroke in osebe z zdravstvenimi stanji, potreb katerih meniji ne izpolnjujejo). Namen tega je povečati prihodke, ki nato prispevajo k financiranju dejavnosti (Pražské Centrum, 2025). Dodatni predpisi varujejo mir in tišino za lokalne prebivalce, da bi preprečili potencialne konflikte, ki lahko nastanejo zaradi dejavnosti na zunanjem dvorišču (Kasárna Karlín, 2024).

4.3 Participativno odločanje

Na treh lokacijah je pomen participativnega odločanja majhen, kar je značilno za druga samoupravljana središča po Evropi; to je podobno (vendar v manjšem merilu) Svobodnemu mestu Christiania. Močne ideološke dejavnosti in vrednote, ki jih spodbujajo zasedniki, obiskovalce v vseh primerih, ne glede na to, ali delijo to etiko ali ne, vabijo k spoštovanju članov združenj.

Leta 2011 je participativni proces, ki je vključeval posvetovanja z vsemi uporabniškimi organizacijami, predhodno odobril pravila DCR. Nato so trije člani SUR, ki so del koordinacijskega telesa, pravila DCR predlagali lokalni upravi v končno odobritev (Jakovčić idr., 2013). Ker pa izdatki mestnega sveta financirajo vzdrževanje lokacije v višini približno 200.000 EUR letno, izid participativnega procesa morda ni v celoti upoštevan, če lokalna oblast meni, da je to potrebno.

V primeru MM med uporabniki skupnih virov in mestnim svetom potekajo le neformalni pogovori, vendar ni participativnega procesa za pripravo dokumentov ali sprejemanje odločitev.

Pražské Centrum določa pravila za KK, pri čemer ni participativnega procesa, ki bi vključeval lokalne prebivalce ali sodelujoče organizacije. Nekatera od teh pravil sledijo skrbi za okoljsko trajnost, druga pa odgovarjajo na pritožbe prebivalcev zaradi hrupa. Trenutno so pravila KK del začasnega operativnega načrta, uvedenega po delnem ponovnem odprtju leta 2025, Pražské Centrum (2025) pa še naprej vztraja pri ponovni pridobitvi uporabe notranjih prostorov, ki so še vedno zaprti.

4.4 Nadzor

DCR izvaja različne mehanizme nadzora. Prvič, mestni svet Pulja, ki mu svetuje koordinacijsko telo DCR, zagotavlja, da so vse organizacije na tekočem s svojimi obveznostmi po najemni pogodbi. Drugič, varnostna ekipa in vratar nadzorujeta vsakodnevno uporabo lokacije in zagotavljata spoštovanje pravil. Tretjič, koordinacijsko telo DCR nadzoruje finančno stanje in pravilno uporabo sredstev, trije člani zveze društev DCR, ki so del koordinacijskega telesa, pa nadzorujejo vse spremembe pravil (Tomašević, 2018: 90).

MM je zavrnilo avtoriteto in formalna navodila, njegovo sodelovanje z javnimi organi pa je minimalno, brez kakršnega koli zunanjega nadzora nad njegovimi dejavnostmi in odločitvami. Zasedniki so uvedli horizontalni pristop k upravljanju svojih notranjih zadev, pri čemer spodbujajo demokratične vrednote in sodelovanje vseh svojih članov. Poleg tega se izogibajo vključevanju v odločanje večjega obsega z drugimi deležniki, kar je strategija za ohranjanje njihove avtonomije. To izhaja iz dejstva, da MM poganja politični boj, ki je tesno povezan z urbanimi družbenimi gibanji, ki črpajo navdih iz gibanj za pravico do mesta, da bi se zoperstavila neoliberalizmu, nastajočemu desničarskemu avtoritarizmu, gentrifikaciji in represivnim vladnim ukrepom.

Po ponovnem odprtju maja 2025 je vojašnica KK v okviru zapletenih pogajanj z lokalnimi oblastmi okrepila varnost, zlasti z najemom zunanjega podjetja za uveljavljanje skladnosti s pravili vsakodnevnega delovanja, ki predvsem zadevajo obiskovalce (Pražské Centrum, 2025). Cilj je preprečiti konflikte ali neželeno vedenje, ki bi lahko povzročilo nelagodje lokalnim prebivalcem, s potencialnimi grožnjami za Pražské Centrum pri razvijanju njegovih dejavnosti.

4.5 Stopnjevane sankcije

DCR kaznuje neustrezno uporabo objektov lokacije v skladu z zahtevami najema. Če organizacija dva meseca zamuja s plačilom stroškov komunalnih storitev (npr. elektrike), se storitev prekine, vendar jo je mogoče takoj po plačilu ponovno vzpostaviti. Če zamuda traja štiri mesece, se najemna pogodba nemudoma enostransko prekine, organizaciji pa se prepove prihodnji najem. Druge sankcije zadevajo vsakodnevno uporabo prostorov. Kazni obsegajo formalna opozorila, ki jih izda mestni svet Pulja. Ko so izdana tri opozorila, se pogodba razveljavi, organizaciji pa se prepove prihodnji najem.

Nasprotno KK in MM v svojih notranjih predpisih nimata stopnjevanih kazni, prav tako ni nobenega zapisa o sankcijah. V MM policija ne posreduje, razen v primerih nezakonite dejavnosti. V takih primerih se uporablja slovensko kazensko pravo. V KK se obiskovalce ali sodelavce združenja, ki ne spoštujejo predpisov, pozove, naj nemudoma prenehajo vsako dejavnost, ki krši predpise. V primeru ponavljajočih se kršitev se o tem obvesti policijo, da posreduje, pri čemer se uporabijo kazni, določene po češkem kazenskem pravu. KK tudi prepoveduje vstop tistim, ki povzročajo konflikte.

4.6 Reševanje konfliktov

V DCR je vratar odgovoren za poročanje o konfliktih ali nesoglasjih in njihovo napotitev na koordinacijsko telo DCR, ki je odgovorno za posredovanje pri reševanju konfliktov. Vendar Tomašević (2018: 90–91) navaja, da so imeli primere, v katerih ta postopek ni bil upoštevan. Določene kršitve so bile neposredno prijavljene članom koordinacijskega telesa, ki jih imenuje SUR, čeprav to telo ni odgovorno za reševanje konfliktov.

V primeru MM ni formalnih mehanizmov za reševanje konfliktov, prav tako ni nobenega subjekta, odgovornega za posredovanje pri konfliktih, zato se ti lahko rešujejo z neformalnimi sredstvi, s čimer se izogne nujnosti klica policije. Pritožbe, ki vključujejo obiskovalce, zasednike in lokalne prebivalce, so bile od leta 2018 vložene pri mestnem svetu in policiji, lokacija pa doživlja porast dejavnosti, povezanih z drogami, kljub vključenosti AKC v kampanje proti drogam. Lokalne oblasti so krivdo pripisale AKC, ta pa je lokalne oblasti in policijo pozval, naj se ukvarjajo s kriminalnimi dejavnostmi in vzdržujejo red.

V KK so osebje združenja Pražské Centrum, prostovoljci in varnostno podjetje vključeni v reševanje konfliktov med obiskovalci ali ustavljanje problematičnega vedenja, vendar noben subjekt ni odgovoren za mediacijo in reševanje konfliktov. Podobno kot v DCR lahko, če je oseba, ki povzroča težavo, pripravljena to odpraviti, pride do neformalne rešitve brez vključitve policije.

4.7 Pravica do organiziranja

Pri AKC je v ospredju boj s kulturnimi dogodki, ki jih vodi mestni svet v poskusu ohranjanja urbanih umetniških prostorov za dosego neinstitucionalizirane in neformalne pravice do samoorganiziranja, kar vodi v močno opolnomočenje in skoraj popolno neodvisnost. Te okoliščine lahko pojasni več dejavnikov. Prvič, AKC se upira formalizaciji svoje legitimnosti, hkrati pa ustavlja poskuse izselitve, paralizira predloge rušenja in zavrača ponudbe za preselitev. Drugič, obstaja možnost samofinanciranja s prodajo vstopnic za kulturne dogodke in prek barov. Tretjič, mednarodni ugled MM je privedel do pridobitve močnih organizacijskih pravic. Posledično bi poseganje v njegovo avtoriteto škodovalo ugledu lokalnih oblasti, če bi MM prisilno zaprle, zato raje iščejo način, kako ga tržiti in promovirati kot kulturno in turistično prizorišče (Culture.Si, 2025). Kljub temu je ta pravica strogo povezana z vplivom lokalnih urbanih in kulturnih politik ter interesi mestnega sveta, zato lokalne oblasti običajno ne posredujejo v primerih nepravilnosti in pravnih neskladij niti ne poskušajo razvijati donosnejših rab.

Koordinacijsko telo DCR sestavljajo po trije člani iz zveze društev DCR in mestnega sveta Pulja, kar jasno kaže omejeno priznavanje njegovih organizacijskih pravic s strani lokalnih oblasti. Natančneje, ti člani koordinacijskega telesa so prostovoljci, ki brez kakršne koli koristi prevzemajo veliko odgovornost v smislu soupravljanja (Tomašević, 2018: 94), pri čemer ima mestni svet moč odločanja in je zato odobritveni organ. Tako je zato, ker organizacije, ki delujejo v DCR, nimajo zadostnega financiranja za dosego večje neodvisnosti.

V primeru KK upravljanje prostora v celoti nadzorujejo lokalne oblasti. To se je pokazalo ob njegovem zaprtju junija 2024, ki ga je odredila uprava mestnega okrožja Praga 8 pod pretvezo nezakonite uporabe notranjega prostora, ki ni bil potrjen za uporabo združenja Pražské Centrum niti ni bil po sestavi odobren za njegove namene. Dejansko je trenutno operativno le zunanje dvorišče, ki se je ponovno odprlo maja 2025 po pogajanjih med kulturnim združenjem, mestnim svetom in upravo mestnega okrožja Praga 8, kar je postavilo pod vprašaj upravljanje, ki ga ponujajo javni akterji (ČTK, 2024).

4.8 Vgnezdene organizacijske enote

MM je tipičen primer, kako je mreža lokalnih kulturnih nevladnih organizacij, ki delujejo na lokaciji, skupaj z vzpostavljenim odnosom z mednarodnimi nevladnimi organizacijami sodelovala pri podpori širokemu naboru dejavnosti, ki so se sčasoma razvijale (Popa idr., 2025). Prvotno je Mrežo za Metelkovo sestavljalo več kot dvesto nevladnih organizacij pod vodstvom Gibanja za kulturo miru in nenasilja in Društva ŠKUC (Culture.Si, 2026). Zadnje je bilo ustanovljeno za spodbujanje neprofitnih umetniških dejavnosti in je ena najpomembnejših kulturnih organizacij v Ljubljani (Ministrstvo za kulturo Republike Slovenije, 2023).

Nasprotno pa v DCR pri upravljanju in promoviranju dogodkov v nekdanji vojašnici ne sodelujejo nobene druge institucije iz drugih hrvaških mest ali tujine. To nalogo izvajata mestni svet Pulja in SUR. DCR ni del širše mreže organizacij, čeprav je obstajala priložnost za vključitev v mednarodne mreže drugih nekdanjih vojaških območij v okolici Pulja, zlasti pri projektih,

financiranih s sredstvi EU, kot je FORTIC 2024–2026 pod vodstvom mestnega sveta Pulja (Urošević in Afrić Rakitovac, 2025). Enako velja za KK. Tu razen združenja Pražské Centrum in lokalnih oblasti (tj. uprave mestnega okrožja Praga 8 in mestnega sveta Prage) niso vključeni nobeni drugi subjekti ali organizacije.

5 Razprava

Uporaba pristopa Elinor Ostrom na študijah primerov je poseben poskus razumevanja zasedbe (v primerih DCR in MM) in kulturnih podjetij (pri KK) glede na upravljavsko zmogljivost in odnos z javnimi oblastmi, da bi zagotovili njihovo nadaljnje delovanje v nekdanjih vojašnicah. Poleg tega ta analiza poudarja izzive, povezane z odnosom za ohranjanje dejavnosti uporabnikov, in trenutne grožnje njihovemu obstoju. Uporaba načel za oblikovanje po Elinor Ostrom kaže, koliko je mogoče tri nekdanje vojašnice označiti kot skupne vire.

V DCR se trenutno udejanjajo pravila kolektivne izbire (načelo 6) in operativna pravila (načela od 1 do 5), pravila ustavne izbire (načeli 7 in 8) pa so slabo izvedena. Upravljanje lokacije se še ni razvilo v skupni vir. Za dosego tega je ena od možnosti vključitev drugih institucij v upravljanje lokacije, druga pa vstop v širšo mrežo, ki se ukvarja z opuščenimi vojaškimi zemljišči, saj se zdi, da je mesto Pulj dejavno v tem smislu (Mrđen, 2017). Z vidika participativnega odločanja (načelo 3) odločitve sprejema lastnik lokacije, tj. mestni svet, ki ne spoštuje izidov trenutnega mehanizma participativnega procesa v DCR. Ta vidik se izraža v nezadostni pravici do organiziranja (načelo 7) med uporabniki, ker vsa sredstva prihajajo od mestnega sveta. Očitno je, da DCR ne kaže konvencionalnih značilnosti skupnih virov, predvsem zaradi svoje posebne strukture upravljanja, za katero je značilen sodelovalni pristop k upravljanju, ki vključuje lokalno oblast in tudi skupnost uporabnikov. Ta edinstveni upravljavski okvir je mogoče najbolje označiti kot javno-civilno partnerstvo (Hopman idr., 2021).

MM kaže manjšo implementacijo treh pravil kot DCR. Lokacija še vedno ohranja močen značaj zasedbe (skvotanja) kot samoorganizirani avtonomni center, vendar z nezadostnimi pravili kolektivne izbire. MM se še naprej ne vključuje v kulturne dejavnosti, ki jih vodi mestni svet, ne glede na očitne izzive glede varnosti, neobstoja dovoljenj za bare in prodajo alkohola in davčnih utaj (Rodríguez-Barcón in Sousa, 2021: 634). Te nepravilnosti se še vedno dopuščajo, predvsem zaradi posrednih koristi, ki jih MM ustvarja kot turistična znamenitost. To nakazuje, da ima kulturna znamka te samoupravljane skupnosti posreden vpliv na lokalni proces revalorizacije prek pobud, vodenih s kulturo.
Zdi se, da je KK primer, ki najmanj ustreza skupnim virom. Ugotovitve kažejo, da kulturne dejavnosti, ki se izvajajo v KK, le stežka ustrezajo pristopu skupnih virov, ker ta izkušnja v glavnem izhaja iz pristopa upravljanja tega območja od zgoraj navzdol. Uporabniki skupnih virov izkazujejo manj moči v primerjavi z drugima študijama primerov, ker je bil najem prostorov med letoma 2017 in 2024 odvisen od češkega ministrstva za pravosodje, od leta 2025 pa je odvisen od mestnega sveta. Ustanavljanje združenja Pražské Centrum je kljub prvotni ponudbi triletnega brezplačnega najema naletelo na zamude. Tem je sledil prenos lastništva na mestni svet, ki je dejansko ustavil dejavnosti, ki jih je vodilo združenje. Posledično to ni moglo vplivati na načrtovalske sheme in preusmeriti prioritet mestnega sveta za preoblikovanje območja v novo večnamensko središče.

Pri poskusu primerjave študij primerov si pozornost zaslužijo štirje vidiki. Prvič, te lokacije kažejo boje družbenih akterjev na presečišču zapletenih mehanizmov moči in odnosov javnih akterjev (van der Leer, 2026). Te nekdanje vojašnice poudarjajo, kako dogovori o začasni uporabi in pogajanja o upravljanju izražajo širše napetosti med razvojnimi prioritetami lokalne vlade in skupnostno vodenimi kulturnimi pobudami. Namesto da bi zgolj dokumentirala dogodke, ta študija kaže krhkost sodelovalnega upravljanja, ko začnejo gospodarski interesi prevladovati pri odločanju o kulturnih prostorih. Drugič, tri lokacije se kljub svojemu statusu, ugledu in identiteti soočajo z institucionalnimi omejitvami in negotovostmi. Čeprav njihova ponovna uporaba deluje avtonomno brez dovoljenja, imajo status kulturne dediščine in so nekdanja degradirana območja, preoblikovana za nove civilne rabe z velikim potencialom za javne in zelene prostore, to ni jamstvo, ki bi jih zaščitilo pred potencialnim prihodnjim razvojem ali dobičkonosno usmerjenimi naložbami. Poskus gradnje alternativnih in heterotopičnih krajev kot družbenih sredstev iz opuščenih prostorov ali krajev v stanju prehoda je lahko vodilna os njihovega obstoja, vendar je še vedno tvegan proces. Tretjič in v povezavi s prejšnjo točko je nadaljevanje sedanjih ponovnih uporab podvrženo potencialnim prihodnjim izzivom in celo spremembam, ki izhajajo iz odločanja mestnega sveta o izvajanju donosnejših funkcij. Zdi se, da je najbolj ogrožen primer KK. Njegovo zanašanje na izpogajano legitimnost prek formalnih dogovorov kaže na krhkejšo obliko zasedenosti, ki je odvisna od institucionalnih odločitev in ne od strateškega vzvoda. Kljub svoji vključenosti v sodelovalne upravljavske strukture se je združenje Pražské Centrum znašlo v položaju, v katerem ni moglo vplivati na odločitve o namembnosti po tem, ko je mesto preusmerilo svoje prihodnje razvojnonačrtovalske prioritete. V nasprotju s pobudami DCR in MM od spodaj navzgor je bil KK legitimiran s pravno kodifikacijo in ne z dejanji uporabnikov za ohranitev njihove prisotnosti, čeprav so njihove kulturne dejavnosti v mestu široko prepoznane kot relevantne. Nazadnje, ne glede na to, ali gre za zasedbo ali začasno kulturno uporabo, trije primeri kažejo, da so njihovim mestom primanjkovali ustrezni prostori

za alternativno kulturo, zlasti za mlade in podskupine. V vseh treh primerih je bil najden prostor za delavnice in predstave ter dom za glasbenike, aktiviste in umetnike, čeprav je nezakonit prevzem propadajočih vojaških območij v Ljubljani in Pulju povzročil razburjenje. Praški primer je drugačen zaradi začetne pripravljenosti za sklenitev dogovora z združenjem Pražské Centrum, ki je sčasoma legitimiral njegov obstoj. Kljub temu je razlika med primeroma v Ljubljani in Pulju v primerjavi s Prago v tem, da imajo uporabniki lokacije v prvih dveh moč in voljo za spodbujanje pobud od spodaj navzgor, v katerih se umeščajo na višjo raven upravljavske strukture (Niranjan, 2015).

Uporaba načel za oblikovanje po Elinor Ostrom ima tudi omejitve. Kot so poudarili njeni kritiki, sta zanašanje na delovanje posameznikov v mikroravenskem kontekstu ter nezmožnost prepoznavanja širšega političnega in gospodarskega konteksta, v katerega so vpeti skupni viri, dejavnika, ki spodkopavata uporabo njenih načel. Zato bi morale nadaljnje raziskave uporabiti razširjen geografski obseg, ki bi dosegel vsaj raven soseske. Ta pristop bi moral omogočiti celovitejše razumevanje širših trendov ter načina, kako so lokalne urbane in kulturne politike skozi čas vplivale na zgodovinske dejavnosti in jih usmerjale. Prihodnje raziskave lahko sprejmejo tudi drugačno strategijo vzorčenja, vključno s tem, kako izbrati intervjuvance in merila za izbiro, s kodiranjem za numerično oceno zaznav akterjev o upravljanju in ponovni uporabi lokacije. Nazadnje je mogoče analizirane primere obravnavati kot pilotne projekte, preizkusna okolja ali žive laboratorije za spodbujanje inovativne institucionalne zmogljivosti v drugih primerih, tudi v tujini (Mazzucato, 2016). To se lahko zgodi z upoštevanjem ambicioznih smernic mednarodnih organizacij, kot so Združeni narodi in Evropska unija, z njihovimi različnimi potmi naprej za doseganje bolj enakopravne, trajnostne in odporne družbe (npr. prek njihovih ciljev trajnostnega razvoja, urbanih in skupnostnih agend ter Evropskega zelenega dogovora).

6 Sklep

Tema, obravnavana v tem članku, je aktualna zaradi intenzivne urbane preobrazbe (sub)kulturnih prostorov v sodobnih mestih, pojava, ki ga je mogoče pripisati več učinkom kulturnega in družbenogospodarskega prestrukturiranja družb. Delna uporaba načel za oblikovanje po Elinor Ostrom je za tri primere informativna iz naslednjih razlogov. Ugotovitve kažejo, da teh lokacij ni mogoče v celoti razlagati kot prave skupne vire. Vključeni nevladni in civilni akterji različno zagotavljajo alternativne modele družbene organizacije in se tako odmikajo od zanašanja na javno-zasebno sodelovanje, vendar lokacij ne samoupravljajo prek ad hoc institucij (kadar so ustvarjene). Poleg tega analiza študij primerov kaže nezadostno vlogo jasno opredeljenih lokalnih skupnosti pri upravljanju virov zaradi različnih razlogov (npr. z vidika kolektivno dogovorjenih pravil in kaznovalnih sankcij za tiste, ki jih kršijo) (Albareda in Sison, 2020).

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Zahvale

Federico Camerin je to raziskavo izvedel v okviru raziskovalnega projekta Vojaške nepremičnine v Evropi: strategije regeneracije in njihovi učinki na procese družbeno-prostorske produkcije (Military Properties in Europe: Regeneration Strategies and Their Effects on Socio-Spatial Production Processes) (štipendija Ramón y Cajal RYC2022-037235-I), ki ga financira špansko ministrstvo za znanost, inovacije in univerze prek nacionalne agencije za raziskave 2021–2023 (2021–2023 National Research Agency) v okviru nacionalnega načrta za znanstvene in tehnične raziskave ter inovacije (National Plan for Scientific, Technical, and Innovation Research), sofinancira pa ga ESS+.

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Vloge avtorjev pri raziskovalnih rezultatih: Federico Camerin (FC) 50 % in Arturo Vicente Ruiz (AVR) 50 %. Konceptualizacija: FC; kuriranje podatkov: AVR; formalna analiza: FC; pridobivanje financiranja: FC; raziskava: FC in AVR (enako); metodologija: FC in AVR (enako); administracija projekta: FC; sredstvo: AVR; programska oprema: AVR; nadzor: FC; validacija: AVR; vizualizacija: AVR; pisanje – izvirni osnutek: FC in AVR (enako); pisanje – pregled in urejanje: FC in AVR (enako).

Izjava o dostopnosti podatkov

Podatkovni niz, ki podpira ugotovitve te študije, je javno dostopen v institucionalnem repozitoriju Univerze v Valladolidu UVaDOC: priloga 1 za sistematični pregled literature: https://uvadoc.uva.es/handle/10324/84037; priloga 2 za vsebino intervjujev: https://uvadoc.uva.es/handle/10324/84039.

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Regenerative urban transformation in urban planning: A systematic review of key themes and planning implications

Regenerative development has gained prominence as an ecological paradigm in urban planning; however, its integration into urban transformation processes remains conceptually fragmented and uneven in practice. This study examines how regenerative development is framed within discussions on urban transformation, with a particular focus on its implications for planning systems and policymaking. A systematic literature review, guided by PRISMA protocols, identified thirty-eight peer-reviewed articles indexed in Scopus, which were coded using MAXQDA and analysed through reflexive thematic analysis. The findings reveal five interrelated dimensions of regenerative urban transformation (RUT): underlying rationales, key components, implementation challenges, modes of integration into urban planning, and evaluation approaches. The literature positions RUT as a response to the unsustainability of dominant urban models that degrade ecosystems and increase climate vulnerability. Core components – such as circular economy principles, public participation, adaptive reuse, and digital technologies – are widely acknowledged but often addressed as isolated interventions rather than integrated planning mechanisms. Key challenges include limited social acceptance, financing constraints, behavioural change requirements, and weak institutional coordination. Although integration into urban planning is commonly framed through alignment with sustainable development strategies and ecosystem services, persistent gaps remain in governance alignment and policy coherence. The study concludes that current assessment tools suffer from limited scale adaptability and weak links to planning and policy decision-making, constraining the practical evaluation of RUT.

Keywords: regenerative development, regenerative urbanism, urban regeneration, circular city, reflexive thematic analysis

1 Introduction

Cities are settlements at the heart of global production and consumption dynamics. Climate change, one of today's most critical environmental issues, and the various negative consequences arising from this change are primarily driven by urbanization processes. For example, problems such as increasing carbon emissions, the unsustainable use of natural resources, and the degradation of ecosystems are directly related to pressures exerted by cities.

The United Nations Sustainable Development Goals also emphasize that transforming cities into more liveable and resilient structures is possible by reducing the effects of climate change on urban areas and restructuring these spaces to adapt to climatic changes (United Nations, 2025). Cities that are particularly vulnerable in terms of infrastructure are under serious threat from climate-related risks, such as heatwaves, urban floods, extreme weather conditions, and drought. The regenerative development approach, which aims to mitigate the adverse effects of climate change and create resilient urban structures, is considered a key planning paradigm that has gained significance in recent years (Sala Benites et al., 2023).

