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## Identification and Perceived Value of Ecosystem Services of Urban Green Areas. Case Study: Kamenički Park in Novi Sad, Serbia

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## Identification and Perceived Value of Ecosystem Services of Urban Green Areas. Case Study: Kamenički Park in Novi Sad, Serbia

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### Abstract

Urban parks, as one of the most significant urban green areas (UGA), bring many direct or indirect benefits, including but not limited to ecosystem services (ES) (Mexia et al. 2018). These services are often generalized, unquantified and poorly supported by empirical evidence and their negative consequences – disservices are rarely mentioned (Roman et al., 2021; Pataki et al., 2011). In order to improve planning, design and management of UGA that can increase their environmental benefits (Xie et al. 2019), better understanding and additional field research of ES and disservices is required. As a result of a survey of employees of the Institute for Nature Conservation of Vojvodina Province that manages the park and on-site users, this study represents a research of the perceived value of generated ES on the example of Kamenički park in Novi Sad, as there are no studies on the actual value of those ES. After identifying major ES, the employees and users evaluated them by their perception on a scale of 1 – the ES is well provided, 2 – service is provided but can be enhanced and 3 – the service is not provided, but has potential. Employees mainly emphasized regulation and supporting services (regulation of air quality, noise reduction, wind protection, maintaining biodiversity), but also cultural services (educational role, recreation and enjoying nature, spiritual peace and prosperity). Users opted mainly for cultural services (recreation and enjoying nature and inspiration for culture, art and design), but also for supporting services like maintaining biodiversity. The specific location, valuable natural and cultural-historical characteristics of Kamenički park contribute to the provision of numerous ES, but also offer the opportunity to develop additional ones that are currently not represented or are not sufficiently provided. The opinions and needs of stakeholders and users regarding ES can be a guideline in planning in accordance with the ES, which is a step to sustainable cities. Quantifying the degree to which various ES are related to plant diversity and structure would provide evidence of the ability to manipulate designed ecosystems to maximize the benefits they provide to urban landscapes (Nighswander et al. 2021).

### 1. Introduction

As the perceived and actual ES values of UGA differ, understanding socio-cultural perceptions about human-nature relationships is essential to promote collective responses for sustainable ecosystem management (Yang et al. 2019). In order to improve the supply of ES and maximize their benefits, understanding how people perceive and value ES of UGA is necessary. The subject of this study is Kamenički Park in Novi Sad, a green area that has potential in ES supplying. Its location makes it especially attractive to a large number of visitors; the large area gives it a significant role in the city's greenery system and the rich dendroflora makes it recognizable. Kamenički Park represents a cultural-historical and environmental unit that has educational, scientific-research, sanitary, aesthetic, environmental, psychological and recreational function (Group of authors 2014). That is why it has great potential for development and improving the

provision of ES. The questions that will be answered by this study are - Are ES recognized by the users and managers of the Park? Which ES are harder to perceive and why? Can understanding of ES be complete without people's perception of them? Is it enough to have actual measured values of ES of parks for planning without a social context? As there are no studies on the actual value of ES generated by Kamenički Park nor the perceived value of ES by users and managers, this study provides insight into people's perception of ES.

## 2. Background and Literature Review

Urban parks are considered a natural solution to combat multiple environmental problems. They provide numerous benefits, including but not limited to ES that are valuable for the well-being of the urban population, i.e., for their physical and mental health (Mexia et al. 2018). Although, they improve the quality of life in cities, many environmental benefits of UGA are often unclear, unquantified and poorly supported by empirical evidence which makes designing and implementing of green infrastructure more difficult. They are often undifferentiated by climatic zone, local vegetation and soils, public interest and institutional or cultural values (Pataki et al. 2011). Given the importance of ES for human health and well-being, sound management of these services is very important. As ES are often generalized, their negative consequences – disservices are rarely mentioned (Pataki et al. 2011; Roman et al. 2021). They result in perceived or actual negative impacts on human wellbeing such as urban plantings that increase the occurrence of allergens and encourage invasive species, the development of pathogens or pests, endanger human mobility and the sense of security (Lyytimäki et al. 2008). In order to reduce disservices and increase services, good design and management of UGA is very important. With good design, parks provide many ES such as water and air purification, wind and noise mitigation, carbon sequestration, microclimate regulation, wildlife habitat provision, social and psychological well-being (Chiesura 2004; MEA 2005). Unlike other ES, cultural ecosystem services are more difficult to assess because their benefits are intangible and not easily discernible (Chan et al. 2012; Daniel et al. 2012), but are easier to perceive. Thus, their value is often underestimated, so preference is given to other services that improve people's physical health (Bedimo-Rung et al., 2005; McCormack et al., 2014), such as regulatory services - for example, improving air quality, water quality or climate regulation, that people cannot directly perceive (Pataki et al. 2011; Chang et al. 2017).

