

Differences Between Perception and Reality – Green Infrastructure Related Cultural Ecosystem Services and Development Preferences under Peri-Urban Pressure

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1. Abstract

Sustainable development and maintenance of green infrastructure (GI) in municipalities is one of today's most important landscape architectural tasks. Most of the research on this topic focus on ecological aspects, however, there is a growing need to pay more attention also to the social aspects of it. Many documents and strategies emphasise the role of social inclusion in the GI development process (e.g Aarhus Convention, European Landscape Convection). This is particularly important in agglomeration-pressured settlements. Several researchers highlight that more attention should be paid to peri-urban ecosystem services and GI in order to elaborate the most effective resource management and policies to decrease the negative demographic and land use impacts. Among these research, the cultural ecosystem services (CES) of GI are the most neglected types. In order to regenerate efficiently landscapes in peri-urban areas, we need a deeper understanding of the CES provided by GI. In our research we focus on the differences between perception and reality of GI-related CES and development preferences, and took Vác from Budapest Metropolitan Region as a suitable peri-urban example.

We applied public participation GIS (ppGIS) method for involvement of local communities and collected information about their CES perception and development preferences related to GI as well as sociodemographic data about the participants. Interviews were carried out with 375 locals, using paper maps and a basic questionnaire. The analyses were performed partly by GIS methods and partly by statistical analyses using the collected almost 5000 CES and development preferences points.

Our results showed interesting relationships among CES and development preferences perceived by locals related to GI. We found differences and similarities in needs and preferences of GI based on sociodemographic background and also on the neighbourhoods of participants. Our results can help for planners and decision makers to understand better the relationships between locals and GI in peri-urban areas.

2. Introduction

The development of green infrastructure (GI) in towns is a key element in fostering a regenerative urban environment. A growing need exists to incorporate social aspects within the GI framework. Numerous documents and strategic plans underscore the importance of social inclusion throughout the GI development process, particularly in areas facing intense urbanization pressures. Several

researchers have called for increased attention to cultural ecosystem services (CES) and GI to devise optimal resource management strategies that mitigate adverse demographic and land-use effects (Jaligot et al., 2018; Oteros-Rozas et al., 2018). An indepth comprehension of the CES provided by GI, along with their perception by the local communities, is vital for efficacious landscape regeneration. In our research we applied public participation GIS (ppGIS) methodology to engage local communities, uncovering noteworthy correlations between CES and the conflicts perceived by locals related to GI and the real structure of GI.

3. Background and Literature Review

The negative impacts of rapid urbanization and suburbanization are also detectable in peri-urban areas (Chen et al., 2019). Despite the growing number of studies, some researchers persist in advocating for a heightened focus on peri-urban ecosystem services and GI in order to develop the most effective policies and resource management strategies to decrease the negative demographic and land use impacts (Jaligot et al., 2018). The development of GI in urban and peri-urban areas stands as a paramount professional task and a fundamental factor of regenerative urban landscape. Various green spaces in peri-urban areas exist, and urban greenery plays a crucial role in sustainable planning for these areas (Mortoja et al., 2020; Berke and Conroy, 2000). From this point of view, socially inclusive planning approaches (van Herzele et al., 2005) and the reduction of the uneven distribution of green spaces within cities (e.g., Dai, 2011) can optimize social benefits. While most of the GI research is ecologically oriented, there is an emergent need to consider social aspects and to deepen our understanding of the CES provided by GI (OterosRozas et al., 2018). According to the most common definition, CES are defined as the nonmaterial benefits derived from ecosystems that affect human well-being (MEA, 2005). The evaluation of CES is difficult, mainly because of their intangible nature and the variation in their relative significance across urban-rural geographical dimensions. (Chen et al., 2019). Researchers highlight the necessity for a better understanding of urbanization's influence on the perception and valuation of CES, particularly in relation to GI. CES evaluation requires either indicator measures using existing database or empirical work, the latter typically encompassing specialized surveys (e.g., questionnaires, in-depth interviews) and frequently incorporating participatory mapping (PPGIS) (Brown and Fagerholm, 2015). PPGIS, which merges contemporary cartography with participatory methods to gather and depict spatial information, allows for the integration of spatially explicit biophysical and perception-based data (Garcia-Martin et al., 2017). PPGIS has received increasing attention in the last decade, with reviews conducted to summarize existing methods and key findings (e.g., Garcia-Martin et al., 2017). These reviews reveal a geographic concentration of studies in North America, Oceania, and North-Western Europe, with a growing body from Central-Eastern Europe (CEE), focusing mainly on local urban settings (e.g., Valánszki et al., 2022).