One of the leading solutions proposed to address the problems of urban sprawl caused by urbanization is the re-evaluation of urban areas that are physically and functionally degraded, worn out, or derelict. This process, referred to in the literature as "urban transformation" or "urban renewal", offers various opportunities that allow not only spatial restructuring but also the holistic reconfiguration of urbanization. The "integrated urban transformation" approach, as defined in the Toledo Declaration (European Union, 2010), is noteworthy. This approach envisages transforming urban transformation processes from fragmented, narrow-scope applications into a planned, strategic process that approaches cities from a holistic perspective and considers their components as integral parts of the urban metabolism (LopezDeAsiain & Díaz-García, 2020).

Urban regeneration projects are of strategic importance due to their potential to inform future resource use models and contribute to shaping urban infrastructure over a period of approximately thirty years (Roberts & Sykes, 2000; UN-Habitat, 2016). However, examining current practices reveals that the vast majority of these focus solely on physical renewal and do not sufficiently consider the ecological dimension in the analysis, design, and implementation phases (Couch et al., 2011). Specifically, from an urban ecology perspective, this narrow focus limits the integration of ecological considerations, thereby constraining the potential of urban transformation processes to generate benefits such as ecosystem restoration, biodiversity enhancement, and improved ecosystem service provision (Alberti, 2008).

Urban regeneration has traditionally referred to the physical, economic, and social revitalization of declining urban areas through redevelopment and place-based investment strategies (Roberts et al., 2017). Although urban regeneration policies – often centred on physical redevelopment, economic revitalization, and place-based improvements – have increasingly incorporated sustainability considerations, they have largely remained focused on enhancing existing urban conditions, rather than reconfiguring the underlying relationships between urban systems and ecological processes (Roberts et al., 2017; Couch et al., 2011). In contrast, regenerative development adopts a systems-oriented perspective that seeks not only to minimize environmental harm but also to restore and enhance the regenerative capacity of socio-ecological systems. Within urban contexts, this perspective has given rise to the concept of regenerative urbanism, which frames cities as active agents capable of producing net-positive ecological and social outcomes in the Anthropocene (Thomson & Newman, 2020). This perspective differs from resilient urbanism, which primarily emphasizes the capacity of urban systems to adapt to disturbances and maintain functionality under conditions of uncertainty and environmental stress (Davoudi, 2014). In contrast, regenerative approaches extend beyond resilience by prioritizing ecological restoration, ecosystem function enhancement, and systemic transformation (Davoudi, 2014; Thomson & Newman, 2020).

Therefore, this study examines how regenerative urban transformation (RUT) is conceptualized and integrated into urban transformation processes, with a particular focus on its implications for planning frameworks, governance structures, and policy-oriented decision-making. By synthesizing fragmented conceptual and methodological discussions through a systematic literature review, the study clarifies how RUT can inform planning practice. To address this objective, the study is guided by the following research questions: 1) What are the fundamental rationales behind RUT? 2) What are the key components of RUT? 3) What are the challenges encountered in the RUT process? 4) How can RUT be integrated into urban planning? 5) How can the success of RUT be measured?

2 Methodological approach

2.1 Research design

In the data collection phase, a systematic literature review was conducted following PRISMA guidelines, consisting of

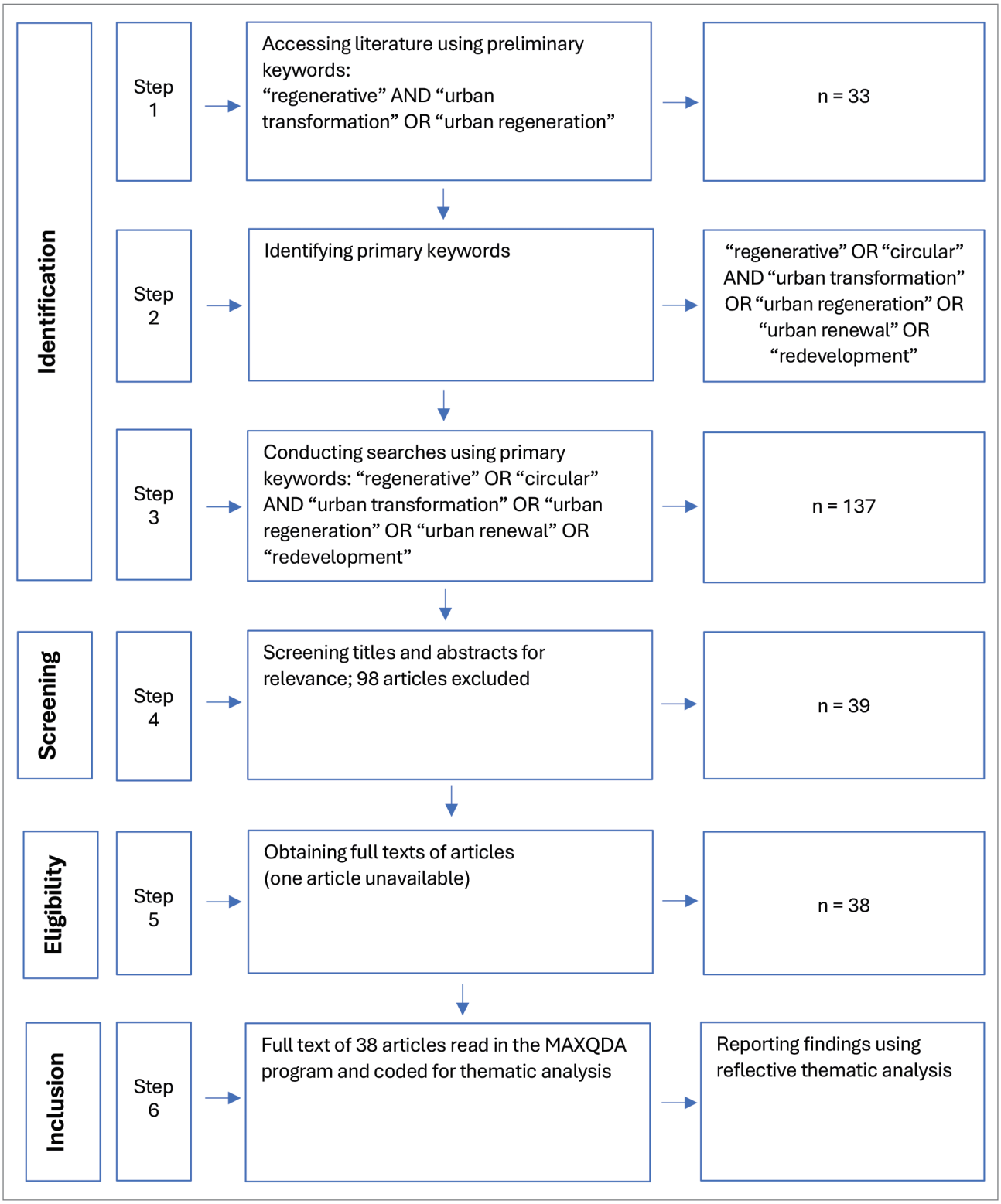

Figure 1: Stages of the systematic literature review process for the study (based on the PRISMA flow diagram).

four stages: identification, screening, eligibility, and inclusion (Moher et al., 2009; Page et al., 2021). The full texts of the selected articles were then accessed and coded using MAXQDA software. The coded material was analysed using reflexive thematic analysis, allowing the identification of patterns of meaning across the dataset (Braun & Clarke, 2021). The results are presented in the section on research outcomes.

2.2 Data collection

A six-step method was employed to structure the data collection and analysis stages of the systematic literature review process (Figure 1). Within this scope, access to relevant literature was first retrieved from the SCOPUS database using preliminary keywords representing the research. The articles retrieved were reviewed, and new keywords selected from these articles that strongly represented the research were added to the research sequence to form the final search strategy for the study. In the next step, a new SCOPUS search was conducted using this final search strategy. The authors reviewed the titles and abstracts of 137 articles to assess their relevance to the study scope, and ninety-eight articles were excluded based on criteria such as lack of relevance to urban planning, non-peer-reviewed publication types, and insufficient engagement with regenerative approaches. Of the thirty-nine articles considered, only one article was inaccessible, and the full texts of thirty-eight articles were archived.

The SCOPUS database search was conducted on 2 March 2025. The criteria considered for including or excluding articles from the study are as follows:

1. Publication in journals indexed in the SCOPUS database: the literature review was conducted using the SCOPUS indexing platform.
2. Publication type as "article": publications that had not undergone a peer-review process were excluded from the study.
3. Publication language "English": publications written in languages other than English were excluded from the study.
4. Article publication date before 31 December 2024: because the final literature review was conducted in early 2025, this date restriction was applied; however, no start date restriction was imposed because the concept of regeneration emerged relatively recently in urban planning literature.
5. Relevance to urban planning: because the concept of regeneration appears in multiple disciplines, the SCOPUS literature search was limited to the subject areas of environmental science and social sciences, which encompass urban planning research.

2.3 Data analysis

Following access to the full texts of the thirty-eight articles, all studies were systematically imported into MAXQDA software and subjected to an iterative coding process. In the first phase, initial codes were generated inductively by closely reading the texts and identifying recurring concepts, arguments, and analytical emphases related to regenerative urban development and urban transformation. In the second phase, these initial codes were reviewed, compared, and clustered based on conceptual similarity and theoretical relevance, rather than on their frequency of occurrence.

Through this process of abstraction and refinement, broader patterns of meaning were identified, leading to the development of five main themes and their corresponding sub-themes. These themes represent analytically constructed categories that synthesize the key dimensions emphasized across the literature reviewed. The resulting thematic structure and its components are presented in Table 1. Detailed supporting data are available in the repository (Başcan Yüce & Tezer, 2026).

It should be noted that Table 1 is structured to distinguish between themes derived directly from the thematic analysis and additional sub-themes developed during the discussion phase. The main themes and sub-themes presented in the results section emerged inductively from the reflexive thematic analysis of the literature reviewed and represent patterns of meaning explicitly identified within the dataset.

In contrast, the sub-themes presented under the discussion section were not directly generated through the coding and thematic analysis process. Instead, these themes were developed interpretively by synthesizing the analytical findings with broader theoretical discussions and gaps identified in the literature. Their inclusion aims to extend the analytical framework by highlighting conceptual dimensions that were underrepresented or absent in the studies analysed but are critical for the effective integration of RUT into planning practice. Accordingly, these discussion-based sub-themes should be understood as conceptual propositions rather than empirical findings.

2.4 Methodological limitations

Despite the systematic approach adopted in this study, several limitations should be acknowledged. First, the literature search was conducted using the SCOPUS database, which, although widely recognized as one of the most comprehensive academic indexing platforms, may not include all relevant publications available in other databases. Second, the review focused on English-language publications, potentially excluding relevant studies published in other languages. Third, as with many systematic literature reviews employing qualitative thematic synthesis, the identification and interpretation of themes involve a certain degree of researcher interpretation. To mitigate this limitation, the coding and thematic categorization process was conducted systematically and iteratively to ensure consistency and transparency in the analytical framework. Despite these

Table 1: Themes and sub-themes of regenerative urban transformation identified through reflexive thematic analysis.

Sub-theme	Main themes				
	1. Rationale	2. Key components	3. Challenges	4. Integration into urban planning	5. Evaluation
1	Unsustainability of the current urban planning model	Circular economy principles	Complexity and need for interdisciplinary approach	Integration into sustainable urban development strategies	Assessment tools and indicators
2	Excessive destruction of ecosystem services	Use of participatory and collaborative planning approaches	High investment requirements	Integration of ESs into the planning system	—
3	Need to increase urban resilience against climate change	Adaptive reuse	Behaviour change and social acceptance	Site-specific design and urban experiments	—
4	—	Use of digital technologies	—	—	—
Additional	Technological developments and smart city applications	Capacity for cross-system integration	Misuse of technology	Institutional governance and policy alignment	Data collection capacity, scale adaptability, technology integration

Source: authors.

limitations, the study provides a comprehensive overview of the emerging discourse on RUT and offers a structured basis for future empirical and theoretical research.

3 Research outcomes

The thematic analysis of the literature reviewed revealed five main themes that structure the conceptual and practical dimensions of RUT. These themes and their associated sub-themes provide a structured overview of how the literature conceptualizes the rationale, components, challenges, integration into urban planning, and evaluation of RUT. The resulting thematic structure and its associated sub-themes are presented in Table 1.

3.1 Main theme: The rationale for RUT

The first of the three rationales identified within the scope of RUT is the unsustainability of the current urban planning model. The literature documents that problems such as the excessive consumption of non-renewable resources (Balletto et al., 2022; Domenech & Borrion, 2022; Girard & Nocca, 2020), waste production (Williams, 2019), pollution (Acri et al., 2021; Valenzuela et al., 2018; Lewin, 2013), and contributions to climate change (Boeri et al., 2022) collectively demonstrate the limitations of prevailing urban planning practices. Several studies further indicate that existing urban planning and governance systems exhibit limited capacity to address significant challenges related to environmental, economic, and social degradation (Nowakowska & Grodzicka-Kowalczyk, 2019). The literature increasingly emphasizes the need to reconsider prevailing development models and discusses alternative frameworks that can integrate ongoing urban change processes into planning systems (Herranz-Pascual et al., 2023). Moreover, previous urban sustainability approaches have been widely reported to be insufficient in ensuring active citizen participation, reducing poverty, preventing food insecurity, and effectively managing inequality in urban areas. In response to these limitations, regenerative urban planning is discussed in the literature as offering a strategic orientation toward the development of sustainable, healthy, and liveable cities (Sala Benites et al., 2023).

The second rationale identified within the scope of RUT concerns the excessive degradation of urban ecosystem services (ES). Previous studies indicate that urban expansion and human activities exert significant pressure on natural ecosystems, leading to the degradation and loss of ES within cities (Nesticò et al., 2022; Caratelli et al., 2019). Cities are further described as spaces where natural systems are displaced, with remaining urban nature often transformed into highly modified ecosystems (Thomson et al., 2022). Empirical evidence from Al-Ain illustrates this dynamic: prolonged intensive agriculture, urban development, and livestock farming have contributed to groundwater depletion, rendering aquifers non-renewable and undermining ecosystem services (Caratelli et al., 2019). These findings point to the limitations of conventional urban water

management approaches and reinforce the relevance of regenerative perspectives within urban planning. RUT is framed as an approach that seeks to reconnect urban areas with ecological systems, support ecosystem revitalization, and reduce further ecological degradation associated with urban use.

The third rationale identified within the scope of RUT relates to the need to enhance urban resilience in the context of climate change. Cities are widely described in the literature as being particularly vulnerable to climate-related impacts, which has focused increasing attention on resilience as a key concern in urban development discussions (Intergovernmental Panel on Climate Change, 2022; UN-Habitat, 2020; Meerow et al., 2016). Studies emphasize that addressing climate-related risks requires sustainable and innovative approaches that integrate social, economic, and physical dimensions of the built environment (Ahern, 2011; Bühler et al., 2024; Elmqvist et al., 2019; Sala Benites et al., 2023).

3.2 Main theme: Key components of RUT

Four sub-themes were identified as the key components of RUT. The first sub-theme concerns the principles of the circular economy. Cappellaro et al. (2019) frame circular urban transformation as an approach that promotes the use of renewable resources and supports the continuous circulation of materials through closed-loop systems. The same authors also emphasize that such systems contribute to the optimization of resource use and are associated with reductions in carbon emissions and pollution levels.

Nowakowska and Grodzicka-Kowalczyk (2019) argue that planning cities according to circular principles is associated with enhanced levels of self-sufficiency and renewability. Viglioglia et al. (2021) and Balletto et al. (2022) discuss circular economy principles as having the potential to be integrated across multiple urban functions when urban problems are addressed from a regenerative perspective. Williams (2019) presents empirical examples, such as organic waste recycling and energy recovery practices, illustrating how circular resource management can reduce pressures on ecosystem services and contribute to the development of regenerative urban systems. Cappellaro et al. (2019) report that cities adopting circular economy planning principles support sustainable growth and strengthen self-renewal capacities through the coordinated management of resource consumption and waste production processes. Valenzuela et al. (2018) provide quantitative evidence from case studies, showing that cities managed according to circular economy principles have achieved substantial reductions in waste generation, with reported decreases from 100% to 21.5% and further reduction potentials of up to 3.5%.

The second key component of RUT identified in the literature is the use of participatory and collaborative planning approaches. Bayulken and Huisingh (2015) and De Medici et al. (2018) emphasize that RUT processes are characterized by the involvement of multiple stakeholders, including residents, civil society organizations, the private sector, and public institutions. These authors further highlight that collaboration among these actors is closely associated with the effectiveness of regenerative processes. Participatory processes implemented in ecological and social contexts are discussed as mechanisms that encourage stakeholders to assume responsibility and foster cultures of cooperation (Bayulken & Huisingh, 2015; De Medici et al., 2018). LopezDeAsiain and Díaz-García (2020) report that flexible evaluation processes that facilitate interaction between expert knowledge and local knowledge support the development of context-specific regenerative solutions. LopezDeAsiain and Díaz-García (2020) also indicate that the initial step in participatory planning involves developing actor maps that identify relevant stakeholders and reflect their social, economic, and political dimensions.

Sala Benites et al. (2023) further underline that participatory processes in RUT are most effective when they are designed to include all relevant and representative stakeholders, rather than functioning as consultation mechanisms serving specific interest groups. LopezDeAsiain and Díaz-García (2020) emphasize the importance of establishing trust among stakeholders, Ricci (2022) highlights the need for participation tools adapted to local contexts, Girard and Nocca (2020) discuss the role of spaces that enable communities to generate innovative responses during periods of crisis, and Trzcińska (2021) focuses on understanding the actual needs of users.

The third fundamental component of RUT is adaptive reuse. Nowakowska and Grodzicka-Kowalczyk (2019), Petruskeviciute (2019), Williams (2019), and Iodice et al. (2020) describe adaptive reuse as encompassing multiple dimensions, including urban resource conservation, waste reduction, the revitalization of vacant and derelict urban areas, the preservation and reuse of cultural heritage, and support for climate change adaptation processes. From a regenerative perspective, Petruskeviciute (2019) frames adaptive reuse as requiring an understanding of urban areas as dynamic and living systems. Ricci (2022) presents empirical examples from integrated renovation projects implemented in Poland, showing how the adaptive reuse of underutilized buildings and spaces can contribute to the revitalization of unsafe areas, enhance their social and cultural functions, and improve urban quality while preserving historical heritage. Ricci (2022) further highlights that the cyclical re-evaluation of vacant properties and the repurposing of underutilized buildings can generate social

benefits, including employment opportunities and enhanced service provision.

The fourth fundamental component identified within the scope of RUT is the use of digital technologies. Franchino et al. (2022) examine the use of digital technologies in the RUT process, particularly in relation to environmental impact assessment and information provision, and Viglioglia et al. (2021) focus on their role in scenario simulation and planning support. They further discuss how digital technologies can support resource efficiency by facilitating the adoption of regenerative behaviours and allowing urban systems to operate more efficiently.

Viglioglia et al. (2021) associate digital tools with managing the complexity of circular economy processes and improving efficiency across design, construction, and operational phases, and Franchino et al. (2022) emphasize the role of digitalization in the restoration and renewal of urban heritage. Empirical applications of digital tools further illustrate these dynamics. For instance, the Building Information Modelling (BIM) software developed and tested in an Italian case study made it possible to identify buildings' ecological impacts at the design stage through digital modelling, allowing for design revisions that reduce ecological damage (Franchino et al., 2022). Such digital tools, implemented at different spatial scales, could contribute to more informed and efficient decision-making processes by allowing the comparison of planning scenarios and associated environmental impacts.

3.3 Main theme: Challenges in the RUT process

The literature consistently identifies complexity as a central challenge in the RUT process, emphasizing that RUT is inherently interdisciplinary in nature. This complexity arises from the need to establish effective interaction within urban systems composed of multiple socio-technical structures, including the joint production of new forms of knowledge, the adaptation of institutional frameworks, and the coherent coordination of these processes (Gianfrate et al., 2020). Della Spina (2019) points to the difficulty of achieving stable interactions between local resources and settlement identity through synergies among the spaces, functions, and actors involved in RUT processes. Because regenerative actions simultaneously engage geographical, administrative, ecological, and social systems, Gianfrate et al. (2020) characterize RUT as a governance-intensive process that requires strong coordination, facilitation, and management capacities. Newton and Frantzeskaki (2021) demonstrate that interdisciplinary collaboration is essential for addressing complex urban challenges. At the same time, Thomson et al. (2022) caution that interdisciplinary work may reproduce siloed forms of knowledge if not carefully structured, potentially constraining its transformative potential.

A second sub-theme widely discussed in relation to challenges in the RUT process concerns financing. Girard and Nocca (2020) emphasize that RUT projects are typically associated with high initial investment requirements, rendering financial feasibility a persistent concern. They further argue that persuading policymakers, private actors, and the public to invest in regenerative transformation remains difficult, despite the increasing promotion of public–private partnerships and innovative financing mechanisms. They also highlight that this challenge is intensified by the limited availability of analytical tools capable of demonstrating the multidimensional benefits of regenerative approaches. Bayulken and Huisingh (2015) emphasize the strategic role of public finance and incentive mechanisms in mobilizing private investment and supporting regenerative urban development. Empirical evidence from France, for example, illustrates how housing cooperatives involved in urban transformation initiatives have leveraged their scale and institutional reliability to secure long-term loan arrangements, thereby increasing financial flexibility for residents (Trzcińska, 2021).

The final sub-theme associated with challenges in the RUT process relates to social behaviour and perception. Beyond physical transformation, the literature increasingly recognizes that RUT is closely linked to shifts in everyday practices, lifestyles, and value systems. Regenerative approaches are framed as requiring a systems-oriented perspective that accounts for entire life cycles and foregrounds alternative modes of production and consumption (Domenech & Borrion, 2022). Boeri et al. (2022) argue that legislative and policy measures alone are insufficient to achieve climate neutrality, and they emphasize the necessity of behavioural change at individual, collective, and institutional levels, supported by participatory processes that foster environmental citizenship and climate justice. Empirical studies suggest that awareness-raising strategies – ranging from symbolic interventions to community-based practices – can positively influence behavioural change and social acceptance of regenerative approaches (Boeri et al., 2022). For instance, evidence from Italy indicates that circular economy practices, including community gardens, collaborative initiatives, and local production facilities, have contributed to positive shifts in social behaviour (Cappellaro et al., 2019). Conversely, other studies argue that, although administrative interventions may temporarily influence individual behaviour, such changes are unlikely to be sustained without the support of knowledge-based technological infrastructures (Newman, 2020). Accordingly, recent research highlights the potential of digital tools and interactive mechanisms – such as gami-

fication, coaching, and real-time feedback – to accelerate behavioural change and reinforce traditional knowledge-based strategies (Viglioglia et al., 2021).

3.4 Main theme: Integration of RUT into urban planning

The literature increasingly frames the integration of RUT into sustainable urban development strategies as an important dimension of embedding regenerative principles within urban planning practice. Existing studies suggest that such integration is closely associated with the need to engage with the complexity of existing urban fabrics, including structural, social, and ecological dimensions (Franchino et al., 2022; Viglioglia et al., 2021; Bayulken & Huisingh, 2015).

Applied urban regeneration studies further emphasize the importance of collaborative and multi-actor frameworks in embedding sustainability principles into planning processes (Idrizbegović Zgonić et al., 2024). Girard and Nocca (2020) describe urban planning as a key instrument for shifting urban organization from linear development models toward more circular and regenerative configurations. Fabi et al. (2021) and Girard and Nocca (2020) highlight that the adoption of holistic planning approaches addressing social, economic, and environmental dimensions, together with the incorporation of sustainable development goals and strategic planning frameworks, is a foundational step in integrating regenerative strategies into urban planning processes. Bellato et al. (2024) emphasize that regenerative approaches, particularly in tourism-oriented contexts, can support place-based transformation processes through multi-actor collaboration and the regeneration of social–ecological systems.

The literature also highlights the challenges associated with linking complex processes across different urban fabrics. Viglioglia et al. (2021) describe these challenges as requiring in-depth analysis of existing urban problems and structural complexities, as well as sustained collaboration among experts from diverse disciplinary backgrounds. Petruskeviciute (2019) and Cappellaro et al. (2019) emphasize the protection and enhancement of natural systems as an integral component of sustainable urban development strategies. They further argue that the weakened relationship between urban populations and urban ecologies can be strengthened through the expansion of green spaces and the reintegration of nature into the city, supported by practices such as community gardens and other nature-based solutions.

Trzcińska (2021) and Williams (2019) identify energy efficiency as an additional dimension of integration from an urban planning perspective. They highlight the role of transport planning policies that prioritize energy-efficient public transportation systems and encourage walking and cycling as key strategies for reducing urban energy consumption. Newman (2020) identifies the broader diffusion of renewable energy sources, particularly solar energy, as a contributing factor to RUT and long-term urban resilience.

A second sub-theme identified in the literature concerns the integration of ecosystem services (ESs) into urban planning systems. Thomson et al. (2022) frame RUT as an approach that seeks to restore, enhance, and actively produce ESs within urban environments through actions such as expanding green infrastructure, protecting water cycles, and supporting urban biodiversity. They further emphasize that, in cities where natural systems have been degraded due to urbanization, interdisciplinary assessments are employed to identify ecological damage, followed by planning interventions aimed at reestablishing and strengthening the relationship between urban form and ecosystem functions. Girard and Nocca (2020) describe urban planning as a key mechanism for safeguarding natural systems and for creating space within urban areas for nature to regenerate and multiply. Nesticò et al. (2022) provide empirical examples showing that cities planned with integrated and robust green infrastructure networks can function as producers of ecosystem services, contributing to the reactivation of abandoned areas, the expansion of social and recreational spaces, and improvements in urban quality of life and social well-being. Tatlić et al. (2024) examine urban green space indicators and demonstrate that data-driven evaluation tools are increasingly used in planning processes; however, their findings also reveal that such approaches remain limited in capturing the systemic and regenerative dimensions of urban transformation.