People's perception, sense, awareness and demand for ecosystem benefits often differ from the actual measured value of ES. This is because people's perceptions are influenced by their cultural education, moral beliefs and life experiences (Plieninger et al., 2013). As there is still insufficient information about ES public perception in developing countries (Yang et al. 2019), most cultural ES are rarely explicitly considered in the decision-making processes that shape the landscape (Chan et al. 2012; Plieninger et al. 2013). Prior to any policy or conservation action, it may be necessary to assess and work on local people's perception of the ES related to their livelihoods (Moutouama et al. 2019) because processes shaping ecosystems cannot be properly understood without considering the cultural context in which they emerge, bearing implications for ES planning and management (Graça et al. 2018). The human preference and perception regarding ES have been proposed as an emerging tool for addressing complex problems associated with global environmental change (Oteros-Rozas et al. 2014). Chen et al. in their study (2020) suggest that urban green infrastructure in the planning process should be balanced between ecological integrity and social perception. Understanding how citizens perceive and value urban ecosystems can

provide insights into the cultural practices that shape them. This knowledge can help guide urban ecosystem planning and management practices based on specific cultural backgrounds and can create stronger value for nature (Graça et al. 2018).

### 3. Method and Data

#### 3.1. Study area

Kamenički Park is the oldest and largest park in Novi Sad. Designed in English style in the 19<sup>th</sup> century around the Marcibanji and Karačonji family castle, the park has retained natural features (native vegetation, water surfaces and specific terrain morphology) (Bajić 2010; Mladenović 2015). With elements of natural and cultural landscape and a favourable location on the right bank of the Danube (Figure 1), Kamenički Park is located on the lowest slopes of Fruška gora and enters the protection zone of the national park “Fruška gora”. According to the IUCN, the park belongs to the third category of protected areas - Natural Monument due to its unique plant material, gene pool, biodiversity, as well as cultural and historical characteristics. The monument of nature "Kamenički Park" covers an area of 32 ha 83 and 09 m<sup>2</sup> and contains a valuable fund of dendroflora - remains of indigenous pedunculate oak forest (*Quercus robur* L.) on the northern slopes of Fruška gora (Group of authors 2014).



Figure 1. Location of Kamenički Park in Novi Sad, Serbia

#### 3.2. Questionnaire methodology (Survey methodology)

The survey was conducted on the employees of the Institute for Nature Conservation of Vojvodina Province (INCVP) that manage the park and on-site users to represent stakeholder and public perception of ES that the park generates or has potential to generate. The aim of this survey is to collect the preference information and estimate the use, perception, sense, awareness and demand of the ES that this park offers. After receiving a brief explanation of ES, participants had to choose 5 from 34 listed ES (Table 1) that they thought were the most important as benefits and potentials of Kamenički Park. After identifying major ES, the respondents evaluated them based on their perception and subjective experiences in the park on a scale of 1 – the ES is well provided, 2 – service is provided but can be enhanced and 3 – the service is not provided, but has potential. The data was analysed and graphically represented via histograms in Microsoft Excel.

**Table 1. List of ecosystem services**

Provisioning services	Regulation services	Supporting services	Cultural services
Food supply	Erosion prevention	Land formation	Recreation, rest, sports, enjoying nature
Wind energy	Land protection	Providing habitat for wild species	Tourism and promotion
Solar energy	Regulation of climate and climate extremes	Maintaining biodiversity	Educational activity
Wood biomass	Temperature and humidity regulation	Provision of genetic resources	Scientific research activity
Water supply	Air quality regulation	Seed dispersal	Aesthetic services in the form of even development of different content
Geothermal groundwater	Noise reduction	Photosynthesis	Spiritual peace and prosperity
	Wind protection	Nutrient cycle	Inspiration for culture, art and design
	Flood regulation	Primary production	Genius loci
	Pest and disease control	Energy	Nature experience
	Pollination		

#### 4. Results

The results showed that employees and on-site users recognized Kamenički Park as a provider of ES. Since 25 on-site users have chosen 5 from the list of 34 ES, there were in total 125 votes for ES. In Figure 2, results show that on site-users opted mainly for cultural ES, followed by supporting services, provisioning and regulation services. The most voted and frequently perceived ES was a cultural ES - recreation, rest, sports and enjoying nature (19/125), followed by a supporting ES - providing habitat for wild species (12/125) and again cultural ES - inspiration for culture, art and design (11/125) and spiritual peace and prosperity (10/125).

