ECONOMICS OF SUSTAINABLE DEVELOPMENT
Vol. 10, January-April 2026, №. 1
UDK 33+502/504
ISSN 2560-421X

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P. 29-42
ORIGINAL SCIENTIFIC PAPER
DOI: 10.5937/ESD2601029N
Received: July 12, 2025
Accepted: September 10, 2025

ASSESSING THE SOCIO-ECONOMIC IMPACTS OF URBAN GREEN SPACES ON COMMUNITY WELL-BEING AND ENVIRONMENTAL JUSTICE: A CASE STUDY OF THE CITY OF NIŠ

Abstract

This study explores the impact of Urban Green Spaces (UGSs) on community well-being and environmental justice in Niš, Serbia. Conducted within the framework of TransformERS (CA 22156), the research focuses on the socio-economic effects of UGSs. UGSs play a crucial role in public health, social cohesion, and economic activities, as demonstrated by numerous studies. However, disparities in access and quality remain a significant challenge, particularly in marginalized urban areas. To evaluate the benefits of UGSs in Niš, this study utilizes a community-wide survey alongside spatial analysis through GIS software to assess real-world conditions. The findings indicate that 37% of the city's area consists of green spaces, including forests, green belts, parks, and lawns. A Structural Equation Model (SEM) is employed to analyze the complex relationships within the study. The results reveal a weak direct link between UGSs and community well-being. However, demographic factors and environmental justice serve as key mediators, clarifying the connection. To enhance community well-being through urban green spaces, policymakers should prioritize reducing income inequality and eliminating barriers that restrict access to UGSs.

Key words: *Urban Green Spaces (UGSs), Structural Equation Models (SEM), Community Well-Being, Environmental Justice*

JEL classification: *Q51, Q56, Q58*

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ПРОЦЕНА ДРУШТВЕНО-ЕКОНОМСКИХ УТИЦАЈА УРБАНИХ ЗЕЛЕНИХ ПОВРШИНА НА ДОБРОБИТ ЗАЈЕДНИЦЕ И ЕКОЛОШКУ ПРАВДУ: СТУДИЈА СЛУЧАЈА ГРАДА НИША

Апстракт

Ова студија истражује утицај урбаних зелених површина (УЗП) на добробит заједнице и еколошку правду у Нишу, Србија. Спроведено у оквиру пројекта TransformERS (CA 22156), истраживање се фокусира на социо-економске ефекте УЗП-а. Урбане зелене површине имају кључну улогу у јавном здрављу, друштвеној кохезији и економским активностима, што је потврђено бројним студијама. Међутим, неједнакост у приступу и квалитету ових простора и даље представља значајан изазов, нарочито у маргинализованим урбаним подручјима. Како би се процениле користи УЗП -а у Нишу, ова студија користи свеобухватну анкету на нивоу заједнице у комбинацији са просторном анализом путем GIS софтвера ради процене стварног стања на терену. Резултати показују да 37% површине града чине зелене површине, укључујући шуме, зелене појасеве, паркове и травњаке. За анализу сложених односа у оквиру студије примењен је Структурни модел једначина (СЕМ). Резултати показују слабу директну повезаност између УЗП-а и добробити заједнице. Међутим, демографски фактори и еколошка правда играју кључну улогу као посредници, јасније објашњавајући ову везу. Како би се унапредила добробит заједнице кроз урбане зелене површине, доносиоци одлука требало би да дају приоритет смањењу доходовне неједнакости и уклањању препрека које ограничавају приступ УЗП.

Кључне речи: *урбане зелене површине (УЗП), модели структурних једначина (СЕМ), добробит заједнице, еколошка правда*

Introduction

In today's world, climate change stands as one of the greatest challenges, and UGSs play a crucial role in mitigating its effects. UGSs are an essential component of urban planning and development, offering not only environmental benefits but also contributing to economic growth and social well-being. These green spaces include parks, gardens, urban forests, and green corridors, all of which help regulate air quality, control temperatures, and reduce the urban heat island effect (Kabisch et al., 2016). In addition to public green infrastructure, sustainability-oriented innovations in the private sector – such as the rise of green hotels – also contribute to the broader goals of sustainable urban development and competitiveness improvement (Jovanović, 2019).