The final sub-theme addressed in the literature relates to site-specific design and urban experiments, particularly through context-sensitive design strategies and pilot interventions that test regenerative solutions at the local scale. LopezDeAsiain and Díaz-García (2020) show that comparative analyses of urban regeneration cases across Europe highlight how the outcomes of regenerative initiatives are significantly influenced by local conditions and site-specific characteristics. Accordingly, Gianfrate et al. (2020) describe RUT as requiring flexible and multi-scalar approaches that integrate the distinctive sociocultural, climatic, and structural features of each urban context. Girard and Nocca (2020) explain that urban transformation practices grounded in circular models aim to reduce economic, environmental, and social costs while simultaneously improving existing urban conditions.

Urban experiments are frequently highlighted as important instruments for testing and operationalizing regenerative ide-

as. The literature characterizes urban experiments as complex yet highly productive processes because they are conducted in real-world environments that cannot be fully controlled and actively involve social actors in both the initiation and implementation phases (Newton & Frantzeskaki, 2021). Illustrative examples include the Buiksloterham project in Amsterdam, initiated in 2015 through a strategy developed by the organization Metabolic and implemented in collaboration with more than twenty public and private actors. Nowakowska and Grodzicka-Kowalczyk (2019) describe the Buiksloterham project as an urban laboratory in which circular development strategies are implemented through requirements for sustainable building practices, the use of recovered materials, advanced waste and water management systems, and the development of renewable and self-sufficient energy solutions, supported by collaboration among multiple public and private actors. The project is described as an urban laboratory aimed at transforming the area into a circular and sustainable district, with long-term objectives oriented toward minimizing environmental losses and achieving regenerative resource use by 2050 (Nowakowska & Grodzicka-Kowalczyk, 2019). Similarly, Al-Ansari et al. (2024) examine a neighbourhood-scale regeneration case in Doha, demonstrating how context-specific planning interventions can address spatial and infrastructural challenges in rapidly urbanizing contexts.

3.5 Main theme: Evaluation of RUT

Bayulken and Huisingh (2015) emphasize the importance of measuring and monitoring the effects of RUT as a means of identifying challenges and informing adaptive improvements throughout the transformation process. They discuss performance evaluation in relation to comprehensive assessment frameworks that combine multiple indicators and evaluation components, addressing dimensions such as sustainability, ecosystem health, and social impacts. They also indicate that most assessment tools and methods currently applied in urban transformation processes primarily focus on optimizing resource consumption levels, rather than capturing net positive or regenerative impacts that account for ecological losses and potential offsets. Williams (2019) further argues that only a limited share of indicators typically used in sustainability reporting is suitable for evaluating regenerative transformation processes. Girard and Nocca (2020) highlight the need for assessment frameworks that more explicitly incorporate regenerative impacts into the evaluation of urban transformation projects. They further suggest that such frameworks benefit from a dynamic structure that integrates assessment, monitoring, and, where necessary, adaptive revision over time.

Several studies have proposed assessment tools designed to address this gap. Fabbricatti and Biancamano (2019) developed an urban regeneration evaluation framework for historic urban fabrics based on indicators of circularity, productivity, and resilience. By examining the tension between the preservation and enhancement of identity in historic contexts through a resilience-oriented lens, their study suggests that productive circular dynamics can emerge within regenerative renewal processes when resilience-oriented evaluation criteria are applied. Similarly, Williams (2019) introduced a performance framework consisting of levers, actions, and outcomes to examine the development of "circular capacities" in the regeneration of a port complex, which was empirically tested in the context of a port redevelopment project in Stockholm. More recently, Sala Benites et al. (2023) proposed the assessment tool Regenerative Circularity for the Built Environment (RC4BE), which comprises 136 criteria identified through a two-stage Delphi method. This tool aims to assess gaps and dynamics across multiple urban cycles, including ecosystems, liveability, infrastructure, governance, participation, and local economic and socioeconomic dimensions.

4 Discussion

Whereas several review studies have addressed regenerative development, circular urbanism, or sustainability-oriented urban transformation independently, this study contributes to the literature by explicitly positioning RUT within the disciplinary framework of urban planning and examining it through a systematic and reflexive thematic lens. Unlike reviews that primarily catalogue tools, indicators, or best practices, this study focuses on how regenerative principles are conceptually framed, operationalized, and problematized within urban transformation processes.

The findings indicate that, although RUT has an expanding presence in both theoretical and practice-oriented literature, it still lacks a fully consolidated conceptual framework. Identified gaps across themes point to ongoing theoretical and practical discontinuities, which are examined in the following discussion.

4.1 Gaps emerging in the rationale for RUT

Although this approach aligns with the main trajectory of the literature, the limited representation of the sub-theme "technological developments and smart urban applications" identified in Table 1 suggests that, despite its growing prominence in broader urban studies and policy discussions, the technological transformation dimension has not yet been addressed in an integrated manner within the RUT literature. Datta (2015) argues that smart city agendas are often shaped by entrepreneurial and efficiency-driven logics, and Luque-Ayala and Marvin (2015) critically examine how smart urbanism tends

to emphasize technical and managerial solutions. Similarly, Colding and Barthel (2017) highlight that urban ecological perspectives remain insufficiently addressed within the smart city literature. Whether digital infrastructures genuinely enhance the regenerative capacity of cities or merely reproduce a modern sustainability paradigm centred on efficiency therefore remains an open area of debate. This gap indicates that the current body of knowledge on the rationale for RUT remains predominantly ecological and governance-oriented, with technology often treated as a secondary or instrumental dimension.

4.2 Limited visibility of cross-system integration among the components of RUT

The findings confirm that widely recognized components of the RUT literature include circular economy principles, participatory processes, adaptive reuse strategies, and the use of digital technologies, but the absence of the theme "Capacity for Cross-System Integration" proposed in Table 1 among the empirical findings highlights a significant conceptual gap. Although regenerative approaches prioritize the strengthening of relational dynamics among ecological, social, and technological subsystems, the current literature often treats these systems as discrete domains. Consequently, the roles of interdependencies among energy–water–waste cycles, social infrastructures, and governance mechanisms in shaping regenerative outcomes remain only minimally examined. McPhearson et al. (2016) argue that urban research continues to address urban systems in a fragmented manner, and Bai et al. (2016) show that systems-based approaches remain insufficiently operationalized in practice. Hoff (2011) introduces the urban nexus as a framework for understanding interdependencies among resource systems, and Liu et al. (2007) emphasize the importance of conceptualizing human and natural systems as interconnected. This gap leads to interpretations of RUT primarily through isolated intervention domains, obscuring the multi-layered interactions that underpin regenerative transformation. Thus, the weak representation of this theme in the findings indicates that the interdisciplinary emphasis frequently highlighted in the literature has not been translated into an actual capacity for cross-system integration in practice, and that conceptually it remains a component whose contours are not yet fully articulated.

4.3 Challenges of RUT: Invisible risks beyond the well-known issues

Themes such as the need for an interdisciplinary approach, high financing requirements, and social acceptance, which emerge prominently in the findings, are recurring challenges to the feasibility of RUT in the literature. Although the theme of "misuse of technology" proposed in Table 1 does not appear prominently in the study, it nonetheless points to an important risk area identified by Ismagilova et al. (2022). Their analysis highlights that the deployment of data-driven technologies and smart systems may generate new forms of dependency and governance-related risks. The question of whether sensor-based monitoring systems or data-driven urban management tools genuinely align with regenerative objectives, or whether they create new dependency relations or governance vulnerabilities, remains unanswered in the literature. The absence of this issue in the findings suggests that the challenges of RUT continue to be discussed predominantly through socioeconomic frameworks. At the same time, technological risks remain peripheral even within theoretical scholarship.

4.4 Limited visibility of institutional governance and policy alignment

The findings concerning the integration of RUT into urban planning processes indicate that the process unfolds along three principal axes: its incorporation into sustainable urban development strategies, the integration of ecosystem services into the planning system, and the creation of place-based spatial experiences. This framework suggests that the regenerative approach should be understood not only as a complementary tool that supports environmental objectives but also as a paradigm that transforms how planning knowledge is produced and evaluated. However, the dimensions of institutional capacity, governance alignment, and policy coherence – which do not appear prominently in the study – constitute a critical gap in the integration of regenerative processes into planning systems. Similarly, recent studies highlight that urban regeneration processes require coordinated action across multiple institutional levels, including municipalities, local communities, and regulatory bodies, to ensure effective implementation (Idrizbegović Zgonić et al., 2024).

Bulkeley et al. (2011) demonstrate the role of multi-level governance and policy coordination in shaping urban transformation processes. Regenerative transformation therefore requires not only the reconfiguration of spatial instruments but also the harmonization of institutional coordination and regulatory frameworks. These perspectives suggest that governance structures play a critical yet underexplored role in shaping urban transformation. This situation highlights the need for further research on regenerative planning from governance and institutional perspectives.

4.5 Contemporary challenges in measuring RUT

The various sustainable city assessment tools and climate adaptation indices identified in the findings indicate an expanding body of literature on the measurability of RUT (Sala Benites et al., 2023; Williams, 2019; Fabbricatti & Biancamano, 2019). However, the overall structure of these assessment tools appears highly fragmented. A significant portion of these tools require access to comprehensive datasets, yet important practical challenges remain regarding data availability and data collection capacity, particularly at local administrative levels. The inability to ensure data continuity reduces the comparability of indicators, making the long-term evaluation of RUT more challenging. Moreover, the scale adaptability of existing tools has emerged as a challenging area. Many assessment frameworks do not provide indicators that can be consistently transferred across neighbourhood, district, city, and regional scales, thereby hindering the development of a measurement structure compatible with the multi-scalar nature of RUT. Therefore, future studies need to enhance RUT assessment frameworks in terms of data collection capacity, scale adaptability, and technology integration.

5 Conclusion

The findings indicate that, although RUT is gaining visibility, its conceptual consolidation and operational clarity remain limited. The analysis reveals that key dimensions of RUT – particularly cross-system integration, governance alignment, and measurement frameworks – remain insufficiently developed, resulting in a fragmented understanding of regenerative processes. These gaps suggest that RUT is still predominantly framed through ecological and project-based perspectives, and that its relational, institutional, and multi-scalar dimensions remain underexplored.

From a planning perspective, the results underline the need to reposition RUT as a governance-oriented paradigm rather than a set of isolated interventions. Advancing RUT requires stronger integration across urban systems, improved alignment between institutional and regulatory frameworks, and the development of adaptable evaluation tools capable of capturing long-term and multi-scalar impacts. Future research should therefore focus on translating regenerative principles into operational planning instruments, policy frameworks, and monitoring systems that can support the implementation and assessment of RUT in diverse urban contexts.

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Data availability statement

The dataset supporting the findings of this study is publicly available in Zenodo at https://doi.org/10.5281/zenodo.19737456. It includes the list of studies reviewed and associated metadata used in the systematic literature review.

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Regenerativna urbana preobrazba v urbanizmu: sistematični pregled ključnih tem in posledic za načrtovanje

Regenerativni razvoj je v urbanizmu pridobil pomen kot ekološka paradigma, vendar njegova integracija v procese urbane preobrazbe ostaja konceptualno razdrobljena in v praksi neenakomerna. Ta študija proučuje, kako je regenerativni razvoj opredeljen v razpravah o urbani preobrazbi, pri čemer so posebej poudarjene njegove posledice za sisteme načrtovanja in oblikovanje politik. S sistematičnim pregledom literature, izvedenem po protokolih PRISMA, je bilo opredeljeno osemintrideset recenziranih člankov, indeksiranih v Scopusu, ki so bili kodirani s programom MAXQDA in analizirani z refleksivno tematsko analizo. Ugotovitve razkrivajo pet medsebojno povezanih dimenzij regenerativne urbane preobrazbe (RUP): temeljna izhodišča, ključne komponente, izzive izvajanja, načine integracije v urbanizem in pristope vrednotenja. Literatura umešča RUP kot odziv na netrajnost prevladujočih urbanih modelov, ki degradirajo ekosisteme in povečujejo podnebno ranljivost. Temeljne sestavine – kot so načela krožnega gospodarstva, sodelovanje javnosti, prilagodljiva ponovna uporaba in digitalne tehnologije – so široko priznane, vendar so pogosto obravnavane kot posamezni posegi, ne pa kot uveljavljeni načrtovalski mehanizmi. Ključni izzivi vključujejo omejeno družbeno sprejemanje, finančne omejitve, zahteve po spremembi vedenja in šibko institucionalno usklajevanje. Čeprav je integracija v urbanizem običajno opredeljena prek uskladitve s strategijami trajnostnega razvoja in ekosistemskimi storitvami, so še vedno vrzeli pri usklajevanju upravljanja in politik. Študija ugotavlja, da so obstoječa orodja za ocenjevanje le delno prilagojena različnim merilom ter imajo šibke povezave z načrtovalskim in političnim odločanjem, kar omejuje praktično vrednotenje RUP.

Ključne besede: regenerativni razvoj, regenerativni urbanizem, urbana regeneracija, krožno mesto, refleksivna tematska analiza

1 Uvod

Mesta so naselja v središču globalnih dinamik proizvodnje in potrošnje. Podnebne spremembe, eno izmed najbolj perečih okoljskih vprašanj današnjega časa, in različne negativne posledice, ki izhajajo iz teh sprememb, so predvsem posledica procesov urbanizacije. Težave, kot so naraščajoče emisije ogljika, netrajnostna raba naravnih virov in degradacija ekosistemov, so neposredno povezane s pritiski, ki jih povzročajo mesta.

V ciljih trajnostnega razvoja Združenih narodov se prav tako poudarja, da je preoblikovanje mest v bolj bivalne in odporne strukture mogoče z zmanjševanjem učinkov podnebnih sprememb na urbana območja in prestrukturiranjem teh prostorov za prilagajanje podnebnim spremembam (United Nations, 2025). Mesta, ki so z vidika infrastrukture posebej ranljiva, so resno ogrožena zaradi tveganj, povezanih s podnebjem, kot so vročinski valovi, urbane poplave, ekstremni vremenski pojavi in suša. Pristop regenerativnega razvoja, cilj katerega je ublažiti škodljive učinke podnebnih sprememb in oblikovati odporne urbane strukture, velja za ključno načrtovalsko paradigmo, pomen katere se v zadnjih letih povečuje (Sala idr., 2023).

Ena od vodilnih rešitev, predlaganih za obravnavo problemov urbanega širjenja, ki ga povzroča urbanizacija, je ponovno ovrednotenje urbanih območij, ki so fizično in funkcionalno degradirana, izrabljena ali zapuščena. Ta proces, v literaturi imenovan »urbana preobrazba« ali »urbana prenova«, ponuja različne priložnosti, ki ne omogočajo le prostorskega prestrukturiranja, temveč tudi celostno preoblikovanje urbanizacije. Omeniti velja pristop »integrirane urbane preobrazbe«, kot je opredeljen v Deklaraciji iz Toleda (Evropska unija, 2010). Ta pristop predvideva preoblikovanje procesov urbane preobrazbe iz razdrobljenih, ozko zastavljenih praks v načrtovan, strateški proces, ki mesta obravnava s celostnega vidika in njihove komponente razume kot sestavne dele urbanega metabolizma (LopezDeAsiain in Díaz-García, 2020).

Projekti urbane regeneracije so strateško pomembni, ker imajo zmožnost za usmerjanje prihodnjih modelov rabe virov in prispevajo k oblikovanju urbane infrastrukture v približno tridesetih letih (Roberts in Sykes, 2000; UN-Habitat, 2016). Vendar pregled obstoječih praks razkriva, da se večina teh osredinja le na fizično prenovo ter v fazah analize, zasnove in izvedbe ne upošteva dovolj ekološke dimenzije (Couch idr., 2011). Natančneje, z vidika urbane ekologije ta ozka usmeritev omejuje vključevanje ekoloških vidikov, s čimer omejuje zmožnost procesov urbane preobrazbe za ustvarjanje koristi, kot so obnova ekosistemov, krepitev biotske raznovrstnosti in izboljšano zagotavljanje ekosistemskih storitev (Alberti, 2008).

Urbana regeneracija se je tradicionalno nanašala na fizično, gospodarsko in družbeno revitalizacijo nazadujočih urbanih območij s strategijami ponovnega razvoja in naložb, vezanih na kraj (Roberts idr., 2017). Čeprav so politike urbane regeneracije – pogosto osredinjene na fizični ponovni razvoj, gospodarsko revitalizacijo in izboljšave, vezane na kraj – vse bolj vključevale vidike trajnosti, so večinoma ostale osredinjene na izboljševanje obstoječih urbanih razmer, ne pa na preoblikovanje temeljnih razmerij med urbanimi sistemi in ekološkimi procesi (Roberts idr., 2017; Couch idr., 2011). Nasprotno regenerativni razvoj prevzema sistemsko usmerjen vidik, ki si ne prizadeva le zmanjšati okoljske škode, temveč tudi obnoviti in okrepiti regenerativno zmogljivost družbeno-ekoloških sistemov. V urbanih kontekstih je ta vidik oblikoval koncept regenerativnega urbanizma, ki mesta opredeljuje kot aktivne akterje, zmožne ustvarjati neto pozitivne ekološke in družbene izide v antropocenu (Thomson in Newman, 2020). Ta vidik se razlikuje od odpornega urbanizma, ki predvsem poudarja zmožnost urbanih sistemov, da se prilagodijo motnjam in ohranijo funkcionalnost v razmerah negotovosti in okoljskega stresa (Davoudi, 2014). Nasprotno regenerativni pristopi presegajo odpornost, saj dajejo prednost ekološki obnovi, krepitvi delovanja ekosistemov in sistemski preobrazbi (Davoudi, 2014; Thomson in Newman, 2020).

Zato ta študija proučuje, kako je regenerativna urbana preobrazba (RUP) konceptualizirana in integrirana v procese urbane preobrazbe, pri čemer je poseben poudarek na njenih posledicah za načrtovalske okvire, strukture upravljanja in politično usmerjeno odločanje. S sintezo razdrobljenih konceptualnih in metodoloških razprav prek sistematičnega pregleda literature študija pojasnjuje, kako lahko RUP usmerja načrtovalsko prakso. Za uresničitev tega cilja študija obravnava ta raziskovalna vprašanja: 1. Katera so temeljna izhodišča RUP? 2. Katere so ključne komponente RUP? 3. S katerimi izzivi se srečujemo v procesu RUP? 4. Kako je mogoče RUP integrirati v urbanizem? 5. Kako je mogoče meriti uspešnost RUP?

2 Metodološki pristop

2.1 Raziskovalna zasnova

V fazi zbiranja podatkov je bil izveden sistematični pregled literature po smernicah PRISMA, ki obsega štiri faze: identifikacijo, presejanje, preverjanje ustreznosti in vključitev (Moher idr., 2009; Page idr., 2021). Nato so bila pridobljena celotna besedila izbranih člankov in kodirana s programom MAXQDA. Kodirano gradivo je bilo analizirano z refleksivno tematsko analizo, kar je omogočilo prepoznavanje vzorcev pomena v celotnem naboru podatkov (Braun in Clarke, 2021). Rezultati so predstavljeni v razdelku o raziskovalnih izidih.

2.2 Zbiranje podatkov

Za strukturiranje faz zbiranja in analize podatkov v procesu sistematičnega pregleda literature je bila uporabljena metoda v šestih korakih (slika 1). V tem okviru je bila relevantna literatura najprej pridobljena iz podatkovne zbirke Scopus z uporabo predhodnih ključnih besed, na katerih je raziskava temeljila. Pridobljeni članki so bili pregledani, nove ključne besede, ki so bile izbrane iz teh člankov in so bile temelj za raziskavo, pa so bile dodane raziskovalnemu zaporedju, da bi se oblikovala končna iskalna strategija študije. V naslednjem koraku je bilo s to končno iskalno strategijo izvedeno novo iskanje v Scopusu. Avtorici sta pregledali naslove in povzetke 137 člankov, da bi presodili njihovo relevantnost za obseg študije, pri čemer je bilo osemindevetdeset člankov izključenih na podlagi meril, kot so pomanjkanje relevantnosti za urbanizem, nerecenzirane vrste objav in nezadostna obravnava regenerativnih pristopov. Med devetintridesetimi obravnavanimi članki ni bil dostopen le eden, celotna besedila osemintridesetih člankov pa so bila arhivirana.

Iskanje po podatkovni zbirki Scopus je bilo izvedeno 2. marca 2025. Merila, upoštevana pri vključevanju ali izključevanju člankov iz študije, so bila:

1. Objava v revijah, indeksiranih v podatkovni zbirki Scopus: pregled literature je bil izveden z uporabo indeksne platforme Scopus.
2. Vrsta objave kot »članek«: objave, ki niso prestale postopka recenziranja, so bile izključene iz študije.
3. Jezik objave »angleščina«: objave, napisane v drugih jezikih, so bile izključene iz študije.
4. Datum objave članka pred 31. decembrom 2024: ker je bil končni pregled literature izveden v začetku leta 2025, je bila uporabljena ta datumska omejitev; začetna datumska omejitev pa ni bila določena, ker se je koncept regeneracije v literaturi o urbanizmu pojavil razmeroma pred kratkim.
5. Relevantnost za urbanizem: ker se koncept regeneracije pojavlja v več disciplinah, je bilo iskanje literature v Scopusu omejeno na predmetni področji okoljskih znanosti in družbenih ved, ki zajemata raziskave urbanizma.

2.3 Analiza podatkov

Po pridobitvi celotnih besedil osemintridesetih člankov so bile vse študije sistematično uvožene v program MAXQDA in podvržene iterativnemu procesu kodiranja. V prvi fazi so bile začetne kode oblikovane induktivno s podrobnim branjem besedil ter prepoznavanjem ponavljajočih se konceptov, argumentov in analitičnih poudarkov, povezanih z regenerativnim urbanim razvojem in urbano preobrazbo. V drugi fazi so bile te začetne kode pregledane, primerjane in združene na podlagi konceptualne podobnosti in teoretične relevantnosti, ne pa na podlagi pogostnosti pojavljanja.

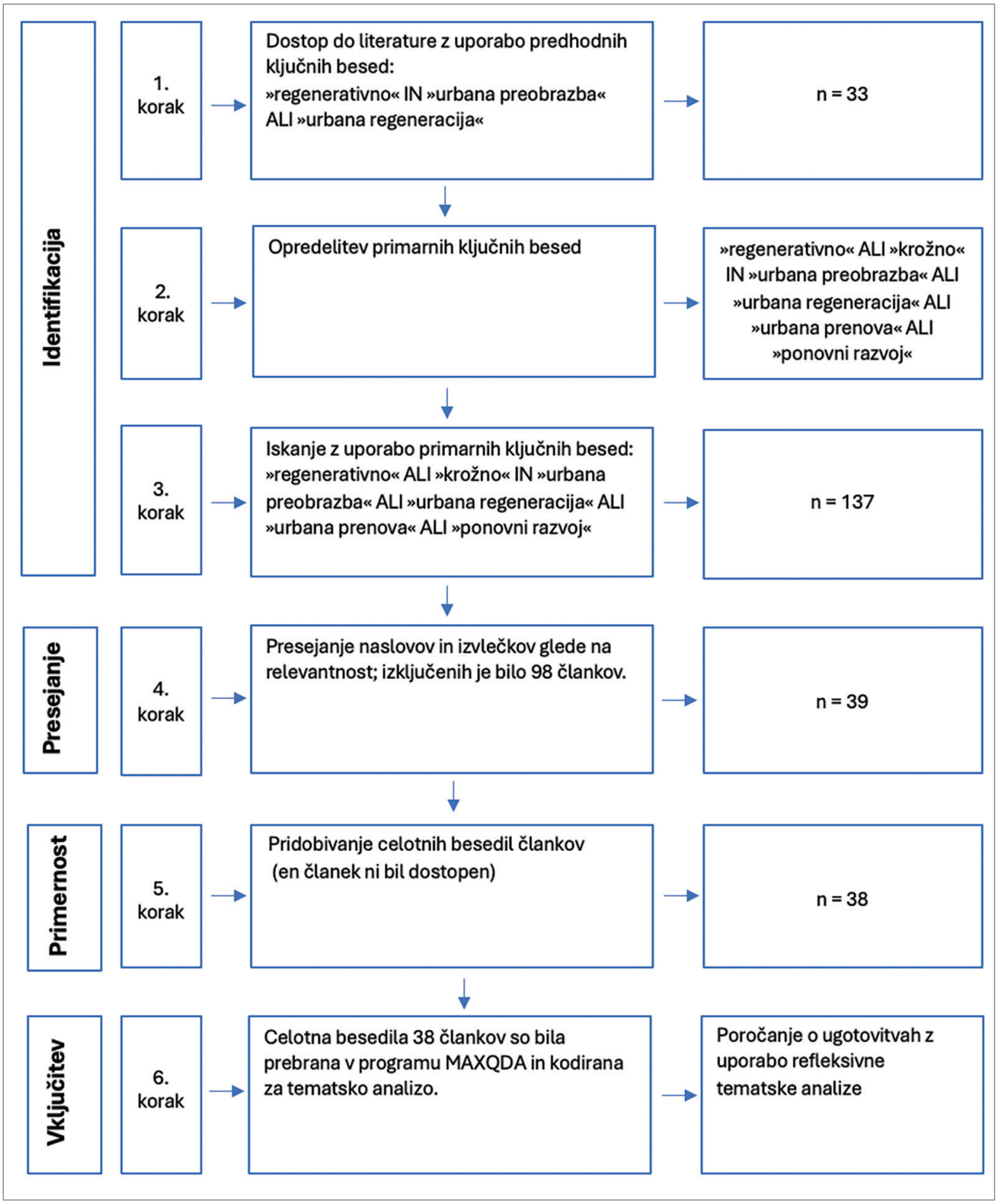
S tem procesom abstrakcije in izpopolnjevanja so bili prepoznani širši vzorci pomena, kar je privedlo do oblikovanja petih glavnih tem in njihovih ustreznih podtem. Te teme tvorijo analitično konstruirane kategorije, ki sintetizirajo ključne dimenzije, poudarjene v pregledani literaturi. Nastala tematska struktura in njene komponente so predstavljene v tabeli 1. Podrobni podporni podatki so dostopni v repozitoriju (Başcan Yüce in Tezer, 2026).