Besides solar energy which is mainly perceived as provided but can be enhanced, other provisioning services like wind energy, water supply and geothermal ground water are mainly perceived as not provided services that have potential. From the group of cultural ES tourism and promotion are perceived as not provided but have potential and recreation, rest, sport, enjoying nature, and inspiration for culture are perceived as services that are provided but can be enhanced. Other than maintaining biodiversity and providing habitat for wild species that are perceived as provided but can be enhanced, other supporting services were not opted by on-site users. From the group of regulation services on-site users opted mainly for noise reduction which is perceived as a service that is provided but can be enhanced (Figure 3).

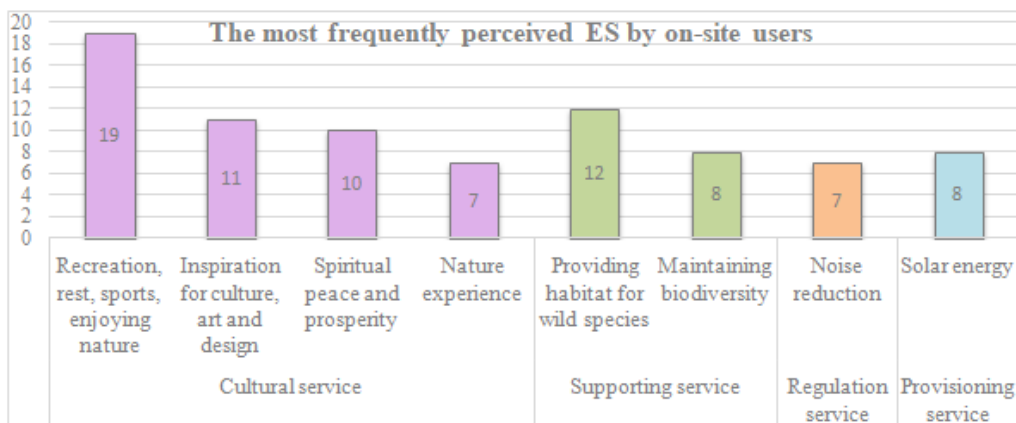


Figure 2. The most frequently perceived ES by on-site users

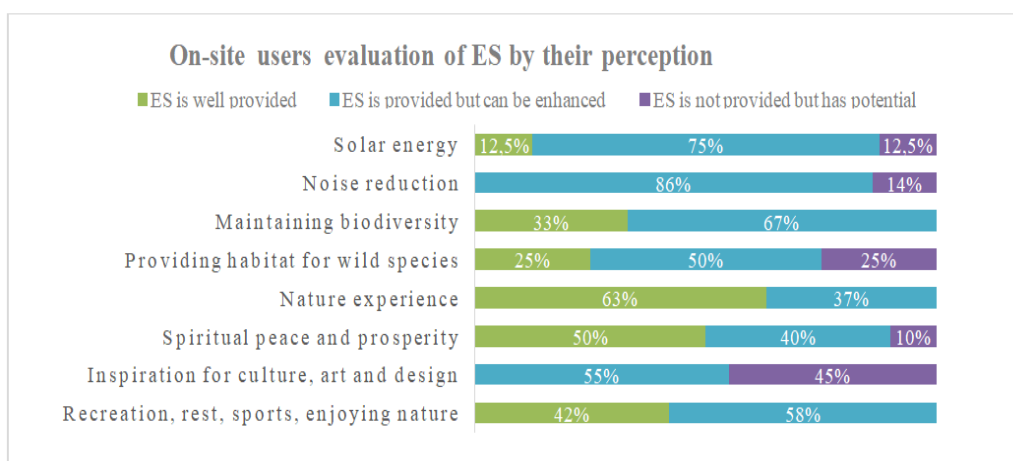
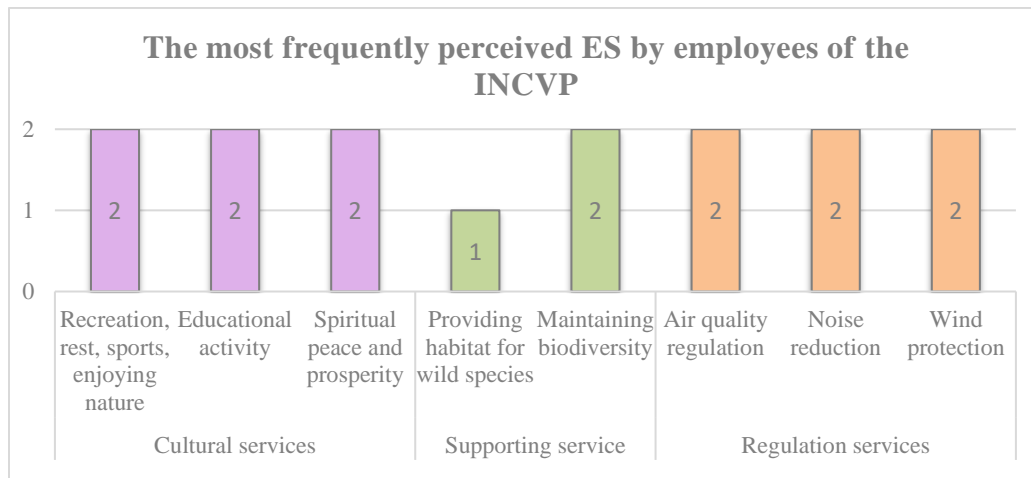
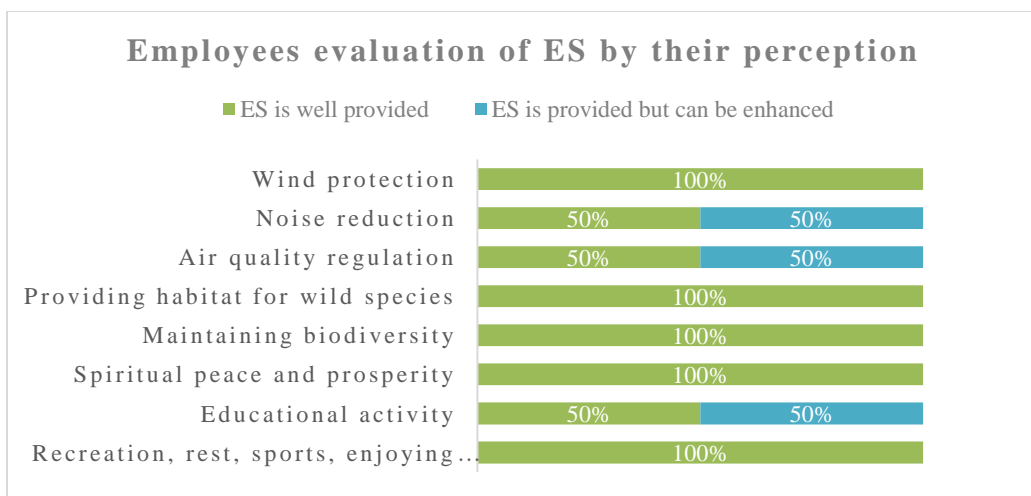