Beyond their environmental impact, UGSs serve as spaces for physical activity, social interaction, and relaxation, significantly improving both the mental and physical health of urban residents (Hartig et al., 2014). Research in developed countries shows that equitable access to well-distributed green spaces is strongly linked to higher levels of individual happiness and life satisfaction, even after controlling for socio-demographic

factors (Kwon et al., 2021). Moreover, they boost local economies by increasing property values, attracting tourists, and creating jobs in urban planning and environmental management (Haaland & van den Bosch, 2015). As the third-largest city in Serbia, Niš is experiencing rapid urban growth, making the preservation and expansion of UGSs critical for maintaining a sustainable and livable urban environment. This research examines the socio-economic impact of UGSs in Niš and investigates their contribution to the overall well-being of its residents.

UGSs are increasingly recognized as essential for urban sustainability and social justice, offering free and accessible spaces for people of all socio-economic backgrounds (Jennings et al., 2017). However, many studies highlight disparities in access to green spaces, with low-income and marginalized communities often having limited availability of these essential resources (Rigolon, 2016; Loughran, 2014). European-level analyses further confirm that both access and quality of green spaces tend to be poorer in disadvantaged neighborhoods (EEA, 2022). UGS are increasingly recognized as crucial contributors to urban sustainability and public health worldwide (Li et al., 2023). Disparities in access and quality persist, with socio-economic inequities shaping urban residents' exposure to green infrastructure (EEA, 2022; Csomós et al., 2021).

In the city of Niš, Serbia, similar patterns have been identified, highlighting the urgency of integrating environmental justice into UGS planning (Mitrović et al., 2024). In Niš, historical significance and population growth have contributed to unequal distribution of UGSs, raising concerns about environmental justice (Anguelovski et al., 2020). The fair distribution of environmental benefits and burdens is a key principle of environmental justice (Schlosberg, 2013). Marginalized communities often face greater environmental and health risks, including limited park access, poor infrastructure, and exposure to pollution (Heynen et al., 2006). These inequalities widen socio-economic gaps and restrict access to green spaces for disadvantaged groups.

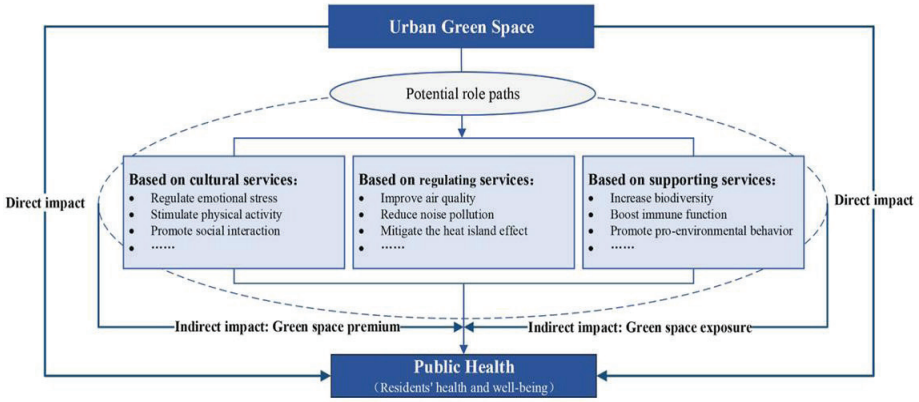
Niš is uniquely positioned within Serbia's broader urban development initiatives, which aim to expand public green spaces and promote social equity. When considering community well-being, this concept encompasses physical health, mental health, and economic stability - all of which are positively influenced by accessible and well-maintained UGSs (Markevych et al., 2017). UGSs provide spaces for recreation and exercise, encouraging an active lifestyle and reducing the risk of diseases such as obesity and cardiovascular conditions (James et al., 2015). Furthermore, green environments help alleviate stress, anxiety, and depression, promoting overall psychological well-being (Beyer et al., 2014; Gubić and Wolff, 2022). UGSs support local economies through tourism, maintenance jobs, and increased property values, contributing to economic stability (Wolch et al., 2014).