Treba je opozoriti, da je tabela 1 strukturirana tako, da so ločene teme, neposredno izpeljane iz tematske analize, in dodatne podteme, razvite v fazi razprave. Glavne teme in podteme, predstavljene v razdelku z rezultati, induktivno izhajajo iz refleksivne tematske analize pregledane literature in tvorijo vzorce pomena, izrecno opredeljene v naboru podatkov.

Nasprotno podteme, predstavljene v razdelku razprave, niso bile neposredno ustvarjene v procesu kodiranja in tematske analize. Namesto tega so bile razvite interpretativno s sintezo analitičnih ugotovitev s širšimi teoretičnimi razpravami in vrzelmi, opredeljenimi v literaturi. Njihova vključitev je namenjena razširitvi analitičnega okvira s poudarjanjem konceptualnih dimenzij, ki so bile v analiziranih študijah premalo zastopane ali jih ni bilo, vendar so ključne za učinkovito integracijo RUP v načrtovalsko prakso. V skladu s tem je treba te podteme, ki temeljijo na razpravi, razumeti kot konceptualne predloge in ne kot empirične ugotovitve.

2.4 Metodološke omejitve

Kljub sistematičnemu pristopu, uporabljenemu v tej študiji, je treba priznati več omejitev. Prvič, iskanje literature je bilo izvedeno z uporabo podatkovne zbirke Scopus, ki, čeprav je splošno priznana kot ena najobsežnejših akademskih indeksnih platform, morda ne vključuje vseh relevantnih objav, dostopnih v drugih podatkovnih zbirkah. Drugič, pregled se je osredinil na objave v angleškem jeziku, kar je lahko izključilo relevantne študije, objavljene v drugih jezikih. Tretjič, kot pri številnih sistematičnih pregledih literature, ki uporabljajo kvalitativno tematsko sintezo, identifikacija in interpretacija tem vključujeta določeno stopnjo raziskovalske interpretacije. Za ublažitev te omejitve je bil proces kodiranja in tematske kategorizacije izveden sistematično in iterativno, da bi se zagotovili doslednost in transparentnost analitičnega okvira. Kljub tem omejitvam študija ponuja celovit pregled nastajajočega diskurza o RUP in strukturirano podlago za prihodnje empirične in teoretične raziskave.



Slika 1: Faze procesa sistematičnega pregleda literature za študijo (na podlagi pretočnega diagrama PRISMA)

3 Raziskovalni izidi

Tematska analiza pregledane literature je razkrila pet glavnih tem, ki strukturirajo konceptualne in praktične dimenzije RUP. Te teme in z njimi povezane podteme strukturirano predstavljajo, kako literatura konceptualizira izhodišča, komponente, izzive, integracijo v urbanizem in vrednotenje RUP. Nastala tematska struktura in z njo povezane podteme so navedene v tabeli 1.

Tabela 1: Teme in podteme regenerativne urbane preobrazbe, opredeljene z refleksivno tematsko analizo.

Podtema	Glavne teme				
	1. Izhodišče	2. Ključne komponente	3. Izzivi	4. Integracija v urbanizem	5. Vrednotenje
1	Netrajnost trenutnega modela urbanizma	Načela krožnega gospodarstva	Kompleksnost in potreba po interdisciplinarnem pristopu	Integracija v strategije trajnostnega urbanega razvoja	Orodja in kazalniki za ocenjevanje
2	Čezmerno uničevanje ekosistemskih storitev (ES)	Uporaba participativnih in sodelovalnih načrtovalskih pristopov	Visoke investicijske zahteve	Integracija ES v sistem načrtovanja	—
3	Potreba po povečanju urbane odpornosti na podnebne spremembe	Prilagodljiva ponovna uporaba	Sprememba vedenja in družbeno sprejemanje	Zasnova, prilagojena lokaciji, in urbani eksperimenti	—
4	—	Uporaba digitalnih tehnologij	—	—	—
Dodatno	Tehnološki razvoj in aplikacije pametnega mesta	Zmogljivost za medsistemsko integracijo	Zloraba tehnologije	Institucionalno upravljanje in uskladitev politik	Zmogljivost zbiranja podatkov, prilagodljivost različnim merilom, integracija tehnologije

Vir: avtorici.

3.1 Glavna tema: Izhodišče za RUP

Prvo od treh izhodišč, prepoznanih v okviru RUP, je netrajnost trenutnega modela urbanizma. Iz literature izhaja, da problemi, kot so čezmerna poraba neobnovljivih virov (Balletto idr., 2022; Domenech in Borrion, 2022; Girard in Nocca, 2020), nastajanje odpadkov (Williams, 2019), onesnaževanje (Acri idr., 2021; Valenzuela idr., 2018; Lewin, 2013) in prispevanje k podnebnim spremembam (Boeri idr., 2022), skupaj izražajo omejitve prevladujočih praks urbanizma. Več študij tudi kaže, da obstoječi sistemi urbanizma in upravljanja izkazujejo omejeno zmožnost obravnave pomembnih izzivov, povezanih z okoljsko, gospodarsko in družbeno degradacijo (Nowakowska in Grodzicka-Kowalczyk, 2019). V literaturi se tudi vse bolj poudarja potreba po ponovnem premisleku prevladujočih razvojnih modelov in razpravlja o alternativnih okvirih, ki lahko tekoče procese urbanih sprememb integrirajo v sisteme načrtovanja (Herranz-Pascual idr., 2023). Poleg tega se v literaturi pogosto poroča, da so bili prejšnji pristopi k urbani trajnosti nezadostni pri zagotavljanju aktivnega sodelovanja državljanov, zmanjševanju revščine, preprečevanju prehranske negotovosti in učinkovitem obvladovanju neenakosti na urbanih območjih. Kot odgovor na te omejitve se regenerativni urbanizem v literaturi obravnava kot pristop, ki ponuja strateško usmeritev k razvoju trajnostnih in zdravih mest z visoko kakovostjo bivanja (Sala Benites idr., 2023).

Drugo izhodišče, opredeljeno v okviru RUP, zadeva čezmerno degradacijo urbanih ekosistemskih storitev (ES). Prejšnje študije kažejo, da urbano širjenje in človeške dejavnosti izvajajo velik pritisk na naravne ekosisteme, kar vodi v degradacijo in izgubo ES v mestih (Nesticò idr., 2022; Caratelli idr., 2019). Mesta so opisana kot območja, na katerih so naravni sistemi izrinjeni, preostala urbana narava pa je pogosto preoblikovana v močno spremenjene ekosisteme (Thomson idr., 2022). Empirični dokazi iz Al-Aina ponazarjajo to dinamiko: dolgotrajno intenzivno kmetijstvo, urbani razvoj in živinoreja so prispevali k izčrpavanju podzemne vode, zaradi česar so vodonosniki postali neobnovljivi, ekosistemske storitve pa oslabljene (Caratelli idr., 2019). Te ugotovitve kažejo omejitve konvencionalnih pristopov k urbanemu upravljanju voda in krepijo relevantnost regenerativnih perspektiv v urbanizmu. RUP je opredeljena kot pristop, ki si prizadeva ponovno povezati urbana območja z ekološkimi sistemi, podpreti revitalizacijo ekosistemov in zmanjšati nadaljnjo ekološko degradacijo, povezano z urbano rabo.

Tretje izhodišče, opredeljeno v okviru RUP, se nanaša na potrebo po krepitvi urbane odpornosti v kontekstu podnebnih sprememb. Mesta so v literaturi pogosto opisana kot posebej ranljiva za vplive, povezane s podnebjem, kar je povečalo pozornost, usmerjeno v odpornost kot ključno vprašanje v razpravah o urbanem razvoju (Intergovernmental Panel on Climate Change, 2022; UN-Habitat, 2020; Meerow idr., 2016). V študijah se poudarja, da so za obravnavo tveganj, povezanih s podnebjem, potrebni trajnostni in inovativni pristopi, ki integrirajo družbene, gospodarske in fizične dimenzije grajenega okolja (Ahern, 2011; Bühler idr., 2024; Elmqvist idr., 2019; Sala Benites idr., 2023).

3.2 Glavna tema: Ključne komponente RUP

Kot ključne komponente RUP so bile opredeljene štiri podteme. Prva podtema zadeva načela krožnega gospodarstva. Cappellaro idr. (2019) krožno urbano preobrazbo opredeljujejo kot pristop, ki spodbuja uporabo obnovljivih virov in podpira neprekinjeno kroženje materialov prek sistemov zaprte zanke. Isti avtorji poudarjajo tudi, da taki sistemi prispevajo k optimizaciji rabe virov ter so povezani z zmanjšanjem emisij ogljika in ravni onesnaževanja.

Nowakowska in Grodzicka-Kowalczyk (2019) trdita, da je načrtovanje mest po krožnih načelih povezano z večjimi ravnmi samozadostnosti in obnovljivosti. Viglioglia idr. (2021) in Balletto idr. (2022) obravnavajo načela krožnega gospodarstva kot taka, ki imajo potencial za integracijo v več urbanih funkcijah, kadar se urbani problemi obravnavajo z regenerativnega vidika. Williams (2019) predstavlja empirične primere, kot sta recikliranje organskih odpadkov in energetska predelava, ki ponazarjajo, kako lahko krožno upravljanje virov zmanjša pritiske na ekosistemske storitve in prispeva k razvoju regenerativnih urbanih sistemov. Cappellaro idr. (2019) poročajo, da mesta, ki sprejemajo načela načrtovanja krožnega gospodarstva, podpirajo trajnostno rast in krepijo zmogljivosti samoobnove z usklajenim upravljanjem procesov porabe virov in nastajanja odpadkov. Valenzuela idr. (2018) navajajo kvantitativne dokaze iz študij primerov, ki kažejo, da so mesta, upravljana po načelih krožnega gospodarstva, dosegla znatna zmanjšanja nastajanja odpadkov, pri čemer so poročana zmanjšanja s 100 na 21,5 % in nadaljnji potenciali zmanjšanja do 3,5 %.

Druga ključna komponenta RUP, opredeljena v literaturi, je uporaba participativnih in sodelovalnih načrtovalskih pristopov. Bayulken in Huisingh (2015) ter De Medici idr. (2018) poudarjajo, da procese RUP zaznamuje vključevanje več deležnikov, vključno s prebivalci, organizacijami civilne družbe, zasebnim sektorjem in javnimi institucijami. Ti avtorji tudi poudarjajo, da je sodelovanje med temi akterji tesno povezano z učinkovitostjo regenerativnih procesov. Participativni procesi, ki jih izvajajo v ekoloških in družbenih kontekstih, so obravnavani kot mehanizmi, ki deležnike spodbujajo k prevzemanju odgovornosti in krepijo kulturo sodelovanja (Bayulken in Huisingh, 2015; De Medici idr., 2018). LopezDeAsiain in Díaz-García (2020) poročata, da fleksibilni procesi vrednotenja, ki omogočajo interakcijo med strokovnim in lokalnim znanjem, podpirajo razvoj kontekstualno svojevrstnih regenerativnih rešitev. LopezDeAsiain in Díaz-García (2020) prav tako navajata, da začetni korak v participativnem načrtovanju vključuje razvoj zemljevidov akterjev, ki opredeljujejo relevantne deležnike ter izražajo njihove družbene, gospodarske in politične dimenzije.

Sala Benites idr. (2023) poudarjajo, da so participativni procesi v RUP najučinkovitejši, kadar so zasnovani tako, da vključujejo vse relevantne in reprezentativne deležnike, ne pa da delujejo kot posvetovalni mehanizmi, ki služijo posebnim interesnim skupinam. LopezDeAsiain in Díaz-García (2020) poudarjata pomen vzpostavljanja zaupanja med deležniki, Ricci (2022) potrebo po orodjih za sodelovanje, prilagojenih lokalnim kontekstom, Girard in Nocca (2020) razpravljata o vlogi prostorov, ki skupnostim omogočajo ustvarjanje inovativnih odzivov v obdobjih krize, Trzcińska (2021) pa se osredinja na razumevanje dejanskih potreb uporabnikov.

Tretja temeljna komponenta RUP je prilagodljiva ponovna uporaba. Nowakowska in Grodzicka-Kowalczyk (2019), Petruskeviciute (2019), Williams (2019) in Iodice idr. (2020) opisujejo prilagodljivo ponovno uporabo kot pristop, ki zajema več dimenzij, vključno z ohranjanjem urbanih virov, zmanjševanjem odpadkov, revitalizacijo praznih in zapuščenih urbanih območij, varovanjem in ponovno uporabo kulturne dediščine ter podporo procesom prilagajanja podnebnim spremembam. Petruskeviciute (2019) prilagodljivo ponovno uporabo z regenerativnega vidika opredeljuje kot pristop, za katerega je potrebno razumevanje urbanih območij kot dinamičnih in živih sistemov. Ricci (2022) predstavlja empirične primere iz integriranih prenovitvenih projektov, izvedenih na Poljskem, ki kažejo, kako lahko prilagodljiva ponovna uporaba premalo izkoriščenih stavb in prostorov prispeva k revitalizaciji nevarnih območij, okrepi njihove družbene in kulturne funkcije in izboljša urbano kakovost ob ohranjanju zgodovinske dediščine. Ricci (2022) poudarja, da lahko ciklično ponovno vrednotenje praznih nepremičnin in preoblikovanje premalo izkoriščenih stavb za nov namen ustvarita družbene koristi, vključno z zaposlitvenimi možnostmi in izboljšanim zagotavljanjem storitev.

Četrta temeljna komponenta, opredeljena v okviru RUP, je uporaba digitalnih tehnologij. Franchino idr. (2022) proučujejo uporabo digitalnih tehnologij v procesu RUP, zlasti v povezavi z ocenjevanjem vplivov na okolje in zagotavljanjem informacij, Viglioglia idr. (2021) pa se osredinjajo na njihovo vlogo pri simulaciji scenarijev in podpori načrtovanju. Razpravljajo o tem, kako lahko digitalne tehnologije podpirajo učinkovitost rabe virov z olajševanjem sprejemanja regenerativnih vedenjskih vzorcev in omogočanjem učinkovitejšega delovanja urbanih sistemov.

Viglioglia idr. (2021) digitalna orodja povezujejo z obvladovanjem kompleksnosti procesov krožnega gospodarstva ter izboljševanjem učinkovitosti v fazah zasnove, gradnje in obratovanja, Franchino idr. (2022) pa poudarjajo vlogo digitalizacije pri obnovi in prenovi urbane dediščine. Empirične aplikacije digitalnih orodij dodatno ponazarjajo te dinamike. Programska oprema Building Information Modelling (BIM), razvita

in preizkušena v italijanski študiji primera, je na primer omogočila prepoznavanje ekoloških vplivov stavb v fazi zasnove z digitalnim modeliranjem, kar je zagotovilo revizije zasnove, ki zmanjšujejo ekološko škodo (Franchino idr., 2022). Taka digitalna orodja, uporabljena na različnih prostorskih ravneh, bi lahko prispevala k bolj informiranim in učinkovitim procesom odločanja, saj omogočajo primerjavo načrtovalskih scenarijev in okoljskih vplivov, povezanih z njimi.

3.3 Glavna tema: Izzivi v procesu RUP

V literaturi se dosledno opredeljuje kompleksnost kot osrednji izziv v procesu RUP in poudarja, da je RUP po svoji naravi interdisciplinarna. Ta kompleksnost izhaja iz potrebe po vzpostavitvi učinkovite interakcije znotraj urbanih sistemov, sestavljenih iz več družbeno-tehničnih struktur, vključno s skupno produkcijo novih oblik znanja, prilagajanjem institucionalnih okvirov in skladnim usklajevanjem teh procesov (Gianfrate idr., 2020). Della Spina (2019) opozarja na težavnost doseganja stabilnih interakcij med lokalnimi viri in identiteto naselja prek sinergij med prostori, funkcijami in akterji, vključenimi v procese RUP. Ker regenerativna dejanja hkrati vključujejo geografske, administrativne, ekološke in družbene sisteme, Gianfrate idr. (2020) RUP označujejo kot upravljavsko intenziven proces, za katerega so potrebne močne zmogljivosti usklajevanja, facilitacije in vodenja. Newton in Frantzeskaki (2021) dokazujeta, da je interdisciplinarno sodelovanje bistveno za obravnavo kompleksnih urbanih izzivov. Hkrati Thomson idr. (2022) opozarjajo, da lahko interdisciplinarno delo, če ni skrbno strukturirano, ustvarja ločene, silosne oblike znanja, kar lahko omeji njegov preobrazbeni potencial.

Druga podtema, široko obravnavana v povezavi z izzivi v procesu RUP, zadeva financiranje. Girard in Nocca (2020) poudarjata, da so projekti RUP običajno povezani z visokimi začetnimi investicijskimi zahtevami, zaradi česar je finančna izvedljivost ves čas vprašljiva. Trdita tudi, da je prepričevanje oblikovalcev politik, zasebnih akterjev in javnosti, naj vlagajo v regenerativno preobrazbo, še naprej težavno kljub vse večjemu spodbujanju javno-zasebnih partnerstev in inovativnih finančnih mehanizmov. Izpostavljata tudi, da se ta izziv stopnjuje zaradi omejene razpoložljivosti analitičnih orodij, zmožnih prikazati večdimenzionalne koristi regenerativnih pristopov. Bayulken in Huisingh (2015) poudarjata strateško vlogo javnih financ ter spodbujevalnih mehanizmov pri mobilizaciji zasebnih naložb in podpori regenerativnemu urbanemu razvoju. Empirični dokazi iz Francije na primer ponazarjajo, kako so stanovanjske zadruge, vključene v pobude urbane preobrazbe, izkoristile svoj obseg in institucionalno zanesljivost za zagotovitev dolgoročnih posojil, s čimer so povečale finančno fleksibilnost za prebivalce (Trzcińska, 2021).

Zadnja podtema, povezana z izzivi v procesu RUP, se nanaša na družbeno vedenje in zaznavanje. Onkraj fizične preobrazbe literatura vse bolj priznava, da je RUP tesno povezana s premiki v vsakdanjih praksah, življenjskih slogih in vrednostnih sistemih. Regenerativni pristopi so uokvirjeni kot taki, ki zahtevajo sistemsko usmerjen vidik, ki upošteva celotne življenjske cikle ter postavlja v ospredje alternativne načine proizvodnje in potrošnje (Domenech in Borrion, 2022). Boeri idr. (2022) trdijo, da samo zakonodajni in politični ukrepi ne zadoščajo za doseganje podnebne nevtralnosti, ter poudarjajo nujnost vedenjskih sprememb na individualni, kolektivni in institucionalni ravni, podprtih s participativnimi procesi, ki krepijo okoljsko državljanstvo in podnebno pravičnost. Empirične študije kažejo, da lahko strategije ozaveščanja – od simbolnih intervencij do praks, temelječih na skupnosti – pozitivno vplivajo na vedenjske spremembe in družbeno sprejemanje regenerativnih pristopov (Boeri idr., 2022). Dokazi iz Italije na primer kažejo, da so prakse krožnega gospodarstva, vključno s skupnostnimi vrtovi, sodelovalnimi pobudami in lokalnimi proizvodnimi zmogljivostmi, prispevale k pozitivnim premikom v družbenem vedenju (Cappellaro idr., 2019). Nasprotno druge študije trdijo, da čeprav lahko administrativni posegi začasno vplivajo na individualno vedenje, take spremembe verjetno ne bodo vzdržne brez podpore na znanju temelječih tehnoloških infrastruktur (Newman, 2020). V skladu s tem novejše raziskave poudarjajo potencial digitalnih orodij in interaktivnih mehanizmov – kot so igrifikacija, svetovanje in povratne informacije v resničnem času – za pospeševanje vedenjskih sprememb in krepitev tradicionalnih strategij, temelječih na znanju (Viglioglia idr., 2021).

3.4 Glavna tema: Integracija RUP v urbanizem

Literatura integracijo RUP v strategije trajnostnega urbanega razvoja vse bolj opredeljuje kot pomembno dimenzijo vgrajevanja regenerativnih načel v prakso urbanizma. Obstoječe študije kažejo, da je taka integracija tesno povezana s potrebo po obravnavi kompleksnosti obstoječih urbanih tkiv, vključno s strukturnimi, družbenimi in ekološkimi dimenzijami (Franchino idr., 2022; Viglioglia idr., 2021; Bayulken in Huisingh, 2015).

Aplikativne študije urbane regeneracije poudarjajo tudi pomen sodelovalnih in večakterskih okvirov pri vgrajevanju načel trajnosti v načrtovalske procese (Idrizbegović Zgonić idr., 2024). Girard in Nocca (2020) opisujeta urbanizem kot ključen instrument za premik urbane organizacije od linearnih razvojnih modelov k bolj krožnim in regenerativnim konfiguracijam. Fabi idr. (2021) ter Girard in Nocca (2020) poudarjajo, da je sprejemanje celostnih načrtovalskih pristopov, ki obravnavajo družbene, gospodarske in okoljske dimenzije, skupaj z vključevanjem ciljev trajnostnega razvoja in strateških načrtovalskih

okvirov temeljni korak pri integraciji regenerativnih strategij v procese urbanizma. Bellato idr. (2024) so prepričani, da lahko regenerativni pristopi, zlasti v turistično usmerjenih kontekstih, podpirajo procese preobrazbe, vezane na kraj, prek večakterskega sodelovanja in regeneracije družbeno-ekoloških sistemov.

V literaturi so predstavljeni tudi izzivi, povezani s povezovanjem kompleksnih procesov prek različnih urbanih tkiv. Viglioglia idr. (2021) jih opisujejo kot take, ki zahtevajo poglobljeno analizo obstoječih urbanih problemov in strukturnih kompleksnosti in trajno sodelovanje med strokovnjaki iz različnih disciplin. Petruskeviciute (2019) ter Cappellaro idr. (2019) poudarjajo, da sta varovanje in krepitev naravnih sistemov sestavna dela strategij trajnostnega urbanega razvoja. Trdita tudi, da je oslabljen odnos med urbanimi populacijami in urbanimi ekologijami mogoče okrepiti s širjenjem zelenih površin in ponovno integracijo narave v mesto, podprto s praksami, kot so skupnostni vrtovi in druge sonaravne rešitve.

Trzcińska (2021) in Williams (2019) opredeljujeta energetsko učinkovitost kot dodatno dimenzijo integracije z vidika urbanizma. Poudarjata vlogo politik prometnega načrtovanja, ki dajejo prednost energetsko učinkovitim sistemom javnega prevoza ter spodbujajo hojo in kolesarjenje kot ključni strategiji za zmanjševanje urbane porabe energije. Newman (2020) širšo razširitev obnovljivih virov energije, zlasti sončne energije, opredeljuje kot dejavnik, ki prispeva k RUP in dolgoročni urbani odpornosti.

Druga podtema, opredeljena v literaturi, zadeva integracijo ekosistemskih storitev (ES) v sisteme urbanizma. Thomson idr. (2022) RUP opredeljujejo kot pristop, ki si prizadeva obnoviti, okrepiti in aktivno proizvajati ES v urbanih okoljih prek ukrepov, kot so širjenje zelene infrastrukture, varovanje vodnih ciklov in podpiranje urbane biotske raznovrstnosti. Poudarjajo tudi, da se v mestih, kjer so bili naravni sistemi degradirani zaradi urbanizacije, uporabljajo interdisciplinarne presoje za identifikacijo ekološke škode, čemur sledijo načrtovalski posegi, usmerjeni v ponovno vzpostavljanje in krepitev razmerja med urbano obliko in funkcijami ekosistemov. Girard in Nocca (2020) opisujeta urbanizem kot ključni mehanizem za varovanje naravnih sistemov in ustvarjanje prostora v urbanih območjih, kjer se narava lahko regenerira in množi. Nesticò idr. (2022) navajajo empirične primere, ki kažejo, da lahko mesta, načrtovana z integriranimi in robustnimi omrežji zelene infrastrukture, delujejo kot proizvajalci ekosistemskih storitev ter prispevajo k reaktivaciji opuščenih območij, širjenju družbenih in rekreacijskih prostorov ter izboljšanju urbane kakovosti življenja in družbene blaginje. Tatlić idr. (2024) proučujejo kazalnike urbanih zelenih površin in dokazujejo, da se podatkovno podprta orodja za vrednotenje vse pogosteje uporabljajo v načrtovalskih procesih, vendar njihove ugotovitve tudi razkrivajo, da taki pristopi ostajajo omejeni pri zajemanju sistemskih in regenerativnih dimenzij urbane preobrazbe.