Figure 3. On-site users' evaluation of ES by their perception

Since 5 employees from of the INCVP, that manages the park, have chosen 5 from the list of 34 ES, there were in total 25 votes for ES. In Figure 4, results show that employees mainly emphasized regulation services (regulation of air quality (2/25), noise reduction (2/25), wind protection (2/25)) and cultural services (educational activity (2/25), recreation, rest, sports and enjoying nature (2/25), spiritual peace and prosperity (2/25)), but also supporting services like maintaining biodiversity (2/25) and providing habitat for wild species (1/25). Votes were more or less equal among the listed ES. It can be noted that employees did not choose provisioning ES. Regulation ES like noise reduction and air quality regulation were perceived as provided but with the chance of enhancing. Unlike on-site users, employees emphasized educational activity as a provided service that can be enhanced (Figure 5).



**Figure 4. The most frequently perceived ES by employees of of the INCVP**



**Figure 5. Employees' evaluation of ES by their perception**

## 5. Discussion and Conclusion

The well-known recreational public role of Kamenički Park was confirmed by the results of this study, though it revealed a much broader and varied set of ES types recognized by users. The results showed that both on-site users and managers of the park perceive Kamenički Park as a valuable green area for recreation that provides habitat for many species of plants and animals. As the easiest to perceive, on-site users opted mainly for cultural ES. Studying the differences between perception and measurements of ES provided by urban green infrastructures, authors Chen et al. (2020) confirmed that cultural services were the most easily perceived by the respondents, which is in line with our results. Although, they cannot directly perceive them, many respondents opted for supporting and regulation ES probably because of their education and beliefs. Many authors showed that the perception of ES services could vary in case of many factors. Authors Grača et al. (2018) noted that school level age and gender had the greatest influence on perception of ES in the case of street trees. Authors Yang et al. (2019) showed that place of living (urban/rural residents) has influence on perception. Authors Koyata et al (2021) showed that gender and age predict local



people's perception of ES. Since the survey of this study was conducted without division on age, gender or school level, the results are not definite but this research can serve as a starting point for future research on the perception of ES of parks in Novi Sad. We can conclude that on-site users in general opted for cultural services like recreation, rest, sports and enjoying nature inspiration for culture, art and design and spiritual peace and prosperity as they come to Kamenički Park mainly because of that role. Choices of the employees of the INCVP were influenced by their backgrounds regarding their protection and education activity. As our study represents ES perception as a social context, to address the actual value of ES as an ecological context, future field empirical study is needed. Altogether, comparison of perceived and actual value of ES can be used as a guideline for humanized urban planning that improves the usability of ES.

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