Concurrently, various international documents and conventions, such as the Aarhus Convention (UNECE, 1998) and the European Landscape Convention (Council of Europe, 2000), highlight the significance of social inclusion in planning and strategy development processes (Chen et al., 2019), and in this way during GI development process. This is particularly important in agglomeration-pressured settlements (Dai, 2011; van Herzele et al., 2005).

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In our study, we analyse and evaluate the CES provided by GI and their perception by local communities to facilitate the effective regeneration of landscapes in peri-urban areas. To address this topic, we selected a district within the Budapest Agglomeration Region in Hungary as a case study. The analysis was guided by the following research questions:

- How do GI elements influence the perception of CES?
- What kinds of CES and problems do locals associate with GI in a town under urbanization pressure?
- How the basic sociodemographic influence the perception of GI-related CES and development preferences?

4. Method and Data

Vác, also known as the southern gateway of the Danube Bend, is a town located on the left bank of the Danube, at the foot of the Naszály Mountain. It is located approximately 20 km north of Budapest. The area of Vác is 61.5 km², with a population of 34,040 people (KSH, 2023). Vác is a significant settlement in the Budapest Agglomeration and has a substantial influence as a population attraction and regional center. According to the current urban development plan, the green areas categorized as public parks and public gardens within the administrative area of Vác cover an area of 87 hectares (size of green areas per capita is 26.15 m²). The public recreational green areas (e.g., playgrounds, sports fields) are predominantly found in the residential areas surrounding the historic city center.