Zadnja podtema, obravnavana v literaturi, se nanaša na zasnovo, prilagojeno lokaciji, in urbane eksperimente, zlasti prek kontekstualno občutljivih oblikovalskih strategij in pilotnih intervencij, ki preizkušajo regenerativne rešitve na lokalni ravni. LopezDeAsiain in Díaz-García (2020) kažeta, da primerjalne analize primerov urbane regeneracije po Evropi izpostavljajo, kako na izide regenerativnih pobud pomembno vplivajo lokalne razmere in značilnosti posamezne lokacije. Skladno s tem Gianfrate idr. (2020) RUP opisujejo kot pristop, ki zahteva fleksibilne in večravninske pristope, ki integrirajo značilne družbenokulturne, podnebne in strukturne značilnosti vsakega urbanega konteksta. Girard in Nocca (2020) pojasnjujeta, da si prakse urbane preobrazbe, utemeljene v krožnih modelih, prizadevajo zmanjšati gospodarske, okoljske in družbene stroške, hkrati pa izboljšati obstoječe urbane razmere.

Urbani eksperimenti so pogosto poudarjeni kot pomembni instrumenti za preizkušanje in operacionalizacijo regenerativnih idej. V literaturi so označeni kot kompleksni, vendar zelo produktivni procesi, ker se izvajajo v resničnih okoljih, ki jih ni mogoče v celoti nadzorovati, ter ker aktivno vključujejo družbene akterje v začetnih in izvedbenih fazah (Newton in Frantzeskaki, 2021). Ponazoritveni primeri vključujejo projekt Buiksloterham v Amsterdamu, začet leta 2015 na podlagi strategije, ki jo je razvila organizacija Metabolic ter je bila izvedena v sodelovanju z več kot dvajsetimi javnimi in zasebnimi akterji. Nowakowska in Grodzicka-Kowalczyk (2019) projekt Buiksloterham opisujeta kot urbani laboratorij, v katerem se krožne razvojne strategije izvajajo prek zahtev za trajnostne gradbene prakse, uporabo predelanih materialov, napredne sisteme ravnanja z odpadki in vodo ter razvoj obnovljivih in samozadostnih energetskih rešitev, podprtih s sodelovanjem med več javnimi in zasebnimi akterji. Projekt je opisan kot urbani laboratorij, cilj katerega je preoblikovati območje v krožno in trajnostno četrt z dolgoročnimi cilji, usmerjenimi v zmanjšanje okoljskih izgub in doseganje regenerativne rabe virov do leta 2050 (Nowakowska in Grodzicka-Kowalczyk, 2019). Podobno Al-Ansari idr. (2024) proučujejo primer regeneracije na ravni soseske v Dohi ter prikazujejo, kako lahko kontekstualno svojevrstne načrtovalske intervencije obravnavajo prostorske in infrastrukturne izzive v hitro urbanizirajočih se kontekstih.

3.5 Glavna tema: Vrednotenje RUP

Bayulken in Huisingh (2015) poudarjata pomen merjenja in spremljanja učinkov RUP kot sredstva za prepoznavanje izzivov in informiranje prilagoditvenih izboljšav v celotnem procesu preobrazbe. O vrednotenju uspešnosti razpravljata v

povezavi s celovitimi ocenjevalnimi okviri, ki združujejo več kazalnikov in komponent vrednotenja ter obravnavajo dimenzije, kot so trajnostnost, zdravje ekosistemov in družbeni vplivi. Navajata tudi, da se večina orodij in metod za ocenjevanje, ki se trenutno uporabljajo v procesih urbane preobrazbe, osredinja predvsem na optimizacijo ravni porabe virov, ne pa na zajemanje neto pozitivnih ali regenerativnih vplivov, ki upoštevajo ekološke izgube in potencialne izravnave. Williams (2019) trdi, da je le omejen delež kazalnikov, ki se običajno uporabljajo v poročanju o trajnostnosti, primeren za vrednotenje procesov regenerativne preobrazbe. Girard in Nocca (2020) poudarjata potrebo po ocenjevalnih okvirih, ki bi regenerativne vplive izrecneje vključili v vrednotenje projektov urbane preobrazbe. Prepričana sta tudi, da imajo taki okviri koristi od dinamične strukture, ki sčasoma integrira ocenjevanje, spremljanje, in kadar je potrebno, prilagoditveno revizijo.

Več študij je predlagalo orodja za ocenjevanje, zasnovana za obravnavo te vrzeli. Fabbricatti in Biancamano (2019) sta razvila okvir vrednotenja urbane regeneracije za zgodovinska urbana tkiva, temelječ na kazalnikih krožnosti, produktivnosti in odpornosti. S proučevanjem napetosti med ohranjanjem in krepitvijo identitete v zgodovinskih kontekstih skozi lečo, usmerjeno v odpornost, njuna študija kaže, da se lahko produktivne krožne dinamike pojavijo v procesih regenerativne prenove, kadar se uporabljajo merila za vrednotenje, usmerjena v odpornost. Podobno je Williams (2019) uvedel okvir uspešnosti, sestavljen iz vzvodov, ukrepov in izidov, za proučevanje razvoja »krožnih zmogljivosti« pri regeneraciji pristaniškega kompleksa, ki je bil empirično preizkušen v kontekstu projekta ponovnega razvoja pristanišča v Stockholmu. Pred kratkim so Sala Benites idr. (2023) predlagali ocenjevalno orodje Regenerative Circularity for the Built Environment (RC4BE), ki obsega 136 meril, opredeljenih z dvostopenjsko metodo Delphi. Namen tega orodja je določiti vrzeli in dinamike v več urbanih ciklih, vključno z ekosistemi, bivalnostjo, infrastrukturo, upravljanjem, sodelovanjem ter lokalnimi gospodarskimi in družbeno-gospodarskimi dimenzijami.

4 Razprava

Medtem ko je več preglednih študij regenerativni razvoj, krožni urbanizem ali v trajnost usmerjeno urbano preobrazbo obravnavalo ločeno, ta študija prispeva k literaturi tako, da RUP izrecno umešča v disciplinarni okvir urbanizma ter jo proučuje s sistematičnega in refleksivnega tematskega vidika. V nasprotju s pregledi, ki predvsem katalogizirajo orodja, kazalnike ali dobre prakse, se ta študija osredinja na to, kako so regenerativna načela konceptualno uokvirjena, operacionalizirana in problematizirana v procesih urbane preobrazbe.

Ugotovitve kažejo, da RUP, čeprav je vse bolj prisotna v teoretični in v prakso usmerjeni literaturi, še vedno nima popolnoma konsolidiranega konceptualnega okvira. Opredeljene vrzeli po temah kažejo trajajoče teoretične in praktične diskontinuitete, ki so obravnavane v nadaljnji razpravi.

4.1 Vrzeli, ki se pojavljajo v izhodiščih za RUP

Čeprav je ta pristop skladen z glavno usmeritvijo literature, omejena zastopanost podteme »tehnološki razvoj in aplikacije pametnega mesta«, opredeljene v tabeli 1, kaže, da dimenzija tehnološke preobrazbe kljub svojemu vse večjemu pomenu v širših urbanih študijah in političnih razpravah v literaturi o RUP še ni bila obravnavana na integriran način. Datta (2015) trdi, da agende pametnih mest pogosto oblikujejo podjetniške in v učinkovitost usmerjene logike, Luque-Ayala in Marvin (2015) pa kritično proučujeta, kako pametni urbanizem običajno poudarja tehnične in menedžerske rešitve. Podobno Colding in Barthel (2017) poudarjata, da so urbani ekološki vidiki v literaturi o pametnih mestih nezadostno obravnavani. Ali digitalne infrastrukture resnično krepijo regenerativno zmogljivost mest ali le reproducirajo sodobno paradigmo trajnostnosti, osredinjeno na učinkovitost, je zato odprto področje razprave. Ta vrzel kaže, da je trenutno znanje o izhodiščih za RUP pretežno ekološko in upravljavsko usmerjeno, pri čemer se tehnologija pogosto obravnava kot sekundarna ali instrumentalna dimenzija.

4.2 Omejena vidnost medsistemske integracije med komponentami RUP

Ugotovitve potrjujejo, da splošno priznane komponente literature o RUP vključujejo načela krožnega gospodarstva, participativne procese, strategije prilagodljive ponovne uporabe in uporabo digitalnih tehnologij, vendar neupoštevanje teme »zmogljivost za medsistemsko integracijo«, predlagane v tabeli 1, med empiričnimi ugotovitvami poudarja pomembno konceptualno vrzel. Čeprav regenerativni pristopi dajejo prednost krepitvi relacijskih dinamik med ekološkimi, družbenimi in tehnološkimi podsistemi, obstoječa literatura te sisteme pogosto obravnava kot ločene domene. Zato so vloge soodvisnosti med cikli energija–voda–odpadki, družbenimi infrastrukturami in mehanizmi upravljanja pri oblikovanju regenerativnih izidov proučene le minimalno. McPhearson idr. (2016) trdijo, da urbane raziskave še naprej razdrobljeno obravnavajo urbane sisteme, Bai idr. (2016) pa zatrjujejo, da so sistemski pristopi v praksi nezadostno operacionalizirani. Hoff (2011) uvaja urbani nexus kot okvir za razumevanje soodvisnosti med sistemi virov, Liu idr. (2007) pa poudarjajo pomen konceptualizacije človeških in naravnih sistemov kot medsebojno povezanih. Ta vrzel vodi k interpretacijam RUP predvsem prek posameznih

domen intervencij, pri čemer zakriva večplastne interakcije, ki podpirajo regenerativno preobrazbo. Tako obrobna obravnava te teme v ugotovitvah kaže, da interdisciplinarni poudarek, ki je v literaturi pogosto izpostavljen, v praksi ni bil preveden v dejansko zmogljivost za medsistemsko integracijo, konceptualno pa ostaja komponenta, obrisi katere še niso popolnoma izraženi.

4.3 Izzivi RUP: nevidna tveganja onkraj dobro znanih vprašanj

Teme, kot so potreba po interdisciplinarnem pristopu, visoke finančne zahteve in družbeno sprejemanje, ki izrazito izhajajo iz ugotovitev, so v literaturi ponavljajoči se izzivi za izvedljivost RUP. Čeprav se tema »zloraba tehnologije«, predlagana v tabeli 1, v študiji ne pojavlja izrazito, vseeno opozarja na pomembno področje tveganja, ki so ga opredelili Ismagilova idr. (2022). Njihova analiza poudarja, da lahko uvajanje podatkovno podprtih tehnologij in pametnih sistemov ustvarja nove oblike odvisnosti in tveganja, povezana z upravljanjem. Vprašanje, ali so sistemi spremljanja, temelječi na senzorjih, ali podatkovno podprta orodja urbanega upravljanja resnično usklajeni z regenerativnimi cilji ali ustvarjajo nova razmerja odvisnosti oziroma ranljivosti upravljanja, v literaturi ostaja neodgovorjeno. Neobravnava tega vprašanja v ugotovitvah kaže, da se izzivi RUP še naprej obravnavajo pretežno v družbeno-gospodarskih okvirih. Hkrati so tehnološka tveganja obrobna celo v teoretični znanstveni literaturi.

4.4 Omejena vidnost institucionalnega upravljanja in usklajenosti politik

Ugotovitve v zvezi z integracijo RUP v procese urbanizma kažejo, da proces poteka po treh glavnih oseh: vključitev v strategije trajnostnega urbanega razvoja, integracija ekosistemskih storitev v sistem načrtovanja in ustvarjanje prostorskih izkušenj, vezanih na kraj. Ta okvir kaže, da regenerativnega pristopa ni treba razumeti le kot dopolnilno orodje, ki podpira okoljske cilje, temveč tudi kot paradigmo, ki preoblikuje način, na katerega se proizvaja in vrednoti načrtovalsko znanje. Vendar so dimenzije institucionalne zmogljivosti, usklajenosti upravljanja in usklajenosti politik – ki se v študiji ne pojavljajo izrazito – kritična vrzel pri integraciji regenerativnih procesov v sisteme načrtovanja. Podobno novejše študije poudarjajo, da procesi urbane regeneracije zahtevajo usklajeno delovanje na več institucionalnih ravneh, vključno z občinami, lokalnimi skupnostmi in regulativnimi organi, da bi se zagotovila učinkovita izvedba (Idrizbegović Zgonić idr., 2024).

Bulkeley idr. (2011) prikazujejo vlogo večravninskega upravljanja in usklajevanja politik pri oblikovanju procesov urbane preobrazbe. Regenerativna preobrazba zato ne zahteva le preoblikovanja prostorskih instrumentov, temveč tudi uskladitev institucionalnega usklajevanja in regulativnih okvirov. Ti vidiki kažejo, da imajo strukture upravljanja kritično, vendar premalo raziskano vlogo pri oblikovanju urbane preobrazbe. To stanje poudarja potrebo po nadaljnjih raziskavah regenerativnega načrtovanja z upravljavskih in institucionalnih vidikov.

4.5 Sodobni izzivi pri merjenju RUP

Različna orodja za ocenjevanje trajnostnih mest in indeksi prilagajanja podnebju, opredeljeni v ugotovitvah, kažejo širjenje literature o merljivosti RUP (Sala Benites idr., 2023; Williams, 2019; Fabbricatti in Biancamano, 2019). Vendar se zdi splošna struktura teh ocenjevalnih orodij zelo razdrobljena. Znaten del teh orodij zahteva dostop do obsežnih naborov podatkov, vendar ostajajo pomembni praktični izzivi glede razpoložljivosti podatkov in zmogljivosti zbiranja podatkov, zlasti na ravni lokalne uprave. Nezmožnost zagotavljanja kontinuitete podatkov zmanjšuje primerljivost kazalnikov, zaradi česar je dolgoročno vrednotenje RUP zahtevnejše. Poleg tega se je prilagodljivost obstoječih orodij različnim merilom izkazala za zahtevno področje. Številni ocenjevalni okviri ne zagotavljajo kazalnikov, ki bi jih bilo mogoče dosledno prenašati med ravnmi soseske, četrti, mesta in regije, s čimer ovirajo razvoj merilne strukture, združljive z večravninsko naravo RUP. Zato morajo prihodnje študije okrepiti ocenjevalne okvire RUP z vidika zmogljivosti zbiranja podatkov, prilagodljivosti različnim merilom in integracije tehnologije.

5 Sklep

Ugotovitve kažejo, da RUP, čeprav pridobiva vidnost, ostaja omejena v svoji konceptualni konsolidaciji in operativni jasnosti. Analiza razkriva, da so ključne dimenzije RUP – zlasti medsistemska integracija, usklajenost upravljanja in merilni okviri – nezadostno razvite, kar vodi v razdrobljeno razumevanje regenerativnih procesov. Te vrzeli nakazujejo, da je RUP še vedno pretežno uokvirjena v ekoloških in projektno usmerjenih vidikih, njene relacijske, institucionalne in večravninske dimenzije pa so premalo raziskane.

Z načrtovalskega vidika rezultati poudarjajo potrebo po ponovni umestitvi RUP kot upravljavsko usmerjene paradigme, ne pa kot nabora posameznih posegov. Napredovanje RUP zahteva močnejšo integracijo med urbanimi sistemi, izboljšano uskladitev med institucionalnimi in regulativnimi okviri ter razvoj prilagodljivih orodij za vrednotenje, zmožnih zajeti dolgoročne in večravninske vplive. Prihodnje raziskave bi se zato morale osrediniti na prevajanje regenerativnih načel v operativne načrtovalske instrumente, politične okvire in sisteme

spremljanja, ki lahko podprejo izvajanje in ocenjevanje RUP v raznovrstnih urbanih kontekstih.

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Izjava o razpoložljivosti podatkov

Nabor podatkov, ki podpira ugotovitve te študije, je javno dostopen v repozitoriju Zenodo na https://doi.org/10.5281/zenodo.19737456. Vključuje seznam pregledanih študij in povezane metapodatke, uporabljene v sistematičnem pregledu literature.

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Adolescent girls in public space: Toward a framework for action in urban design and planning

This article reviews recent academic literature on adolescent girls in public spaces with the objective of defining a framework for action in designing and planning public spaces for adolescent girls. There is growing global relevance of this age group, which now represents over 16% of the world population. Despite their demographic weight, adolescent girls are often overlooked in urban studies, which tend to focus on either children or adult women. Anchored in a gender-sensitive planning framework, this study conducts a scoping literature review following PRISMA guidelines, reviewing 2,737 documents and analysing sixty-eight publications indexed in Scopus and Web of Science Core Collection between 2010 and 2025. The findings are grouped by implications for planning and design. The review also identifies significant gaps in the literature, including limited evaluation of effective strategies or design elements that promote adolescent girls' use of public space, minimal focus on leisure environments, and scarce integration of cultural and social norms that shape gendered mobility. The findings underscore the fragmented research of intersecting issues such as violence, safety, adolescent needs, and spatial justice.

Keywords: public spaces, adolescent girls, gender-based violence, scoping review

1 Introduction

The urban adolescent population has surged, with more than 732 million adolescents living in urban areas worldwide (UNICEF, 2022). This geographic and demographic shift highlights the growing importance of recognizing adolescent girls as active participants in urban life. Entering adulthood is becoming more difficult as young people face challenges such as the climate crisis, unstable employment, health epidemics, displacement, insecurity, and violence (Majeed & Lee, 2017; Gharabaghi & Anderson-Nathe, 2018; Jones, 2019). These pressures often affect adolescent girls more severely, highlighting the need for intentional efforts to support their agency and empowerment (Banati et al., 2021).

Consequently, their needs must be considered in urban policies as well as in designing and programming public spaces in urban environments. Although there is abundant literature on public space, there is still limited research on adolescents, especially girls, as well as disaggregated city-level data by age and sex worldwide (Braverman-Bronstein et al., 2023). Previous scoping reviews have focused on barriers to use and remain anchored in physical and mental health disciplines (Hjort & Larsen, 2025).

This study develops an evidence-informed framework for planning and designing public spaces for adolescent girls by synthesizing recent research from various disciplines on their interactions with public spaces across diverse geographical contexts. Guided by the question "What is being said about adolescent girls and their engagement with public space, and what common themes can be identified across studies?", the review examines how this topic has been addressed in the literature and what implications emerge for urban planning and design. It is based on the assumption that research at the intersection of adolescent girls and public spaces remains relatively limited and dispersed across disciplines, and that a synthesis of existing knowledge can help identify recurring themes, gaps in the literature, and opportunities for future research and practice. When places are designed and programmed with an evidence-based approach, they have greater probabilities of success (Gootman & Eccles, 2002; Lippman, 2010; Marcus & Sachs, 2013; Sandström et al., 2024).

Within feminist geography and girlhood studies, the concept of an adolescent girl is not static or universal, but is shaped by historical, cultural, and contextual factors (Bettis & Adams, 2005; Driscoll, 2008; Mazzarella, 2008, 2019). The range for adolescent girlhood includes aspects beyond biological factors, such as social roles, behaviours, and expectations associated with femininity and youth. In many societies, girls are socialized into gender roles and norms that shape their opportunities and participation in public spheres, such as public spaces. In the context of this research, the term *adolescent girl* is used to refer to a young person transitioning from childhood to adulthood, loosely between the ages of ten and nineteen, who identifies as female or is assigned female at birth. Although policy documents such as the United Nations Convention on the Rights of the Child cover all individuals under eighteen, understanding the unique challenges faced by adolescent girls requires focused attention. Critical spatial scholarship has long maintained that spatial divisions and gender roles are socially constructed and mutually reinforcing (Gilbert, 1997; Women and Geography Study Group, 2014; Blidon & Zaragocin, 2019). This body of work shows how experiences in urban spaces (Rose, 2017; Hayden, 1980) are deeply gendered (Massey, 2013), shaped by social norms (Fenster, 2005; Beebeejaun, 2017), power relations, and historical intersectional inequities (McDowell, 1983; Ruddick, 1996) that often marginalize women's needs and perspectives. These social, racial, age, and gender inequalities influence people's ability to claim and inhabit space (Teelucksingh, 2006; Listerborn, 2008, 2016). Within this context, young women construct their identities (Bettie, 2014), embody difference (Francombe-Webb & Silk, 2016; Toussaint, 2018), and negotiate their presence in public space. Yet, as girls reach puberty, their engagement with public spaces often contracts, whereas boys' spatial freedom tends to expand (Valentine, 1997; Chant et al., 2017).

Building on these insights, gender-responsive planners, designers, and researchers have emphasized the need to design public spaces that support safety, mobility, comfort, and inclusion (Muxí Martínez et al., 2011; Massey, 2013; Soto Villagrán, 2016; Sánchez-de Madariaga & Zucchini, 2020). Research highlights the importance of spatial features such as lighting (Sumartojo, 2022), visibility (Navarrete-Hernandez et al., 2021), seating arrangements (Lesan & Gjerde, 2021), pathways, and facilities in shaping how welcoming and accessible public spaces are perceived to be (Loebach et al., 2020). These design considerations are particularly relevant for adolescent girls, whose opportunities to use and appropriate public space are often constrained by broader gendered inequalities. In architecture, urban planning, and geography, the desires and experiences of adolescent girls have often been overlooked (Gleason, 2008). Discussions on inclusion in urban strategies have predominantly centred on younger children or older adults, neglecting the distinct needs and preferences of teenagers (Khalifa et al., 2024; Bain, 2003; Kern, 2020). Sometimes, when there are data about teenagers, they are not disaggregated by gender (Chant et al., 2017) or, when there are gendered data, they are not disaggregated by age. Despite extensive studies on parks and recreational spaces for children and adolescents (Bedimo-Rung et al., 2005; Cohen et al., 2007; Ding et al., 2011), which primarily emphasize physical activity for

health benefits, gender-based differences in motivation to visit such spaces are frequently disregarded. Consequently, public space and park design criteria tend to prioritize active play while overlooking other crucial aspects such as socializing or rest and relaxation, contributing to a decline in girls' presence as they transition into adolescence (González Palomares & Sánchez Vela, 2014; Cohen et al., 2021).

Public spaces, defined as accessible areas for social interaction, recreation, and civic engagement, are vital components of community life, contributing to overall well-being and quality of life (Francis et al., 2012; Burke et al., 2016; Van Hecke et al., 2018; Carmona, 2019). These spaces are, and must be seen as, multifunctional areas for social interaction and cultural expression among a wide diversity of people. This review includes all types of publicly accessible spaces. It is for urban planning to establish and organize these public spaces, and for urban design to facilitate and encourage their use while enhancing a sense of identity and belonging. Public space is not only a physical space but also a socially constructed space that is deeply shaped by gender power dynamics (Navarrete-Hernandez et al., 2021). It is a "gendered, sexualized and racialized arena" (Scraton & Watson, 1998: 123). These factors can restrict the freedom of movement of adolescent girls, shaping both their decisions about accessing these spaces and their perception of them.

2 Materials and methods

This study conducted a scoping review to examine how existing research addresses the relationship between adolescent girls and public space, with the aim of identifying key implications for their inclusion in public space design and planning. A scoping review approach was chosen due to its suitability for exploring broad research topics, identifying key characteristics of a concept, and analysing gaps in current knowledge (Munn et al., 2018; Levac et al., 2010; Lockwood et al., 2019).

The initial search was conducted in two databases. The first search, in the SCOPUS database, focused on peer-reviewed literature published between January 2010 and July 2025. This initial search identified 130 records. The search of the second database, Web of Science Core Collection, identified 2,607 records, although it was already evident in the title of the articles that many were unrelated to public spaces and adolescent girls. The initial screening process was made via abstract review by two researchers and two research assistants. The process of identification, screening, eligibility, and inclusion is shown in Figure 1.

The review process followed three stages. First, titles were screened to identify studies explicitly related to adolescent girls and public spaces. Second, abstracts of potentially relevant articles were reviewed to assess their alignment with the research objective. Finally, full articles deemed relevant were analysed in detail for inclusion in the review. After abstract screening and repeat record elimination, sixty-eight records were eliminated from the Scopus search, and most of the Web of Science results, 2,602, were eliminated.

This scoping review focused on studies that explicitly addressed adolescent girls' interactions with public space. Although this approach was effective in capturing a diverse and relevant body of work, future research may benefit from incorporating broader search terms that could complement and enrich this perspective.

To identify themes or dimensions emerging from the research, the resulting sixty-seven documents were jointly reviewed and analysed using an expanded database. Descriptive characteristics (author, year, country, and disciplinary field) were used to contextualize literature, and qualitative synthesis focused on conceptual content related to adolescent girls' experiences in public space. The guiding question was the following: What is being said about adolescent girls and their engagement with public space, and what common ideas or patterns can be identified across studies?

The identification of dimensions followed an inductive and iterative process. Each of the sixty-seven texts was examined to detect insights, and the database was analysed to detect recurring concepts, allowing shared meanings to surface progressively through comparison across studies. Key concepts were identified first, and the strategic dimension emerged from there (Hinojosa Hinojosa & Casillas Zapata, 2026).

3 Results

Building on the methodological analysis described in the previous section, the emerging themes are discussed in this section as potential strategic dimensions for action in public space design and programming that includes adolescent girls, as shown in Table 1. More than one theme was identified in most articles.