Model for UGSs by Yang et al. (2022) presented in Figure 1 also advocates that UGSs directly regulate emotional stress, stimulate physical activity, and promote social interactions based on cultural service. Furthermore, based on regulating services, UGSs improve the air quality index, reduce noise pollution, andmitigate the heat island effect. Based on supporting services, UGSs increase biodiversity, boost immune function, and promote pro-environmental behavior.

Like many cities in Southeastern Europe, Niš faces major urbanization challenges, including the loss of green spaces, population growth, and widening socio-economic inequalities (Živanović et al., 2022). Despite efforts by the local administration to preserve

and expand UGSs, disparities in access to these areas remain a significant concern for residents. Vujović et al. (2021) also emphasize the importance of environmental justice and social equity, highlighting the uneven distribution of green spaces across different socio-economic groups.

Figure 1: Model of UGSs affecting public health



Source: Yang et al. (2022)

This research is part of the broader TransformERS (CA 22156) initiative, which aims to develop transformative solutions to societal challenges through research and innovation. A key focus of TransformERS is sustainable urban development, emphasizing the integration of green infrastructure while addressing issues of social equity and environmental justice.

Accordingly, this study seeks to answer the following key questions:

- How are UGSs distributed in Niš, and how do they relate to socio-economic inequalities?
- What role does environmental justice play in the planning and management of UGSs in Niš?
- How do UGSs impact the socio-economic well-being of Niš residents?

By exploring these aspects, the research aims to contribute to more equitable and sustainable urban planning strategies.

Data and Discussion

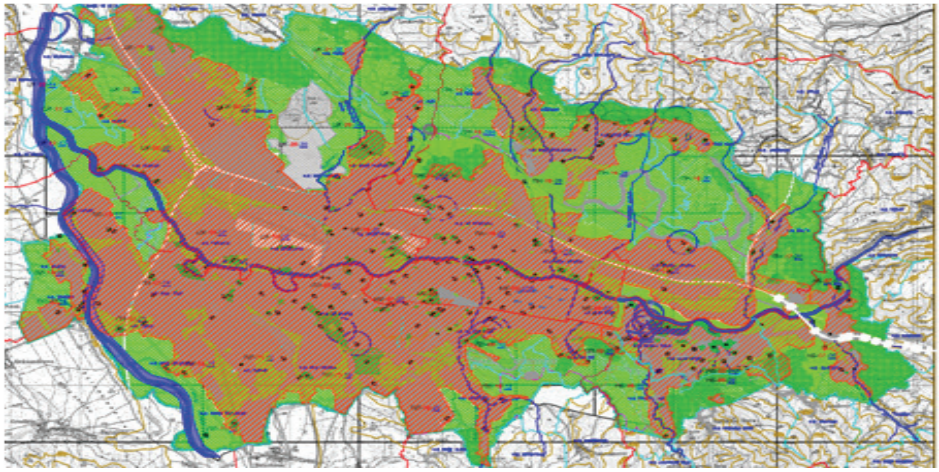
Serbia is situated in Southeastern Europe, with Niš being one of its most historically and culturally rich cities. As the third-largest city in Serbia, Niš is well-managed and serves as both a cultural hub and an economic center. Its strategic location and scenic landscape attract tourists from across the world, particularly from Europe.