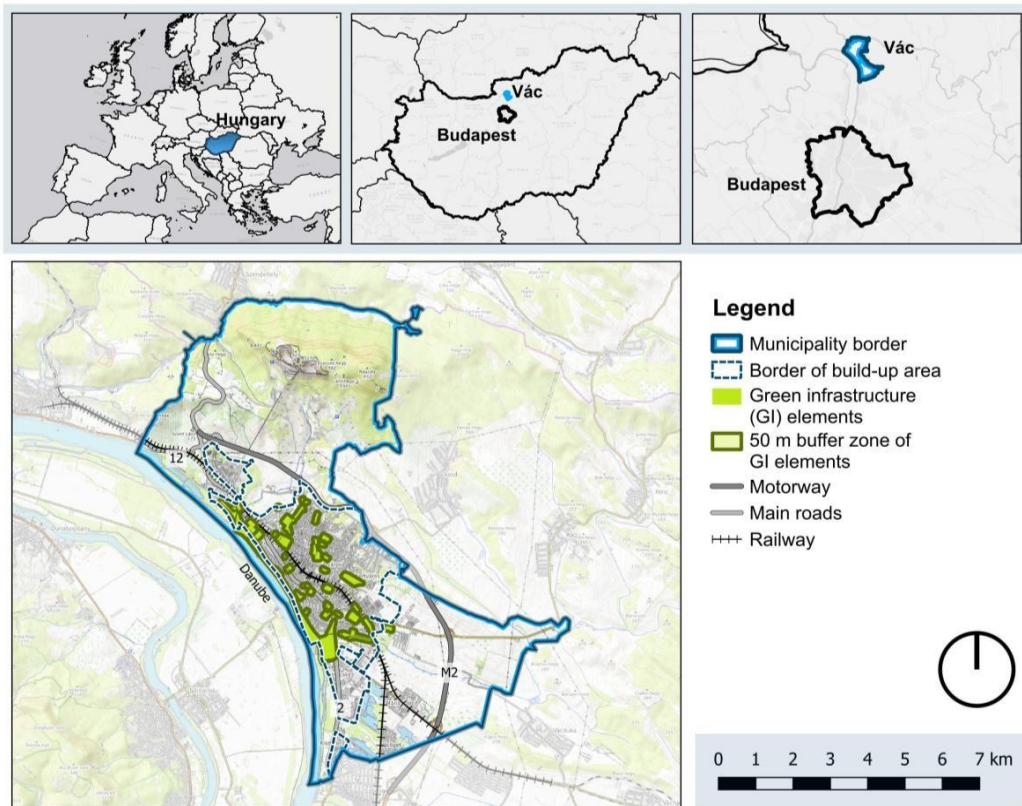


Figure 1. Location of the study area, town of Vác in the Budapest Agglomeration area (own figure)

During our research, we applied public participation GIS (ppGIS) method for involvement of local communities. In total six CES and six development preferences/problems were selected and mapped. They are mainly based on existing participatory and GI-related typologies (e.g., Fagerholm et al., 2016). The indicators were developed applying an operational description to help locals to respond. The six selected CES are: Places with high natural value and rich flora; Places for social activities; Places of historical and cultural interest; Places for physical or mental health, recharging; Well-ordered places with a beautiful townscape; Places for quiet rest and relaxation. The six development preferences/problems are: Congestion reduction is necessary in these places; Safety improvements are necessary in these places; Strengthening nature and environment protection is necessary in these places; The development of facilities, equipment and opportunities for leisure activities in these areas is necessary; Strengthening leisure services in these places is necessary; Improving accessibility and availability in these places is necessary.

The data collection was carried out between September 2023 and April 2024 involving bachelor and master students of the Hungarian University of Agriculture and Life Sciences, Institute of Landscape Architecture, Urban Planning and Garden Art. Interviews were carried out with 375 residents (gender: 202 women, 173 men; age: 0-17 years (84), 18-39 years (129); 40-64 years (88), 65- years (74)), using paper maps and a basic questionnaire (Valánszki et al., 2022). For an easier orientation, the names of the main streets and the neighbourhoods of the town were marked on the map. During the mapping, simple point markers were used. Minimum 1 and maximum three markers were employed per indicators. The 10-20-minute-long interviews started with exploring basic demographic characteristics and place of residence of the participants, and finished with the mapping process (Valánszki et al., 2022). The interviews were randomly distributed regardless of age and gender. In order to involve a high number of people, the interviews were carried out at many different locations such as railway stations, bus stops, schools, cafes, health care centres, parks (Fagerholm et al., 2016).

The mapped almost 5000 points were digitized in Quantum GIS software. The database contains the geographical location of points and the associated data (type of indicator demographic characteristics, etc.). The database also contains GI elements of Vác with 50 m buffer zones, both of them were overlaid with the marked points. Further analyses were performed partly by GIS methods and partly by statistical analyses. The results were analysed in tables and also on cartograms to understand the geographical relationships.

5. Results

In the first phase, the most commonly marked CES-type and development preferences among locals were analysed. Out of the 4926 points 2695 were CES, while 2231 were development preferences points. The order of the CES points was the following: Places for social activities (556); Places of historical and cultural interest (501); Places for quiet rest and relaxation (436); Places with high natural value and rich flora (406); Well-ordered places with a beautiful townscape (406); Places for physical or mental health, recharging (390). The order of the development preferences was: Congestion reduction is necessary in these places (470); Safety improvements are necessary in these places (441); Strengthening leisure services in these places is necessary (408); Improving accessibility and availability in these places is necessary (333); Strengthening nature and

environment protection is necessary in these places (310); The development of facilities, equipment and opportunities for leisure activities in these areas is necessary (269).