The studies reviewed include thirty-four countries with different cultural contexts, from western Europe and North America to South Asia, sub-Saharan Africa, and Latin America. The degree to which adolescent girls differ from boys or other user groups in their use of public space likely varies across these settings. In highly gender-segregated contexts, restrictions on girls' mobility are likely more pronounced than in more egalitarian ones, a distinction that western-centric literature tends to underrepresent. To make this geographic spread transparent,

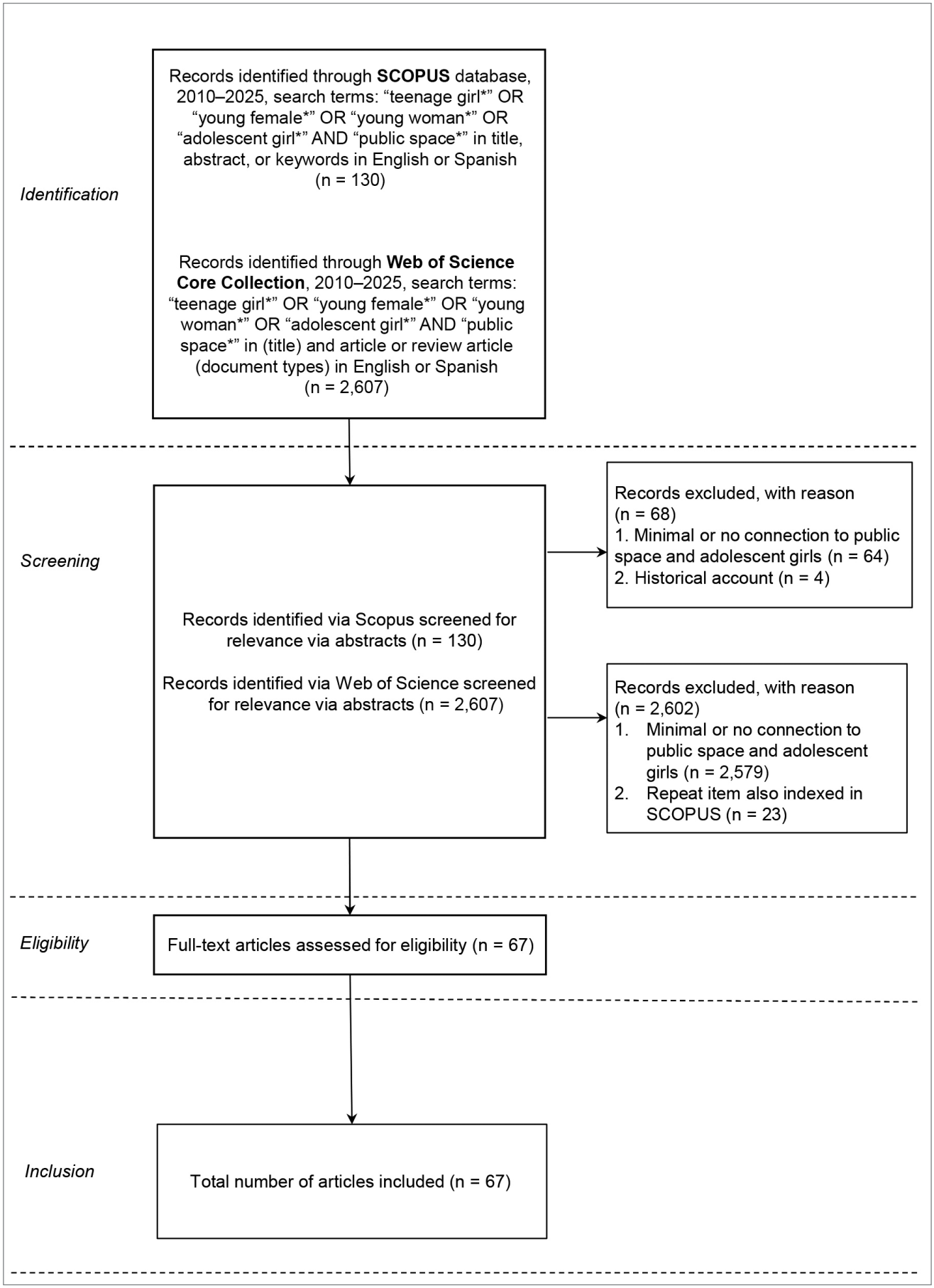

Figure 1. PRISMA flow diagram of the scoping literature review process (source: authors).

Table 1: Key concepts and emerging themes.

Key concepts identified	Emerging themes	Definition	Studies discussing theme
Peer connection, social interaction, shared experiences, opportunities for encounter, socialization, social support, social behaviour, social cohesion, social disorganization, social inclusion	Social connection	Relationships and interactions that enable individuals to engage and form networks in public space	5
Representation, inclusion, visibility, identity, participation, intersectionality, racism, discrimination, gender identity, social discrimination, placemaking, social participation, affordances, affect theory	Belonging	Sense of acceptance, visibility, and inclusion experienced by individuals in a shared environment	15
Perceived safety, comfort, social surveillance, safety, sexual harassment, violence, gender-based violence, street harassment, harassment, perception, place avoidance, fear of crime, psychological distress, sexual violence	Safety	Physical, emotional, and perceived conditions that allow users to occupy and move through space without fear	41
Play, mobility, recreation, mental health, physical activity, skateboarding, space use, physical activities, sedentary time, non-competitive sports	Activity	Range and intensity of behaviours that animate public life and reflect everyday spatial use	19
Sidewalk, walkability, walking, Google street view, GPS tracking, active travel, bicycle, internal displacement, metro system, mobilization, coping strategies, gender norms, restricted movement	Mobility	Ability of people to move through the city using several means of transportation	8

Source: authors.

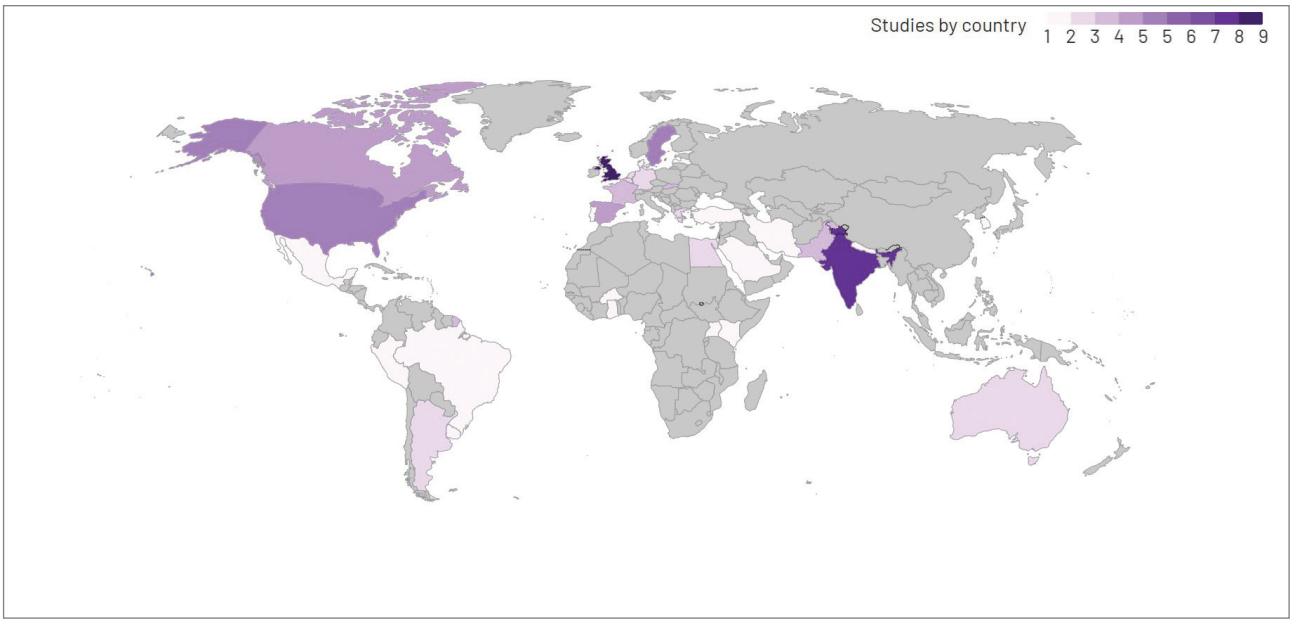

Figure 2: Geographic distribution of studies reviewed by country of origin (source: authors, based on publication count and country of origin as published in the articles on a World Bank official boundaries basemap).

we have mapped the distribution of the studies included in Figure 2. Future reviews would strengthen the evidence base further by explicitly analysing how cultural context moderates findings across settings.

3.1 Social connection

Social connection is essential to adolescent girls because it supports their development, identity formation, and well-being. Social connection is also a way to achieve feelings of safety, autonomy, and empowerment. Group companionship protects

adolescent girls from unwanted interactions with strangers and provides collective strategies to navigate gendered risks in public spaces. Social connection functions as a protective social infrastructure that allows access to public life (Spierings et al., 2016). For example, Dutch Moroccan teenage girls in disadvantaged neighbourhoods socialize in privately owned public places to avoid misinterpretation and minimize encounters with young men (Wijntuin & Koster, 2019). For adolescent girls, opportunities for social connection are closely linked to spatial preferences.

Cities and the public space they offer shape preferences. For example, in Barcelona, public spaces in urban centres such as plazas, parks, and markets are appealing because they allow collective presence and group socialization, which reinforce peer connection and belonging (Pérez et al., 2012). Further research from various cities shows other public space preferences; for example, a small qualitative study using structured interviews with adolescents from Tel Aviv, Hannover, Volos, and Lisbon found that adolescent girls tended to prefer semi-public environments such as malls, museums, and cinemas, where they could gather informally with peers while maintaining a sense of safety and comfort (Menezes et al., 2023).

When social connection is difficult in public spaces, online platforms have become alternative arenas where adolescent girls cultivate social ties and exchange experiences. Young Hispanic and Latinx feminists use digital networks and online groups to overcome the difficulties of meeting in physical public spaces (Delgado, 2018). Similarly, further research from Cerva Cerna (2021) shows how adolescent girls and young women protest in public spaces through physical presence and collective organization through digital platforms, which amplify their visibility, claims, and forms of resistance, expanding the reach of their engagement with public space. Digital tools can also increase the participation of girls in the design and planning of urban environments by allowing them to express spatial needs and preferences, while also generating social connections. However, technological gaps can reproduce existing inequalities when girls in rural or marginalized urban areas have limited access and no alternative channels for participation and connection (Geropanta & Cornelio-Marí, 2022).

Participation in sports offers another meaningful pathway for social connection. Adolescent girls appreciate recreational spaces where physical activity emphasizes collaboration and shared enjoyment rather than competition (Kalniņa & Stokmane, 2022). The need for social connection often coexists with a wish for distance. Although girls value proximity to peers, they also seek spaces that provide privacy and autonomy. Research in neighbourhood parks shows that girls tend to prefer areas away from playgrounds and residential buildings, where they can converse freely without being disturbed or disturbing others (Pyyry, 2015; Li et al., 2018; Sundevall & Jansson, 2020). This balance between closeness and control over space reveals that social connection also depends on the ability to choose when and how to engage with others.

3.2 Belonging

Belonging, in the deepest sense, means recognizing aspects of one's identity in space and with others. It emerges through identification with specific environments, such as places perceived as for women, K-pop fans (Fedorenko, 2021), or skaters (Paechter et al., 2023), and through relationships with peers that share similar experiences or traits. Within peer socialization, belonging reflects the intersection of multiple identities such as being a woman, an adolescent, a young person, or a skateboarder, and how these shape individuals' sense of self and group affiliation. Ultimately, belonging links social identity to the appropriation and meaning of public space.

Adolescent girls and those advocating for them employ diverse gender inclusion strategies to navigate and reclaim spaces often dominated by males. These strategies reflect both individual and collective efforts to foster affiliation and visibility in the public realm, showing that belonging is an active and negotiated process.

Two Swedish cases exemplify distinct approaches to creating belonging. The first, called strategic visibility, emphasizes girls' presence by designating girls-only spaces, making them visible and protected from male dominance (van der Burgt, 2015). The second, strategic entitlement, assumes girls' participation as natural and unquestioned, reinforcing their right to occupy spaces such as skateparks (Bäckström & Nairn, 2018). Both cement the idea that adolescent girls belong in public spaces.

Programming is also very relevant in fostering a sense of belonging. Programs that build life skills and confidence enable girls to navigate public spaces safely and assertively (Gillespie et al., 2025), empowering them to take active roles in their communities (Asghar et al., 2018).

Methodological approaches that view girls as subjects rather than objects of study become inclusion practices in themselves. Participatory and qualitative methods such as focus groups, observational mapping (Paechter et al., 2023), sensory ethnographic methods (Bäckström & Nairn, 2018), and walking interviews (Sundevall & Jansson, 2020) capture the depth of girls' lived experiences.

Acts of reclaiming space, such as decorating subway stations by K-pop fans in Seoul (Fedorenko, 2021), or participating

in civic initiatives (Cele, 2013), illustrate how girls and young women express belonging through creative and political agency in public life. Further research also documents mural painting as one of these forms of claiming space (Roy & Chatterjee, 2020).

3.3 Safety

Safety in public spaces is a central concern for adolescent girls, with gender-based violence emerging as the dominant theme across the literature reviewed. Outside the body of literature analysed, gender-based violence is defined as violence directed toward a person because of his or her gender, or violence that disproportionately affects persons of dissident genders due to structural power imbalances (van Daalen et al., 2022). Gender-based violence shapes how adolescent girls perceive and use public spaces, often leading to their exclusion and limited participation (Zietz & Das, 2018). Within the body of literature analysed, gender-based violence frequently intersects with other forms of discrimination, exacerbating vulnerability and exclusion (Sahu et al., 2017; Wringe et al., 2019). Of the articles included, thirty-nine address gender-based violence directly and two others indirectly, making safety the most prevalent dimension in research focused on adolescent girls.

The main idea is that there is a perception of public spaces as unsafe. Even in the absence of direct personal experience, culturally normalized fear of violence limits girls' participation in public life, reflecting narratives that are as consequential as actual crime rates (Bromley & Stacey, 2012; Fanghanel, 2014; Rišová & Sládeková Madajová, 2020). Further research suggests that women usually adopt avoidance behaviour because of fear of crime in public spaces, and they place restrictions on their own lives (Erkan & Sevin Topçu, 2021).

This perception is associated with mobility restrictions and control. Patriarchal norms dictate what girls wear, where they go, when they occupy certain spaces, and which activities are considered appropriate (Avendaño et al., 2022). This is further described in the section on mobility.

Sexual harassment occurs in public spaces. Sexual harassment is most commonly associated with streets and public workplaces (Bevilacqua et al., 2022; Casanovas et al., 2022). In some contexts, girls internalize these experiences as normative, compounding their exclusion (Asghar et al., 2018).

However, adolescent girls adopt collective responses and protective factors. Support networks including mothers, female peers, and mentors enable girls to remain active in public spaces despite safety barriers (Bankar et al., 2018; Cislaghi et al., 2020). Sports programs tailored for girls, such as those documented in Delhi, further support this by building confidence and breaking down participation barriers (Chawansky & Mitra, 2015). Positive emotions such as confidence, freedom, and empowerment drive proactive engagement in public life (van der Burgt, 2015; Delgado, 2018; Galanakis, 2016; McCammon et al., 2023; Bankar et al., 2018). At a broader level, collective political action in public spaces is a direct mechanism through which young women contest systemic inequality and assert their right to occupy public space (Bäckström & Nairn, 2018). Further research also suggests that community cohesion acts as a protective buffer against visible forms of public violence (Poix et al., 2022).

3.4 Mobility

Mobility consists of the capacity or action of moving to different places, using several means of transportation. Mobility restrictions can be understood as limitations that hinder or disrupt free movement and the use of public space. Mobility restrictions in public spaces are closely tied to violence, sexual harassment, and social mobility opportunities for adolescent girls. Recent research outside the body of literature reviewed suggests that these restrictions may stem from a lack of affordable transportation options and safety concerns (Nasrin & Chowdhury, 2024). Among the findings in the articles reviewed, including fear of gender-based violence in public spaces, it was observed that cultural gender norms within families and communities may significantly curtail young women's mobility and perpetuate their dependency on being accompanied, hindering their access to education and well-paid employment opportunities (Sahu et al., 2017).

Adolescent girls adopt various coping strategies in their mobility in several ways. Some strive for independent mobility despite social restrictions such as strict curfews, chaperoning, not using public transport, and avoiding unsafe spaces (Chawansky & Mitra, 2015), whereas others resort to roaming within safer, familiar areas to experience freedom while still adhering to social norms and expectations (Wijntuin & Koster, 2019) such as being sensible, respectable, modest, and accommodating, and avoiding risk. Walking quickly to minimize time spent in public spaces and using public transport, despite its own safety concerns (Avendaño et al., 2022), are also common strategies.

In response to perceived risks, adolescent girls adopt individual protective strategies: avoiding male-dominated activity areas, altering their attire, selecting safer routes, and restricting the times they use public spaces (Reimers et al., 2018; Tanner et al., 2020; Rišová, 2021). Family and community hypervigilance, although framed as protection, reinforces these restrictions and reproduces control through fear (Bernard & Carlile, 2021).

3.5 Activity

Activity refers to the range of recreational engagements that adolescent girls experience in public spaces, which are not all physical or social in nature. Research shows that well-designed environments can encourage active lifestyles that contribute to adolescent health and development (Dias et al., 2018; Reimers et al., 2018; Van Hecke et al., 2018). Although not part of the body of literature included in this review, broader evidence indicates that physical activity levels among adolescents remain low worldwide, with nearly 80% of young people eleven to seventeen years old not meeting the recommended sixty minutes of daily moderate-to-vigorous physical activity (Sallis et al., 2016). This wider context highlights public space as a potentially important, yet underutilized, setting for adolescent activity and well-being.

Although addressing this issue is crucial, the research reviewed on adolescent girls' activity and public spaces has predominantly focused on physical activity. Few studies explore what types of activities girls actually enjoy in public environments. Most focus on combating inactivity (Schoeppe et al., 2014; Van Hecke et al., 2018; Dias et al., 2018; Menezes et al., 2019; Leduc, 2021) rather than understanding activities that are emotionally or socially fulfilling (McCammon et al., 2023).

In Australia, independent outdoor play has been linked to improved physical and mental health outcomes among adolescent girls (Schoeppe et al., 2014). Non-competitive activities, including informal play and recreational movement, are preferred by many adolescent girls. These allow participation without the pressure of performance or comparison (Kalniņa & Stokmane, 2022).

Beyond the studies included in this review, previous research indicates that cultural norms, socioeconomic conditions, and the design of public spaces can shape the range of activities available to adolescent girls. Gendered restrictions, safety concerns, and park environments oriented toward competitive sports or children's play may constrain opportunities for recreation and leisure, influencing how and where girls choose to spend their time in public space (Pérez-Tejera et al., 2018; Marquet et al., 2019; Roberts et al., 2019; Loukaitou-Sideris & Sideris, 2009).

Environmental qualities of public space influence how adolescent girls engage in activities. Elements such as ambient noise, the presence of others, and natural surroundings enhance comfort and facilitate more relaxed forms of movement (Li et al., 2018).

Some sports that used to be male dominated, such as skateboarding, increasingly allow girls to participate visibly and confidently in open urban environments (Bäckström & Nairn, 2018). Access to appropriate equipment and women-only areas expands the range of recreational activities available to adolescent girls (Paechter et al., 2023). Nonetheless, intolerance toward gender non-conformity continues to restrict their participation in some spaces. Broader sports literature suggests that experiences of exclusion linked to gender non-conformity remain a barrier to participation. A meta-analysis of non-accidental violence in sport found heightened vulnerability among gender non-conforming athletes (Staurowsky et al., 2020) which can include adolescent girls, highlighting a factor that may influence access to and engagement with recreational public spaces.

4 Discussion

For adolescent girls, social connection in public space is a constant balancing act between seeking visibility with peers and escaping surveillance from everyone else, all while using group companionship as a literal safety shield.

Belonging in public spaces is both a feeling and an active negotiation to reclaim space. They achieve it by gathering in protected "girls-only" spaces, or by asserting an unapologetic right to be there in male-dominated spaces, frequently cementing that connection by physically transforming the environment through creative and civic action. Belonging happens when adolescent girls see their own identities and subcultures reflected in a space or through the peers that gather there.

Safety emerged as the single most prevalent theme across the literature reviewed, with a substantial volume of research focusing on how the pervasive fear of gender-based violence acts as a regulatory force that restricts girls' mobility and presence in public spaces. It also forces girls to rely on coping strategies such as dependence on peer networks, girl-centred programming, and political action to navigate public spaces. Given its severe social consequences, gender-based violence is a humanitarian crisis; however, as van der Harst et al. (2023) note, public attention often focuses on a single category of harm, which in this case has obscured other structural dynamics, such as participation or inclusion opportunities. A critical research gap exists regarding the examination of how public space design and programming can create an inclusive and engaging environment for adolescent girls, in which they can feel free, not just safe.

Within this reviewed body of work, mobility emerged as a key theme, strongly linked with safety, illustrating how adolescent girls face systemic restrictions in public spaces. The literature

shows that community hypervigilance and patriarchal norms enforce strict boundaries, such as curfews and chaperoning, restricting girls access to public life. Adolescent girls navigate this policing through individual coping strategies to reduce their visibility through their clothes, walking rapidly, or sticking to small, familiar zones. One gap is that research, at least in this body of work, remains stuck on cataloguing restrictions and behavioural workarounds rather than proposing urban solutions that guarantee adolescent girls' freedom of movement.

Activity emerged as a key theme restricted by a narrow public health lens, focused heavily on combating physical inactivity. The critical implication and gap is that research and planning fail to investigate leisure, lingering, and collaborative activity instead of conflating all activity with physical activity, and physical activity with sports. A few studies focused on adolescent girls' preferred activities and interests (Kalniņa & Stokmane, 2022; Sayagh & Dusong, 2022; Paechter et al., 2023; Hjort & Larsen, 2025).

Two broader implications emerge from this review. First, although inclusive design for adolescent girls addresses age- and gender-specific needs, its benefits extend to a wider range of users, including adult women, older adults, and people with disabilities, supporting the case for treating adolescent girls as a distinct planning subject, but one that generates wider public benefit. Second, realizing the transformative potential of inclusive urban design and social programming requires a holistic understanding of daily experience, supported by participatory approaches that invite adolescent girls to shape the public spaces they inhabit.

5 Recommendations for urban design and planning practice

The following recommendations are grounded in the findings of the scoping review on adolescent girls and public space, and they are organized along the five themes that emerged from it, although safety and mobility were integrated because of their interrelation.

Safety and mobility: design for protection and freedom. The fear of gender-based violence functions as a structural force that limits girl's presence and mobility in public space. The dominant research and design responses have been protective rather than liberatory. Spatial design should create conditions in which girls feel safe and free.

- Configure lighting, sightlines, circulation paths, and furniture so that girls can move through spaces safely.
- Design for girls' sense of control over their own visibility, including how exposed they want to be, through subtle thresholds, seating arrangements, and spatial arrangements that support appropriation without full enclosure.
- Incorporate girls' own definition of safety into design processes, which often include freedom from surveillance, not only from harm.
- Map adolescent girls' mobility patterns and incorporate them into planning decisions, including transit access, pedestrian infrastructure, and location of amenities they use.

Belonging: making spaces feel theirs. The literature shows that belonging requires active negotiation and is strengthened when girls can see their identities reflected in a space.

- Design spaces that encourage girls' regular, visible presence, reinforcing their right to occupy and enjoy them.
- Designate specific zones or time-based programming where adolescent girls can gather exclusively and be free from harassment.
- Leave room for appropriation, allowing girls to personalize and transform spaces.

Activity: diverse activities beyond sports. Research and programming have largely ignored the leisure, lingering, and collaborative activities that adolescent girls prefer and that serve important social and developmental functions.

- Support a range of activity types beyond competitive sports, including informal play, socializing, creative activity, skill-building, and rest.
- Provide comfortable, welcoming areas designed for low-pressure interaction where girls can linger without a defined purpose or structured program.
- Actively include adolescent girls in the design and programming of active play and competitive sports spaces, rather than assuming their participation or absence from them.

Social connection: supporting peer networks as infrastructure. Peer companionship is a primary coping and belonging strategy and a key aspect of how adolescent girls use public space.

- Include areas that facilitate group gathering, informal conversation, and peer interaction.
- Treat girl-centred social programming as a complement to spatial design, and involve girls in shaping both.
- Genuine connection also requires the ability to disconnect: girls need places to rest, recover, and re-engage on their own terms.

6 Conclusion

This article defines a framework for action in designing and planning public spaces for adolescent girls through a scoping review of sixty-seven studies. The scholarship on adolescent girls and public spaces remains limited and prioritizes risk,

particularly gender-based violence, over aspirations, everyday practices, leisure, and the positive conditions that allow participation. Spaces need to allow belonging, social connection, and the freedom to linger without purpose or pressure. Concrete strategies include seating that supports conversation, semi-enclosed zones that offer privacy without isolation, non-competitive programming at accessible hours, and lighting along routes. Practitioners can use the guiding questions in this article as a site-specific assessment tool alongside these principles. Design recommendations, global case studies, and diverse examples for practitioners have been described by collectives such as Make Space for Girls (2026) and Col·lectiu Punt 6 (2026). The five dimensions identified here – Belonging, Activity, Mobility, Social Connection, and Safety – provide a practical lens for analysis, design, and programming that can be adapted across cultural and geographic contexts.