The city has a total population of approximately 260,237 and spans an area of 596.78 square kilometers. Of this, 9.51% is designated for parks and green spaces,

providing residents with accessible natural areas that contribute to environmental quality and overall well-being. Additionally, forests cover 27% of the total area, reinforcing Niš's reputation as an eco-friendly and green city. Meanwhile, 63% of the land is allocated for construction and urban development, making Niš a compelling case study for examining the socio-economic impacts of UGSs (Figure 2).

After analyzing the spatial dimensions of Niš, we proceeded to validate this data by comparing it with on-the-ground realities. This involved conducting GIS-based spatial analysis, and community surveys to ensure the accuracy of the reported figures regarding green space distribution, urban development, and land use patterns. By integrating empirical observations with documented data, we aimed to identify potential discrepancies and assess the actual accessibility and quality of UGSs across different areas of the city.

Figure 2: Proposed City Plan for Niš

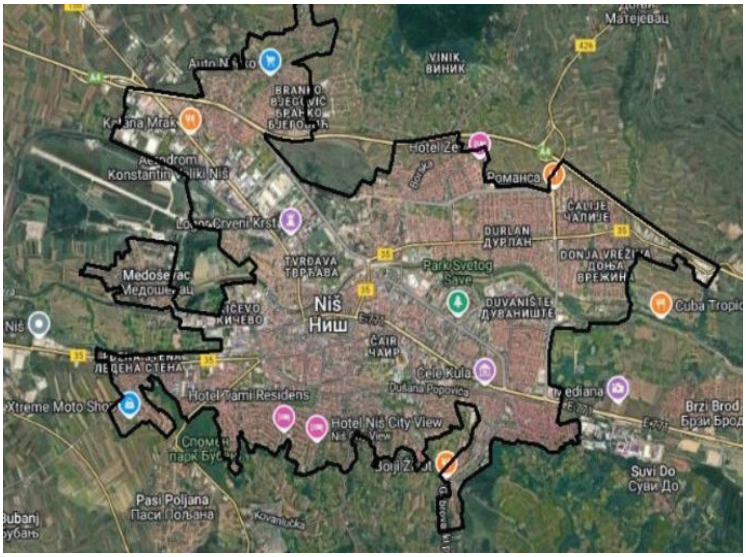


Source: Local Administration Niš

To analyze the land use distribution in Niš, we utilized a satellite image from Google Maps (Figure 3) and applied GIS software to assess the city's structural composition. This analysis classified the area into three key categories:

- Built-up areas – including residential buildings, commercial properties, and industrial sites
- Water bodies – primarily the Nišava River, which flows through the city
- Green spaces – comprising forests, farms, agricultural land, and other vegetation

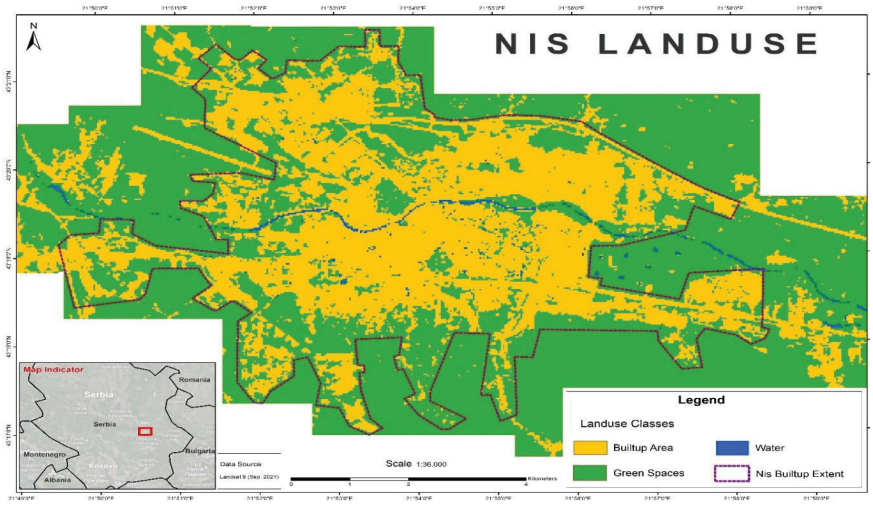
Figure 3: Satellite image from Google Map of the City of Niš