The spatial distribution of six CES-types and six development preferences were separately analysed. We found similar patterns in the cases of the following pairs of CES: “Places for social activities” with “Well-ordered places with a beautiful townscape”; “Places with high natural value and rich flora” with “Places for quiet rest and relaxation”. We also found quite a strong connection between the patterns of mapped points of “Places of historical and cultural interest” and “Well-ordered places with a beautiful townscape”. Points related to “Places for physical or mental health, recharging” have drawn a unique picture (Fig. 2.).

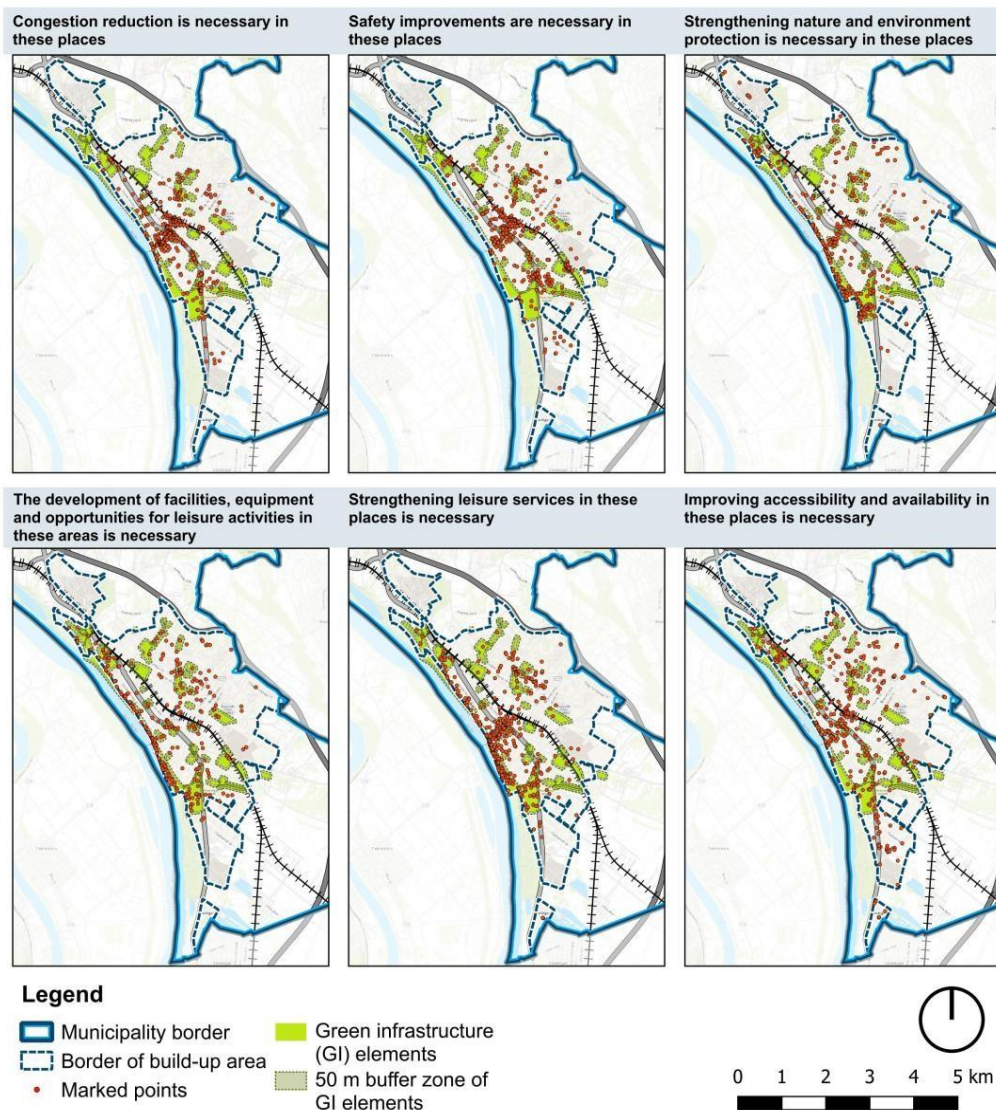
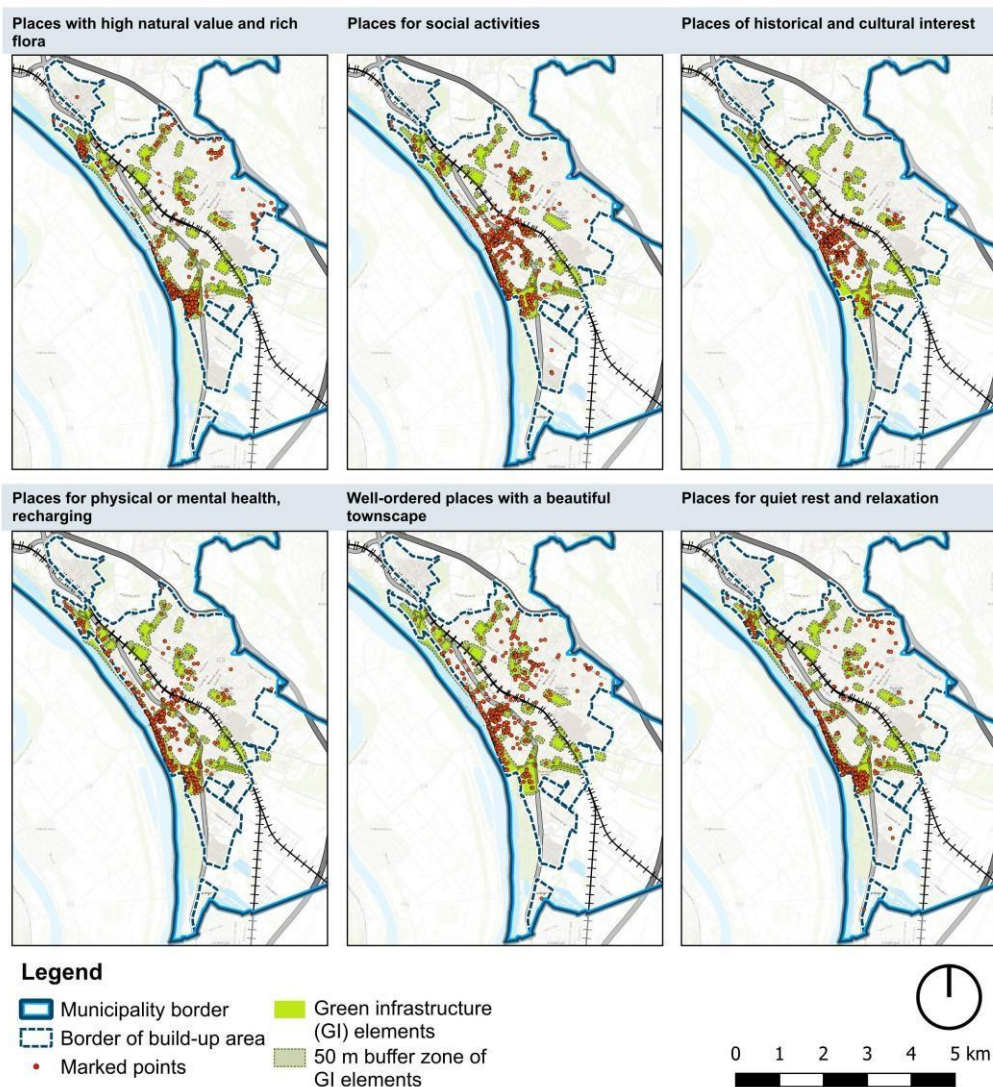