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Data availability statement

The dataset supporting the findings of this study is publicly available in the Zenodo repository: https://doi.org/10.5281/zenodo.20347525.

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Mladostnice v javnem prostoru: razvoj okvira za ukrepanje v prostorskem oblikovanju in načrtovanju

Članek obravnava novejšo akademsko literaturo o mladostnicah v javnih prostorih zaradi opredelitve okvira za ukrepanje pri oblikovanju in načrtovanju javnih prostorov za mladostnice. Pomen te starostne skupine na svetovni ravni narašča, saj zdaj sestavlja več kot 16 % svetovnega prebivalstva. Kljub svoji demografski teži so mladostnice v urbanih študijah pogosto spregledane, saj se te večinoma osredinjajo bodisi na otroke bodisi na odrasle ženske. Študija, umeščena v okvir spolno občutljivega načrtovanja, vključuje pregled obsega literature po smernicah PRISMA, pri čemer sta avtorici pregledali 2.737 dokumentov in analizirali oseminšestdeset publikacij, indeksiranih v bazah Scopus in Web of Science Core Collection med letoma 2010 in 2025. Ugotovitve so razvrščene glede na implikacije za načrtovanje in oblikovanje. Pregled opredeljuje tudi pomembne vrzeli v literaturi, vključno z omejenim vrednotenjem učinkovitih strategij ali oblikovalskih elementov, ki spodbujajo rabo javnega prostora med mladostnicami, minimalno osredinjenostjo na okolja za prosti čas ter skromnim vključevanjem kulturnih in družbenih norm, ki oblikujejo spolno zaznamovano mobilnost. Ugotovitve poudarjajo razdrobljenost raziskovanja prepletajočih se vprašanj, kot so nasilje, varnost, potrebe mladostnikov in mladostnic in prostorska pravičnost.

Ključne besede: javni prostori, mladostnice, nasilje na podlagi spola, pregled obsega literature

1 Uvod

Urbana mladostniška populacija se je močno povečala. Po svetu živi na urbanih območjih več kot 732 milijonov mladostnikov in mladostnic (UNICEF, 2022). Ta geografski in demografski premik poudarja vse večji pomen prepoznavanja mladostnic kot dejavnih udeleženk urbanega življenja. Prehod v odraslost postaja težavnejši, saj se mladi soočajo z izzivi, kot so podnebna kriza, nestabilna zaposlitev, zdravstvene epidemije, razseljevanje, negotovost in nasilje (Majeed in Lee, 2017; Gharabaghi in Anderson-Nathe, 2018; Jones, 2019). Ti pritiski mladostnice pogosto prizadenejo huje, kar poudarja potrebo po namernih prizadevanjih za podporo njihovi zmožnosti delovanja in opolnomočenju (Banati idr., 2021).

Zato je treba njihove potrebe upoštevati v urbanih politikah ter pri oblikovanju javnih prostorov in načrtovanju njihove uporabe v urbanih okoljih. Čeprav je literature o javnem prostoru veliko, je raziskav o mladostnikih in mladostnicah, zlasti dekletih, še vedno malo, prav tako pa po svetu primanjkuje razčlenjenih podatkov na ravni mest po starosti in spolu (Braverman-Bronstein idr., 2023). Prejšnji pregledi obsega literature so se osredinjali na ovire pri rabi ter ostajajo zasidrani v disciplinah telesnega in duševnega zdravja (Hjort in Larsen, 2025).

Ta študija razvija z dokazi podprt okvir za načrtovanje in oblikovanje javnih prostorov za mladostnice s sintezo novejših raziskav iz različnih disciplin o njihovih interakcijah z javnimi prostori v raznolikih geografskih kontekstih. Pregled, ki ga usmerja vprašanje »Kaj literatura govori o mladostnicah in njihovem vključevanju v javni prostor in katere skupne teme je mogoče prepoznati med študijami?«, proučuje, kako je bila ta tema obravnavana v literaturi ter kakšne implikacije izhajajo iz nje za prostorsko načrtovanje. Temelji na predpostavki, da raziskovanje na presečišču mladostnic in javnih prostorov ostaja razmeroma omejeno in razpršeno po disciplinah ter da lahko sinteza obstoječega znanja pomaga prepoznati ponavljajoče se teme, vrzeli v literaturi in priložnosti za prihodnje raziskovanje in prakso. Kadar so prostori oblikovani na podlagi dokazov in je tako načrtovana tudi njihova uporaba, imajo večje možnosti za uspeh (Gootman in Eccles, 2002; Lippman, 2010; Marcus in Sachs, 2013; Sandström idr., 2024).

V feministični geografiji in študijah deklištva pojem mladostnice ni statičen ali univerzalen, temveč ga oblikujejo zgodovinski, kulturni in kontekstualni dejavniki (Bettis in Adams, 2005; Driscoll, 2008; Mazzarella, 2008, 2019). Obseg mladostniškega deklištva vključuje vidike, ki presegajo biološke dejavnike, kot so družbene vloge, vedenja in pričakovanja, povezana z ženskostjo in mladostjo. V številnih družbah so dekleta socializirana v vloge na podlagi spola in norme, ki oblikujejo njihove priložnosti in sodelovanje v javnih sferah, kot so javni prostori. V okviru te raziskave se izraz *mladostnica* uporablja za mlado osebo, ki prehaja iz otroštva v odraslost, okvirno med desetim in devetnajstim letom starosti, ki se opredeljuje kot ženska ali ji je bil ob rojstvu pripisan ženski spol. Čeprav dokumenti javnih politik, kot je Konvencija Združenih narodov o otrokovih pravicah, zajemajo vse posameznike, mlajše od osemnajst let, je za razumevanje posebnih izzivov, s katerimi se soočajo mladostnice, potrebna usmerjena pozornost. Kritično prostorsko raziskovanje že dolgo zagovarja, da so prostorske delitve in spolne vloge družbeno konstruirane in se medsebojno krepijo (Gilbert, 1997; Women and Geography Study Group, 2014; Blidon in Zaragocin, 2019). Ta korpus del kaže, da so izkušnje v urbanih prostorih (Rose, 2017; Hayden, 1980) globoko spolno zaznamovane (Massey, 2013), oblikovane z družbenimi normami (Fenster, 2005; Beebeejaun, 2017), razmerji moči in zgodovinskimi intersekcijskimi neenakostmi (McDowell, 1983; Ruddick, 1996), ki pogosto marginalizirajo potrebe in poglede žensk. Te družbene, rasne, starostne in spolne neenakosti vplivajo na zmožnost ljudi, da si prostor prisvojijo in ga naseljujejo (Teelucksingh, 2006; Listerborn, 2008, 2016). V tem kontekstu mlade ženske konstruirajo svoje identitete (Bettie, 2014), utelešajo razliko (Francombe-Webb in Silk, 2016; Toussaint, 2018) in se pogajajo o svoji prisotnosti v javnem prostoru. Kljub temu se ob vstopu deklet v puberteto njihovo vključevanje v javne prostore pogosto zoži, medtem ko se prostorska svoboda fantov navadno razširi (Valentine, 1997; Chant idr., 2017).

Na podlagi teh spoznanj so načrtovalci, oblikovalci in raziskovalci, ki se odzivajo na spol, poudarili potrebo po oblikovanju javnih prostorov, ki podpirajo varnost, mobilnost, udobje in vključevanje (Muxí Martínez idr., 2011; Massey, 2013; Soto Villagrán, 2016; Sánchez-de Madariaga in Zucchini, 2020). Raziskave poudarjajo pomen prostorskih značilnosti, kot so osvetlitev (Sumartojo, 2022), vidnost (Navarrete-Hernandez idr., 2021), razporeditev sedišč (Lesan in Gjerde, 2021), poti in oprema, pri oblikovanju zaznavanja javnih prostorov kot prijaznih in dostopnih (Loebach idr., 2020). Ti oblikovalski premisleki so posebej pomembni za mladostnice, katerih priložnosti za uporabo in prisvajanje javnega prostora so pogosto omejene s širšimi spolno zaznamovanimi neenakostmi. V arhitekturi, urbanističnem načrtovanju in geografiji so bile želje in izkušnje mladostnic pogosto spregledane (Gleason, 2008). Razprave o vključevanju v urbanih strategijah so bile večinoma osredinjene na mlajše otroke ali starejše odrasle, pri čemer so zanemarile posebne potrebe ter preference najstnikov in najstnic (Khalifa idr., 2024; Bain, 2003; Kern, 2020). Včasih podatki o najstnikih in najstnicah niso razčlenjeni po spolu (Chant idr., 2017), kadar pa obstajajo spolno razčlenjeni podatki, niso razčlenjeni po starosti. Kljub obsežnim študijam o parkih in rekreacijskih prostorih za otroke ter mladostnike in mladostnice (Bedimo-

-Rung idr., 2005; Cohen idr., 2007; Ding idr., 2011), ki primarno poudarjajo telesno dejavnost zaradi zdravstvenih koristi, so pogosto prezrte razlike po spolu v motivaciji za obisk takih prostorov. Posledično merila za oblikovanje javnega prostora in parkov praviloma dajejo prednost aktivni igri, pri tem pa spregledajo druge ključne vidike, kot sta druženje ali počitek in sprostitev, kar prispeva k upadu prisotnosti deklet ob njihovem prehodu v mladostništvo (González Palomares in Sánchez Vela, 2014; Cohen idr., 2021).

Javni prostori, opredeljeni kot dostopna območja za družbeno interakcijo, rekreacijo in državljansko udejstvovanje, so ključni sestavni deli skupnostnega življenja ter prispevajo k splošnemu blagostanju in kakovosti življenja (Francis idr., 2012; Burke idr., 2016; Van Hecke idr., 2018; Carmona, 2019). Ti prostori so in morajo biti razumljeni kot večnamenska območja za družbeno interakcijo in kulturno izražanje med zelo raznolikimi ljudmi. Ta pregled vključuje vse vrste javno dostopnih prostorov. Naloga urbanizma je vzpostaviti in organizirati te javne prostore, naloga urbanističnega oblikovanja pa olajšati in spodbujati njihovo rabo ter hkrati krepiti občutek identitete in pripadanja. Javni prostor ni le fizični prostor, temveč tudi družbeno konstruiran prostor, ki ga globoko oblikujejo spolne dinamike moči (Navarrete-Hernandez idr., 2021). Je »arena, ki je spolno zaznamovana, seksualizirana in zaznamovana z rasizmom« (Scraton in Watson, 1998: 123). Ti dejavniki lahko omejujejo svobodo gibanja mladostnic ter oblikujejo njihove odločitve o dostopu do teh prostorov in tudi njihovo zaznavanje teh.

2 Gradivo in metode

V tej študiji je bil izveden pregled obsega literature, da bi proučili, kako obstoječe raziskave obravnavajo razmerje med mladostnicami in javnim prostorom, zaradi opredelitve ključnih implikacij za njihovo vključevanje v oblikovanje in načrtovanje javnega prostora. Pristop pregleda obsega literature je bil izbran zaradi svoje primernosti za raziskovanje širokih raziskovalnih tem, prepoznavanje ključnih značilnosti pojma in analizo vrzeli v obstoječem znanju (Munn idr., 2018; Levac idr., 2010; Lockwood idr., 2019).

Začetno iskanje je bilo izvedeno v dveh bazah podatkov. Prvo iskanje v bazi Scopus se je osredinilo na recenzirano literaturo, objavljeno med januarjem 2010 in julijem 2025. To začetno iskanje je opredelilo 130 zapisov. Iskanje v bazi Web of Science Core Collection je opredelilo 2.607 zapisov, čeprav je bilo že iz naslovov člankov razvidno, da številni niso povezani z javnimi prostori in mladostnicami. Začetni postopek presejanja je bil izveden s pregledom povzetkov, ki sta ga opravila raziskovalca in raziskovalni asistentki. Postopek identifikacije, presejanja, preverjanja upravičenosti in vključitve je prikazan na sliki 1.

Postopek pregleda je potekal v treh fazah. Najprej so bili pregledani naslovi, da bi se opredelile študije, izrecno povezane z mladostnicami in javnimi prostori. Nato so bili pregledani povzetki potencialno relevantnih člankov, da bi se ocenila njihova skladnost z raziskovalnim ciljem. Nazadnje so bili celotni članki, ocenjeni kot relevantni, podrobno analizirani za vključitev v pregled. Po presejanju povzetkov in odstranitvi podvojenih zapisov je bilo iz iskanja v Scopusu izključenih oseminšestdeset zapisov, izločen pa je bil tudi večji del rezultatov iz baze Web of Science, in sicer 2.602 zapisa.

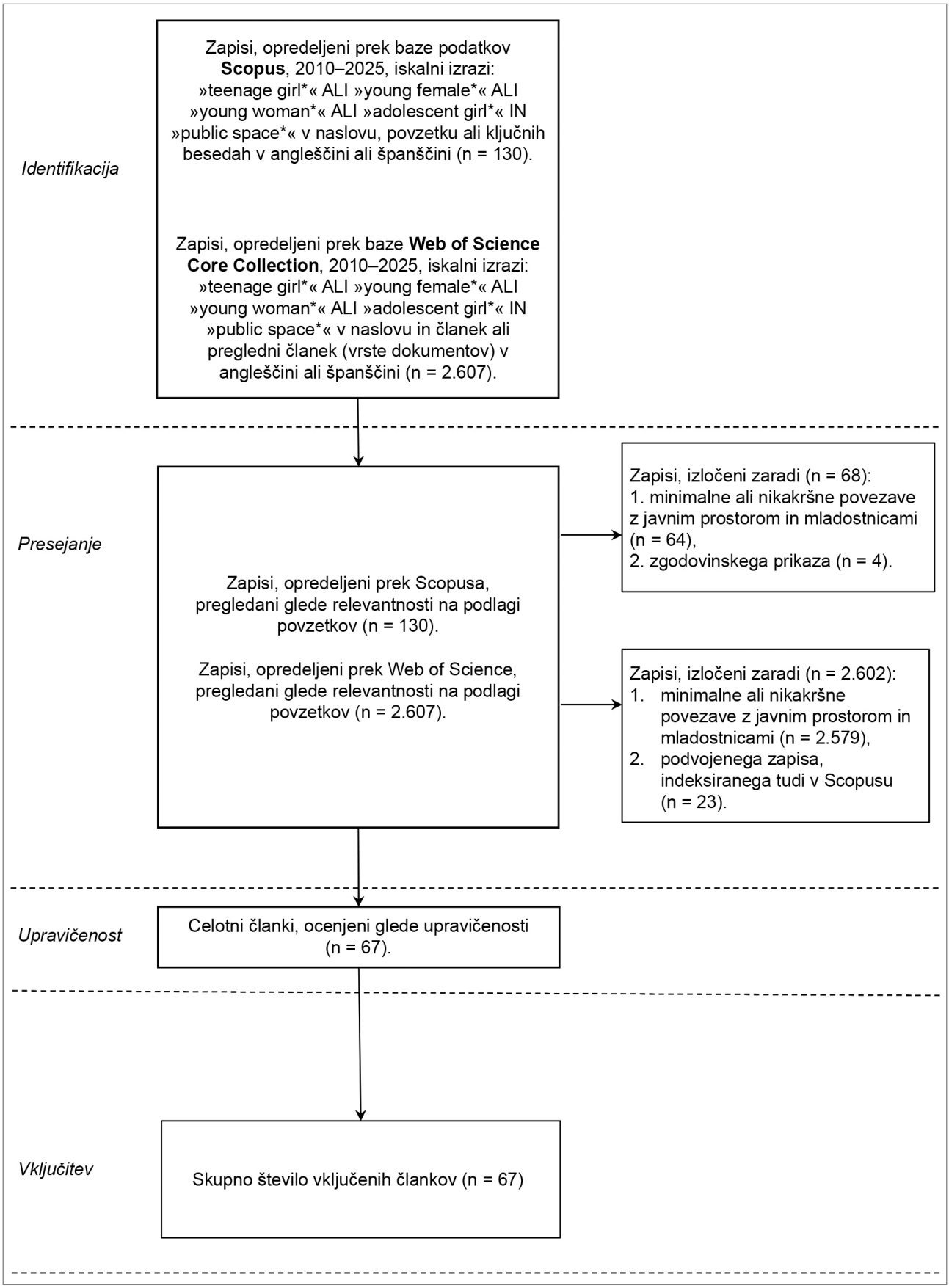
Ta pregled obsega literature se je osredinil na študije, ki so izrecno obravnavale interakcije mladostnic z javnim prostorom. Čeprav je bil ta pristop učinkovit pri zajemanju raznovrstnega in relevantnega korpusa del, bi prihodnjim raziskavam lahko koristila vključitev širših iskalnih izrazov, ki bi lahko dopolnili in obogatili ta vidik.

Za prepoznavanje tem ali razsežnosti, ki izhajajo iz raziskav, je bilo uporabljenih sedeminšestdeset dokumentov, ki so bili pregledani in analizirani z uporabo razširjene baze podatkov. Opisne značilnosti (avtor, leto, država in disciplinarno področje) so bile uporabljene za kontekstualizacijo literature, kvalitativna sinteza pa se je osredinila na konceptualno vsebino, povezano z izkušnjami mladostnic v javnem prostoru. Vodilno vprašanje je bilo: Kaj literatura govori o mladostnicah in njihovem vključevanju v javni prostor in katere skupne ideje ali vzorce je mogoče prepoznati med študijami?

Prepoznavanje razsežnosti je sledilo induktivnemu in iterativnemu procesu. Vsako od sedeminšestdesetih besedil je bilo pregledano zaradi odkrivanja spoznanj, baza podatkov pa je bila analizirana za prepoznavanje ponavljajočih se pojmov, kar je omogočilo, da so se skupni pomeni postopoma izoblikovali s primerjavo med študijami. Najprej so bili prepoznani ključni pojmi, iz njih pa se je nato razvila strateška razsežnost (Hinojosa Hinojosa in Casillas Zapata, 2026).

3 Rezultati

Na podlagi metodološke analize, opisane v prejšnjem poglavju, so v tem poglavju obravnavane nastajajoče teme kot potencialne strateške razsežnosti za ukrepanje pri oblikovanju in načrtovanju uporabe javnega prostora, ki vključuje mladostnice, kar prikazuje preglednica 1. V večini člankov je bila prepoznana več kot ena tema.

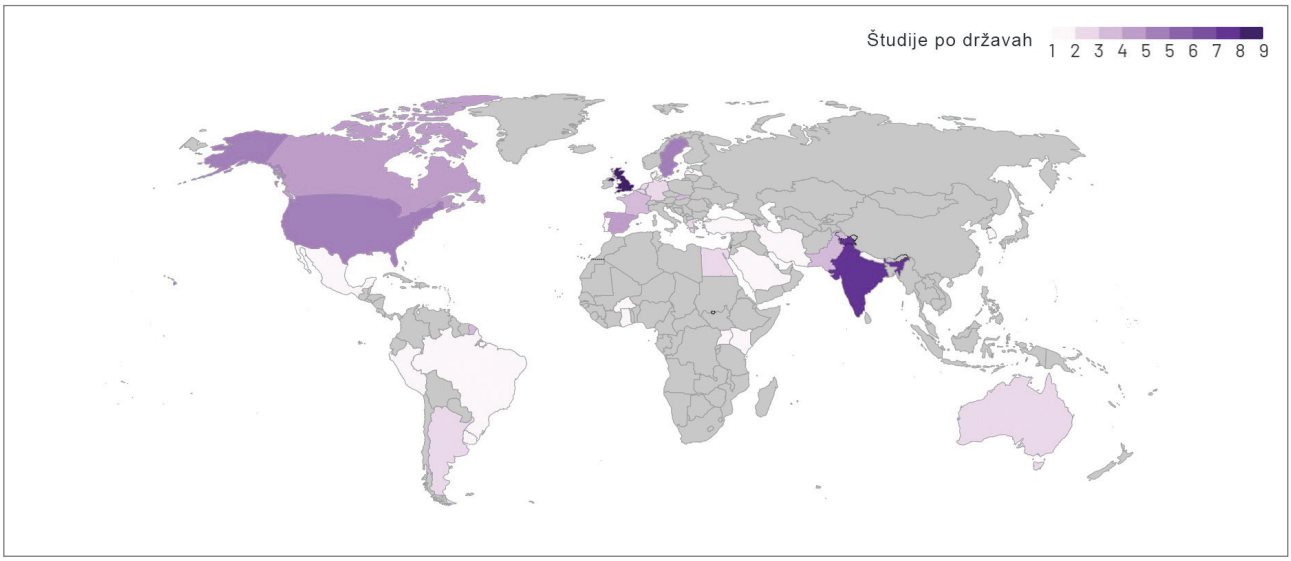


Slika 1: Diagram poteka PRISMA, ki ponazarja postopek pregleda obsega literature (vir: avtorici).

Preglednica 1: Ključni pojmi in nastajajoče teme

Prepoznani ključni pojmi	Nastajajoče teme	Opredelitev	Študije, ki obravnavajo temo
Povezanost z vrstniki, družbena interakcija, skupne izkušnje, priložnosti za srečanje, socializacija, družbena podpora, družbeno vedenje, družbena kohezija, socialna dezorganizacija, družbena vključenost	Družbena povezanost	Odnosi in interakcije, ki posameznikom omogočajo vključevanje in oblikovanje mrež v javnem prostoru.	5
Reprezentacija, vključevanje, vidnost, identiteta, sodelovanje, intersekcionalnost, rasizem, diskriminacija, spolna identiteta, družbena diskriminacija, ustvarjanje kraja, družbeno sodelovanje, omogočevalnosti, teorija afekta	Pripadanje	Občutek sprejetosti, vidnosti in vključenosti, ki ga posamezniki doživljajo v skupnem okolju.	15
Zaznana varnost, udobje, družbeni nadzor, varnost, spolno nadlegovanje, nasilje, nasilje na podlagi spola, ulično nadlegovanje, nadlegovanje, zaznavanje, izogibanje krajem, strah pred kriminaliteto, psihološka stiska, spolno nasilje	Varnost	Fizični, čustveni in zaznani pogoji, ki uporabnikom omogočajo, da prostor zasedajo in se po njem gibljejo brez strahu.	41
Igra, mobilnost, rekreacija, duševno zdravje, telesna dejavnost, rolkanje, raba prostora, telesne dejavnosti, sedeči čas, netekmovalni športi	Dejavnost	Razpon in intenzivnost vedenj, ki poživljajo javno življenje in izražajo vsakdanjo prostorsko rabo.	19
Pločnik, hodljivost, hoja, Google Street View, sledenje GPS, aktivno potovanje, kolo, notranja razseljenost, sistem podzemne železnice, mobilizacija, strategije spoprijemanja, spolne norme, omejeno gibanje	Mobilnost	Zmožnost ljudi, da se premikajo po mestu z uporabo različnih prevoznih sredstev.	8

Vir: avtorici



Slika 2: Geografska porazdelitev pregledanih študij po državi izvora (vir: avtorici; prikaz na podlagi števila publikacij in države izvora na karti uradnih meja Svetovne banke, kot sta objavljena v člankih).

Pregledane študije vključujejo štiriintrideset držav z različnimi kulturnimi konteksti, od Zahodne Evrope in Severne Amerike do Južne Azije, podsaharske Afrike in Latinske Amerike. Stopnja, do katere se mladostnice pri rabi javnega prostora razlikujejo od fantov ali drugih uporabniških skupin, se med temi okolji verjetno razlikuje. V izrazito spolno segregiranih kontekstih so omejitve mobilnosti deklet verjetno izrazitejše kot v bolj egalitarnih okoljih, kar je razlika, na katero zahodnocentrična literatura praviloma premalo opozarja. Da bi bila ta geografska razpršenost pregledna, smo razporeditev vključenih študij kartirali na sliki 2. Prihodnji pregledi bi dodatno okrepili dokazno podlago z izrecno analizo tega, kako kulturni kontekst moderira ugotovitve med različnimi okolji.

3.1 Družbena povezanost

Družbena povezanost je za mladostnice bistvena, ker podpira njihov razvoj, oblikovanje identitete in blagostanje. Je tudi način za doseganje občutkov varnosti, avtonomije in opolnomočenja. Skupinsko druženje mladostnice varuje pred nezaželenimi interakcijami z neznanci in zagotavlja kolektivne strategije za krmarjenje po spolno zaznamovanih tveganjih v javnih prostorih. Družbena povezanost deluje kot zaščitna družbena infrastruktura, ki omogoča dostop do javnega življenja (Spierings idr., 2016). Nizozemsko-maroške najstnice v socialno ogroženih soseskah se na primer družijo v zasebno upravljanih javnih prostorih, da bi se izognile napačnim interpretacijam in omejile srečanja z mladimi moškimi (Wijntuin in Koster, 2019). Za mladostnice so priložnosti za družbeno povezanost tesno povezane s prostorskimi preferencami.

Mesta in javni prostor, ki ga ponujajo, oblikujejo preference. V Barceloni so na primer javni prostori v urbanih središčih, kot so trgi, parki in tržnice, privlačni, ker omogočajo kolektivno prisotnost in skupinsko socializacijo, kar krepi povezanost z vrstniki in pripadanje (Pérez idr., 2012). Nadaljnje raziskave iz različnih mest kažejo druge preference glede javnega prostora, na primer majhna kvalitativna študija s strukturiranimi intervjuji z mladostniki in mladostnicami iz Tel Aviva, Hannovra, Volosa in Lizbone je ugotovila, da mladostnice praviloma dajejo prednost poljavnim okoljem, kot so nakupovalna središča, muzeji in kinematografi, kjer se lahko neformalno zbirajo z vrstniki, hkrati pa ohranjajo občutek varnosti in udobja (Menezes idr., 2023).

Kadar je družbena povezanost v javnih prostorih otežena, so postale alternativna prizorišča spletne platforme, kjer mladostnice gojijo družbene vezi in si izmenjujejo izkušnje. Mlade španske in latinskoameriške feministke uporabljajo digitalna omrežja in spletne skupine za premagovanje težav pri srečevanju v fizičnih javnih prostorih (Delgado, 2018). Podobno nadaljnja raziskava Cerve Cerne (2021) kaže, kako mladostnice in mlade ženske protestirajo v javnih prostorih s fizično prisotnostjo in kolektivno organizacijo prek digitalnih platform, ki povečujejo njihovo vidnost, zahteve in oblike odpora in širijo doseg njihovega vključevanja v javni prostor. Digitalna orodja lahko prav tako povečajo sodelovanje deklet pri oblikovanju in načrtovanju urbanih okolij, saj jim omogočajo izražanje prostorskih potreb in preferenc, hkrati pa ustvarjajo družbene povezave. Vendar lahko tehnološke vrzeli povečajo obstoječe neenakosti, kadar imajo dekleta na podeželju ali v marginaliziranih urbanih območjih omejen dostop ter nimajo alternativnih kanalov za sodelovanje in povezovanje (Geropanta in Cornelio-Marí, 2022).

Sodelovanje v športu ponuja še eno smiselno pot do družbene povezanosti. Mladostnice cenijo rekreacijske prostore, v katerih telesna dejavnost poudarja sodelovanje in skupno uživanje, ne pa tekmovalnosti (Kalniņa in Stokmane, 2022). Potreba po družbeni povezanosti pogosto soobstaja z željo po odmiku. Čeprav dekleta cenijo bližino vrstnikov, iščejo tudi prostore, ki zagotavljajo zasebnost in avtonomijo. Raziskave parkov v soseskah kažejo, da dekleta praviloma dajejo prednost območjem, oddaljenim od igrišč in stanovanjskih stavb, kjer se lahko nemoteno pogovarjajo, ne da bi jih kdo motil njih ali da bi one motile druge (Pyyry, 2015; Li idr., 2018; Sundevall in Jansson, 2020). To ravnovesje med bližino in nadzorom nad prostorom razkriva, da je družbena povezanost odvisna tudi od zmožnosti izbire, kdaj in kako se vključiti v odnose z drugimi.

3.2 Pripadanje

Pripadanje v najglobljem smislu pomeni prepoznavanje vidikov lastne identitete v prostoru in z drugimi. Nastaja pri identifikaciji s specifičnimi okolji, kot so kraji, zaznani kot namenjeni ženskam, oboževalkam K-popa (Fedorenko, 2021) ali rolkarjem in rolkarkam (Paechter idr., 2023), in v odnosih z vrstniki, ki delijo podobne izkušnje ali značilnosti. V okviru vrstniške socializacije izraža pripadanje presečišče več identitet, kot so biti ženska, mladostnica, mlada oseba ali rolkarka, ter način, na katerega te identitete oblikujejo posameznikov občutek sebe in pripadnosti skupini. Navsezadnje pripadanje povezuje družbeno identiteto s prisvajanjem in pomenom javnega prostora.

Mladostnice in tisti, ki jih zagovarjajo, uporabljajo raznovrstne strategije vključevanja na podlagi spola, da bi prve našle svoje mesto v prostorih, v katerih pogosto prevladujejo moški, in si jih ponovno prisvojile. Te strategije izražajo individualna in kolektivna prizadevanja za spodbujanje povezanosti in vidnosti v javni sferi, kar kaže, da je pripadanje aktiven in izpogajan proces.

Švedska primera ponazarjata različna pristopa k ustvarjanju pripadanja. Prvi, imenovan strateška vidnost, poudarja prisotnost deklet z določanjem prostorov samo za dekleta, s čimer postanejo vidna in zaščitena pred moško prevlado (van der Burgt, 2015). Drugi, strateška upravičenost, predvideva sodelovanje deklet kot naravno in samoumevno in krepi njihovo pravico do zasedanja prostorov, kot so rolkarski parki (Bäckström in Nairn, 2018). Oba utrjujeta idejo, da mladostnice spadajo v javne prostore.

Načrtovanje uporabe je prav tako zelo pomembno pri spodbujanju občutka pripadanja. Programi, ki krepijo življenjske

veščine in samozavest, dekletom omogočajo, da javne prostore uporabljajo varno in samozavestno (Gillespie idr., 2025), in jih opolnomočajo za aktivne vloge v njihovih skupnostih (Asghar idr., 2018). Metodološki pristopi, ki dekleta obravnavajo kot subjekte in ne kot objekte raziskovanja, postanejo prakse vključevanja. Participativne in kvalitativne metode, kot so fokusne skupine, opazovalno kartiranje (Paechter idr., 2023), senzorne etnografske metode (Bäckström in Nairn, 2018) in intervjuji med sprehodom (Sundevall in Jansson, 2020), zajamejo globino dekliških življenjskih izkušenj.

Dejanja ponovnega prisvajanja prostora, kot je okraševanje postaj podzemne železnice s strani oboževalk K-popa v Seulu (Fedorenko, 2021) ali sodelovanje v državljanskih pobudah (Cele, 2013), ponazarjajo, kako dekleta in mlade ženske izražajo pripadanje prek ustvarjalne in politične zmožnosti delovanja v javnem življenju. Nadaljnje raziskave dokumentirajo tudi poslikavo muralov kot eno od oblik prisvajanja prostora (Roy in Chatterjee, 2020).

3.3 Varnost

Varnost v javnih prostorih je osrednja skrb za mladostnice, pri čemer se nasilje na podlagi spola v pregledani literaturi pojavlja kot prevladujoča tema. Zunaj analiziranega korpusa literature je nasilje na podlagi spola opredeljeno kot nasilje, usmerjeno proti osebi zaradi njenega spola, ali nasilje, ki nesorazmerno prizadene osebe disidentskih spolov zaradi strukturnih neravnovesij moči (van Daalen idr., 2022). Nasilje na podlagi spola oblikuje, kako mladostnice zaznavajo in uporabljajo javne prostore, kar pogosto vodi v njihovo izključevanje in omejeno sodelovanje (Zietz in Das, 2018). V analiziranem korpusu literature se nasilje na podlagi spola pogosto prepleta z drugimi oblikami diskriminacije, kar poglablja ranljivost in izključenost (Sahu idr., 2017; Wringe idr., 2019). Med vključenimi članki jih nasilje na podlagi spola neposredno obravnava devetintrideset, dva pa posredno, zaradi česar je varnost najpogostejša razsežnost v raziskavah, osredinjenih na mladostnice.

Glavna ideja je, da javni prostori veljajo za nevarne. Tudi ob neobstoju neposredne osebne izkušnje kulturno normaliziran strah pred nasiljem omejuje sodelovanje deklet v javnem življenju, kar izraža narative, ki imajo enako pomembne posledice kot dejanske stopnje kriminalitete (Bromley in Stacey, 2012; Fanghanel, 2014; Rišová in Sládeková Madajová, 2020). Nadaljnje raziskave kažejo, da se ženske zaradi strahu pred kriminaliteto v javnih prostorih običajno vedejo izogibalno in si same omejujejo življenje (Erkan in Sevin Topçu, 2021).

To zaznavanje je povezano z omejitvami mobilnosti in nadzorom. Patriarhalne norme določajo, kaj dekleta nosijo, kam gredo, kdaj zasedajo določene prostore in katere dejavnosti se štejejo za primerne (Avendaño idr., 2022). To je natančneje opisano v poglavju o mobilnosti.

Spolno nadlegovanje se dogaja v javnih prostorih ter je najpogosteje povezano z ulicami in delovnimi mesti, ki se izvajajo na javnih površinah (Bevilacqua idr., 2022; Casanovas idr., 2022). V nekaterih kontekstih dekleta te izkušnje ponotranjijo kot normativne, kar še povečuje njihovo izključenost (Asghar idr., 2018).

Vendar mladostnice sprejemajo kolektivne odzive in varovalne dejavnike. Podporne mreže, ki vključujejo matere, vrstnice in mentorice, dekletom omogočajo, da kljub varnostnim oviram ostanejo aktivna v javnih prostorih (Bankar idr., 2018; Cislaghi idr., 2020). Športni programi, prilagojeni dekletom, kot so dokumentirani v Delhiju, to dodatno podpirajo s krepitvijo samozavesti in odpravljanjem ovir za sodelovanje (Chawansky in Mitra, 2015). Pozitivna čustva, kot so samozavest, svoboda in opolnomočenje, spodbujajo proaktivno vključevanje v javno življenje (van der Burgt, 2015; Delgado, 2018; Galanakis, 2016; McCammon idr., 2023; Bankar idr., 2018). Na širši ravni je kolektivno politično delovanje v javnih prostorih neposreden mehanizem, s katerim mlade ženske izpodbijajo sistemsko neenakost in uveljavljajo svojo pravico do zasedanja javnega prostora (Bäckström in Nairn, 2018). Nadaljnje raziskave kažejo tudi, da kohezija skupnosti deluje kot zaščitni blažilnik pred vidnimi oblikami javnega nasilja (Poix idr., 2022).

3.4 Mobilnost

Mobilnost obsega zmožnost ali dejanje premikanja na različne kraje z uporabo več prevoznih sredstev. Omejitve mobilnosti lahko razumemo kot omejitve, ki ovirajo ali prekinjajo prosto gibanje in rabo javnega prostora. V javnih prostorih so tesno povezane z nasiljem, spolnim nadlegovanjem in priložnostmi za družbeno mobilnost mladostnic. Novejše raziskave zunaj pregledanega korpusa literature kažejo, da lahko te omejitve izvirajo iz pomanjkanja cenovno dostopnih prevoznih možnosti in skrbi za varnost (Nasrin in Chowdhury, 2024). Med ugotovitvami v pregledanih člankih, vključno s strahom pred nasiljem na podlagi spola v javnih prostorih, je bilo opaženo, da lahko kulturne spolne norme v družinah in skupnostih znatno omejijo mobilnost mladih žensk in utrjujejo njihovo odvisnost od spremstva, kar ovira njihov dostop do izobraževanja in dobro plačanih zaposlitvenih priložnosti (Sahu idr., 2017).

Mladostnice pri svoji mobilnosti na različne načine sprejemajo raznovrstne strategije spoprijemanja. Nekatere si prizadevajo za samostojno mobilnost kljub družbenim omejitvam, kot so stroge policijske ure, spremstvo, neuporaba javnega prevoza in izogibanje nevarnim prostorom (Chawansky in Mitra, 2015), medtem ko se druge zatekajo k pohajkovanju znotraj

varnejših, znanih območij, da bi izkusile svobodo, hkrati pa še vedno upoštevale družbene norme in pričakovanja (Wijntuin in Koster, 2019), kot so razumnost, spoštljivost, skromnost, prilagodljivost in izogibanje tveganju. Pogosti strategiji sta tudi hitra hoja, da bi se skrajšal čas, preživet v javnih prostorih, in uporaba javnega prevoza kljub skrbem za varnost, povezanimi z njim (Avendaño idr., 2022).

Kot odziv na zaznana tveganja mladostnice sprejemajo individualne zaščitne strategije: izogibajo se območjem dejavnosti, kjer prevladujejo moški, spreminjajo svoj način oblačenja, izbirajo varnejše poti in omejujejo čas uporabe javnih prostorov (Reimers idr., 2018; Tanner idr., 2020; Rišová, 2021). Družinska in skupnostna hipervigilanca, čeprav je uokvirjena kot zaščita, krepi te omejitve in ustvarja nadzor prek strahu (Bernard in Carlile, 2021).

3.5 Dejavnost

Dejavnost se nanaša na razpon rekreacijskih vključevanj, ki jih mladostnice doživljajo v javnih prostorih, pri čemer niso vsa telesne ali družbene narave. Raziskave kažejo, da lahko dobro oblikovana okolja spodbujajo aktivne življenjske sloge, ki prispevajo k zdravju in razvoju mladostnikov in mladostnic (Dias idr., 2018; Reimers idr., 2018; Van Hecke idr., 2018). Čeprav širši dokazi niso del korpusa literature, vključenega v ta pregled, kažejo, da ostajajo ravni telesne dejavnosti med mladostniki in mladostnicami po svetu nizke, saj skoraj 80 % mladih med enajstim in sedemnajstim letom starosti ne dosega priporočenih šestdeset minut dnevne zmerne do intenzivne telesne dejavnosti (Sallis idr., 2016). Ta širši kontekst poudarja javni prostor kot potencialno pomembno, vendar premalo izkoriščeno okolje za dejavnost in blagostanje mladostnikov in mladostnic.

Čeprav je obravnava tega vprašanja ključna, so se pregledane raziskave o dejavnosti mladostnic in javnih prostorih pretežno osredinjale na telesno dejavnost. Malo študij raziskuje, katere vrste dejavnosti dejansko veselijo dekleta v javnih okoljih. Večina se osredinja na boj proti nedejavnosti (Schoeppe idr., 2014; Van Hecke idr., 2018; Dias idr., 2018; Menezes idr., 2019; Leduc, 2021), namesto da bi razumela dejavnosti, ki so čustveno ali družbeno izpolnjujoče (McCammon idr., 2023). V Avstraliji je bila samostojna igra na prostem povezana z boljšimi izidi telesnega in duševnega zdravja med mladostnicami (Schoeppe idr., 2014). Številne mladostnice imajo raje netekmovalne dejavnosti, vključno z neformalno igro in rekreacijskim gibanjem, saj omogočajo sodelovanje brez pritiska uspešnosti ali primerjanja (Kalniņa in Stokmane, 2022).

Onkraj študij, vključenih v ta pregled, prejšnje raziskave kažejo, da lahko kulturne norme, družbenogospodarske razmere in oblikovanje javnih prostorov oblikujejo razpon dejavnosti, ki so na voljo mladostnicam. Omejitve glede na spol, skrbi glede varnosti in okolja v parkih, usmerjena v tekmovalne športe ali otroško igro, lahko omejujejo priložnosti za rekreacijo in prosti čas ter vplivajo na to, kako in kje se dekleta odločajo preživljati čas v javnem prostoru (Pérez-Tejera idr., 2018; Marquet idr., 2019; Roberts idr., 2019; Loukaitou-Sideris in Sideris, 2009).

Okoljske lastnosti javnega prostora vplivajo na to, kako se mladostnice vključujejo v dejavnosti. Dejavniki, kot so zvok okolja, prisotnost drugih in naravno okolje, povečujejo udobje in omogočajo bolj sproščene oblike gibanja (Li idr., 2018).

Nekateri športi, ki so bili nekoč domena moških, kot je rolkanje, dekletom vse bolj omogočajo vidno in samozavestno sodelovanje v odprtih urbanih okoljih (Bäckström in Nairn, 2018). Dostop do ustrezne opreme in območij samo za ženske razširja razpon rekreacijskih dejavnosti, ki so na voljo mladostnicam (Paechter idr., 2023). Kljub temu nestrpnost do spolne nekonformnosti še naprej omejuje njihovo sodelovanje v nekaterih prostorih. Širša športna literatura kaže, da izkušnje izključevanja, povezane s spolno nekonformnostjo, ostajajo ovira za sodelovanje. Metaanaliza nenaključnega nasilja v športu je ugotovila povečano ranljivost med športniki in športnicami, ki so spolno nekonformni (Staurowsky idr., 2020), kar lahko vključuje mladostnice ter poudarja dejavnik, ki lahko vpliva na dostop do rekreacijskih javnih prostorov in vključevanje vanje.

4 Razprava

Za mladostnice je družbena povezanost v javnem prostoru nenehno lovljenje ravnotežja med iskanjem vidnosti z vrstniki in vrstnicami in izogibanjem nadzoru vseh drugih, pri čemer skupinsko druženje uporabljajo kot dobesedni varnostni ščit.

Pripadanje v javnih prostorih je hkrati občutek in aktivno pogajanje za ponovno prisvajanje prostora. Dosegajo ga z zbiranjem v zaščitenih prostorih »samo za dekleta« ali z uveljavljanjem pravice do prisotnosti v prostorih, kjer prevladujejo moški, brez opravičevanja, pri čemer to povezavo pogosto utrjujejo s fizičnim preoblikovanjem okolja prek ustvarjalnega in državljanskega delovanja. Pripadanje se zgodi, ko mladostnice v prostoru ali prek vrstnikov in vrstnic, ki se tam zbirajo, vidijo odsev lastnih identitet in subkultur.

Varnost se je izkazala kot najpogostejša posamezna tema v pregledani literaturi, pri čemer se obsežen del raziskav osredinja na to, kako vseprisotni strah pred nasiljem na podlagi spola deluje kot regulativna sila, ki omejuje mobilnost in prisotnost

deklet v javnih prostorih. Dekleta tudi sili, da se pri soočanju z izzivi v javnih prostorih zanašajo na strategije spoprijemanja, kot so odvisnost od vrstniških mrež, načrtovanje uporabe, osredinjeno na dekleta, in politično delovanje. Zaradi svojih hudih družbenih posledic je nasilje na podlagi spola humanitarna kriza, vendar, kot ugotavljajo van der Harst idr. (2023), se javna pozornost pogosto osredinja na samo eno kategorijo škode, kar je v tem primeru zasenčilo druge strukturne dinamike, kot so priložnosti za sodelovanje ali vključevanje. Kritična raziskovalna vrzel obstaja pri proučevanju, kako lahko oblikovanje in načrtovanje uporabe javnega prostora ustvarita vključujoče in privlačno okolje za mladostnice, v katerem se lahko počutijo svobodne, ne le varne.

V tem pregledanem korpusu del se je mobilnost pojavila kot ključna tema, močno povezana z varnostjo, kar ponazarja, kako se mladostnice v javnih prostorih soočajo s sistemskimi omejitvami. Literatura kaže, da skupnostna hipervigilanca in patriarhalne norme uveljavljajo stroge meje, kot so policijske ure in spremstvo, in omejujejo dostop deklet do javnega življenja. Mladostnice skozi to nadzorovanje krmarijo z individualnimi strategijami spoprijemanja, da bi zmanjšale svojo vidnost z oblačili, hitro hojo ali zadrževanjem na majhnih, znanih območjih. Ena od vrzeli je, da raziskovanje, vsaj v tem korpusu del, ostaja ujeto v katalogiziranje omejitev in vedenjskih obvodov, namesto da bi predlagalo urbane rešitve, ki zagotavljajo svobodo gibanja mladostnic.

Dejavnost se je pojavljala kot ključna tema, omejena na ozek javnozdravstveni vidik, ki se močno osredinja na boj proti telesni nedejavnosti. Kritična implikacija in vrzel sta, da raziskovanje in načrtovanje ne raziskujeta prostega časa, zadrževanja in sodelovalne dejavnosti, temveč vso dejavnost zamenjujeta s telesno dejavnostjo, telesno dejavnost pa s športom. Nekaj študij se je osredinjalo na dejavnosti in interese, ki jim mladostnice dajejo prednost (Kalniņa in Stokmane, 2022; Sayagh in Dusong, 2022; Paechter idr., 2023; Hjort in Larsen, 2025).

Iz tega pregleda izhajata dve širši implikaciji. Prvič, čeprav vključujoče oblikovanje za mladostnice obravnava starostno in spolno pogojene potrebe, njegove koristi segajo v širši krog uporabnikov, vključno z odraslimi ženskami, starejšimi odraslimi in osebami z invalidnostmi, kar podpira utemeljitev, da je treba mladostnice obravnavati kot poseben načrtovalski subjekt, vendar tak, ki ustvarja širšo javno korist. Drugič, uresničitev transformativnega potenciala vključujočega urbanističnega oblikovanja in družbenega programiranja zahteva celostno razumevanje vsakdanje izkušnje, podprto s participativnimi pristopi, ki mladostnice vabijo k oblikovanju javnih prostorov, ki jih zasedajo.

5 Priporočila za prakso urbanističnega oblikovanja in načrtovanja

Naslednja priporočila temeljijo na ugotovitvah pregledanega obsega literature o mladostnicah in javnem prostoru in so organizirana po petih temah, ki so izšle iz njega, čeprav sta varnost in mobilnost zaradi medsebojne povezanosti združeni.

Varnost in mobilnost: oblikovanje za zaščito in svobodo.
Strah pred nasiljem na podlagi spola deluje kot strukturna sila, ki omejuje prisotnost in mobilnost deklet v javnem prostoru. Prevladujoči raziskovalni in oblikovalski odzivi so bili zaščitni, ne pa osvobajajoči. Prostorsko oblikovanje bi moralo ustvarjati pogoje, v katerih se dekleta počutijo varna in svobodna.

- Oblikujte osvetlitev, vidne linije, poti gibanja in urbano opremo tako, da se lahko dekleta varno premikajo skozi prostore.
- Oblikujte tako, da imajo dekleta občutek nadzora nad lastno vidnostjo, vključno s tem, kako izpostavljena želijo biti, z diskretnimi prostorskimi ločnicami, razporeditvami sedišč in prostorskimi ureditvami, ki podpirajo prisvajanje brez popolne zaprtosti.
- V oblikovalskih procesih omogočite, da lahko dekleta sama opredeljujejo svojo varnost, kar pogosto vključuje svobodo pred nadzorom, ne le pred škodo.
- Proučite vzorce mobilnosti mladostnic in jih upoštevajte pri načrtovalskih odločitvah, vključno z dostopom do javnega prevoza, infrastrukturo za pešce ter lokacijo storitev in opreme, ki jo uporabljajo.

Pripadanje: ustvarjanje občutka, da so prostori njihovi.
Literatura kaže, da pripadanje zahteva aktivno pogajanje in se krepi, kadar dekleta lahko vidijo odsev svojih identitet v prostoru.

- Oblikujte prostore, ki spodbujajo redno, vidno prisotnost deklet in krepijo njihovo pravico, da jih zasedajo in uživajo v njih.
- Določite posebna območja ali časovno opredeljeno načrtovanje uporabe območij, na katerih se lahko zbirajo izključno mladostnice in niso deležne nadlegovanja.
- Pustite prostor za prisvajanje, tako da dekletom omogočite personalizacijo in preoblikovanje prostorov.

Dejavnost: raznovrstne dejavnosti onkraj športa.
Raziskovanje in načrtovanje uporabe sta večinoma prezrla prosti čas, zadrževanje in sodelovalne dejavnosti, ki jih imajo mladostnice raje ter opravljajo pomembne družbene in razvojne funkcije.

- Podprite razpon vrst dejavnosti onkraj tekmovalnega športa, vključno z neformalno igro, druženjem, ustvar-

jalno dejavnostjo, razvijanjem veščin in počitkom.
- Zagotovite udobna, prijazna območja, ki so zasnovana za neobremenjeno interakcijo, da se lahko dekleta tam zadržujejo brez določenega namena ali strukturiranega programa.
- Mladostnice aktivno vključite v oblikovanje in načrtovanje uporabe prostorov za aktivno igro in tekmovalne športe, namesto da bi predvidevali njihovo sodelovanje pri njih ali odsotnost.

Družbena povezanost: podpiranje vrstniških mrež kot infrastrukture.
Vrstniško druženje je primarna strategija spoprijemanja in pripadanja in ključni vidik tega, kako mladostnice uporabljajo javni prostor.
- Vključite območja, ki omogočajo skupinsko zbiranje, neformalne pogovore in vrstniško interakcijo.
- Družbeno programiranje, osredinjeno na dekleta, obravnavajte kot dopolnilo prostorskemu oblikovanju in dekleta vključite v oblikovanje obojega.
- Pristna povezanost zahteva tudi zmožnost odklopa: dekleta potrebujejo kraje za počitek, okrevanje in ponovno vključitev pod lastnimi pogoji.

6 Sklep

Ta članek opredeljuje okvir za ukrepanje pri oblikovanju in načrtovanju javnih prostorov za mladostnice s pregledom obsega sedeminšestdesetih študij. Znanstvena literatura o mladostnicah in javnih prostorih ostaja omejena ter daje prednost tveganju, zlasti nasilju na podlagi spola, pred željami, vsakdanjimi praksami, prostim časom in pozitivnimi pogoji, ki omogočajo sodelovanje. Prostori morajo omogočati pripadanje, družbeno povezanost in svobodo zadrževanja brez namena ali pritiska. Priporočene strategije vključujejo sedišča, ki podpirajo pogovor, polzaprta območja, ki ponujajo zasebnost brez izolacije, načrtovanje uporabe ob dostopnih urah in osvetlitev vzdolž poti. Praktiki lahko vodilna vprašanja v tem članku uporabljajo kot orodje za presojo primernosti posamezne lokacije glede navedenih načel. Oblikovalska priporočila, globalne študije primerov in raznovrstne primere za praktike so opisale strokovne skupine, kot sta Make Space for Girls (2026) in Col·lectiu Punt 6 (2026). Pet razsežnosti, opredeljenih v tem članku – pripadanje, dejavnost, mobilnost, družbena povezanost in varnost –, zagotavlja praktično izhodišče za analizo, oblikovanje in načrtovanje uporabe, ki jo je mogoče prilagoditi različnim kulturnim in geografskim kontekstom.

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