Figure 2. Spatial patterns of the six mapped CES-types (own figure)

The points of development preferences formed the following pairs based on similar spatial patterns: “Congestion reduction is necessary in these places” with “Safety improvements are necessary in these places”; “Strengthening nature and environment protection is necessary in these places” with “Strengthening leisure services in these places is necessary”. Spatial patterns of “The development

of facilities, equipment and opportunities for leisure activities in these areas is necessary” and “Improving accessibility and availability in these places is necessary” are very diverse and spreaded all over the town (Fig. 3.).

The relationships between GI elements of Vác and CES and development preferences were also analysed. We could observe a stronger connection between CES-types and GI: points of the various CES-types overlapping with GI elements varied between 33 and 69%. While weaker connections were identified between development preferences and GI: points of different development preferences overlapping with GI elements varied between 8 and 47%. The strongest connections were seen in the cases of “Places with high natural value and rich flora” (69%) and “Places for quiet rest and relaxation” (69%). The weakest connections were observed in the cases of 2 types of development preferences: “Congestion reduction is necessary in these places” (11%); “Safety improvements are necessary in these places” (8%). Considering the GI elements together with their 50 m buffer zones, similar results have been found: the connection was the strongest in the case of “Places for quiet rest and relaxation” (83%), while the weakest in the case of “Safety improvements are necessary in these places” (31%).



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Figure 3. Spatial patterns of the six mapped development preferences (own figure)

Basic sociodemographic features were also analysed using Games-howell Post-hoc test. In relation of the age groups our results showed significant differences in the cases of the following CES and preferences:

- Places of historical and cultural interest: marks of 65+ years > marks of 18-39 years
- Congestion reduction is necessary in these places: marks of 40-64 years > marks of 65+ years
- The development of facilities, equipment and opportunities for leisure activities in these areas is necessary: marks of 0-17 years > marks of 18-39 years and marks of 40-64 years > marks of 18-39 years
- Strengthening leisure services in these places is necessary: marks of 0-17 years < marks of 18-39 years and marks of 0-17 years < marks of 40-64 years
- Improving accessibility and availability in these places is necessary: marks of 40-64 years > marks of 65+ years

Our marital status-related results showed significant differences in 4 cases:

- Places of historical and cultural interest: marks of married > marks of singles
- Places for physical or mental health, recharging: marks of singles < marks of married and marks of singles < marks of in relationship
- Strengthening leisure services in these places is necessary: marks of singles < marks of married and marks of other types of marital status < marks of married
- Improving accessibility and availability in these places is necessary: marks of in relationship > marks of married

Number of children-related results showed significant differences in the cases of the following CES and preferences:

- Places of historical and cultural interest: marks of childless < marks of child living in the same household and marks of childless < marks of child not living in the same household
- Places for physical or mental health, recharging: marks of childless < marks of child living in the same household
- Well-ordered places with a beautiful townscape: marks of childless < marks of child living in the same household
- Places for quiet rest and relaxation: marks of childless < marks of child living in the same household
- Strengthening leisure services in these places is necessary: marks of childless < marks of child living in the same household

6. Discussion and Conclusion

The paper gives an example of cultural services and needs of green space development of Vác town in Budapest agglomeration. The study area is strongly related to River Danube and the locals have strong attachment to green spaces at river bank, and historical values are also important attractions at town center. However, typical problems of urban sprawl are also seen: emerging new artificial surfaces, tension caused by transport infrastructure.

Based on the results of the survey and PPGIS evaluation the green spaces are mentally connected to cultural services, however not so much related to the development preferences (Chen et al., 2019). Mainly the recreation and natural values have been connected to the GI elements. Another important result of the study is the highlighted difference between town center and areas outside the center. Most important cultural services related to the centres are social and recreational activities, as well as historical and cultural values in well-maintained places with a beautiful townscape. In contrast, outside the center naturality and relaxation are more often mentioned. Development preferences show different patterns. While in the center the congestion and safety are highlighted, beyond the center nature protection, leisure activities, accessibility and availability are more important factors. These different needs have to be taken into consideration for sustainable urban green development (Jaligot et al., 2018).

Our results showed, that there are many differences among the various sociodemographic groups in relation of CES-perception and GI-related development preferences. In these continuously changing areas, it is crucial to pay special attention to these different perspectives in order to avoid conflicts among the different sociodemographic groups and their GI-related needs and appreciation (Samuelsson et al., 2018).

Future research should compare these results with vegetation indexes, and land cover categories of urban tissue in order to improve the understanding of locals' needs related to urban green infrastructure. These aspects will bring us closer the understanding of the importance of physical aspects and vegetation density.

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