Source: Google Map

The findings reveal that 37.6% of the total land area in Niš is covered by green spaces, providing vital environmental and social benefits for residents. Meanwhile, 61.5% of the land is designated for urban development, including housing, businesses, and industrial infrastructure. Additionally, 0.9% of the area is occupied by the Nišava River, which plays an essential role in shaping the city's urban landscape (Figure 4).

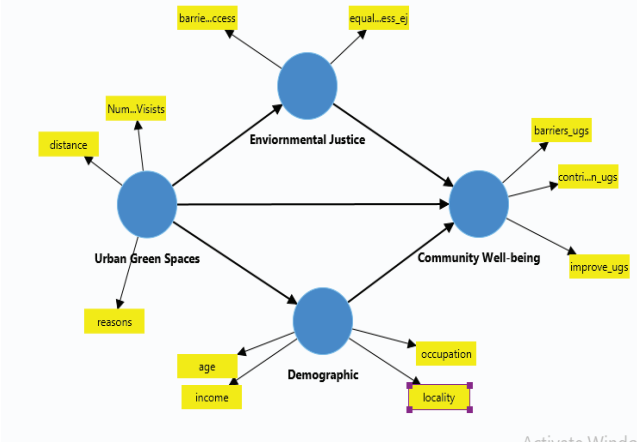
Figure 4: Land use analysis of the City of Niš with GIS software



Source: GIS software

A comprehensive survey was conducted in Niš, Serbia to assess environmental justice and community well-being. The survey, illustrated in Figure 5, aimed to analyze the impact of various factors by gathering public perceptions of UGSs.

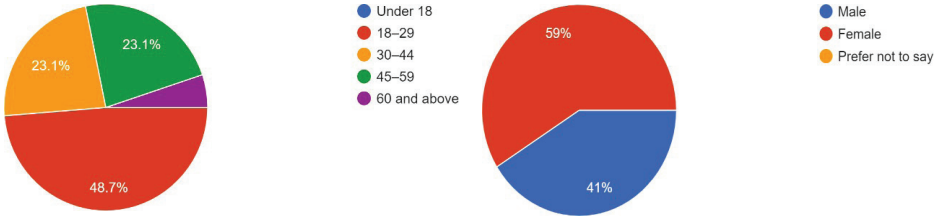
Figure 5: Theoretical Frame Work



Source: Authors

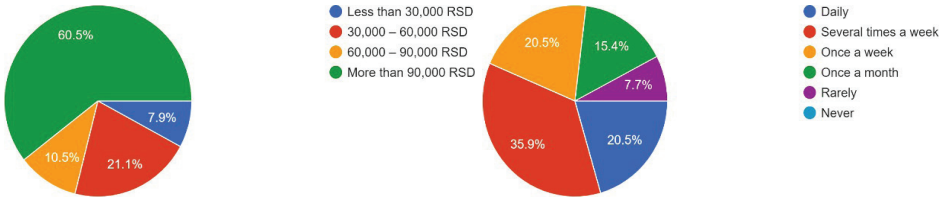
A total of 150 participants took part in the survey, with 120 providing complete responses. Among them, 59% were female and 41% were male, reflecting a balanced gender representation. In terms of age distribution, 48.7% of respondents were between 18 and 29 years old, while 51.3% were 30 years or older (Figure 6). This indicates that concerns about health and the environment are shared across different age groups in Niš.

Figure 6: Respondents age group and gender



The survey also provided valuable insights into the socio-economic status of the respondents. The data revealed that 60.5% of participants earn approximately 770 euros per month, which is nearly twice the minimum wage set by the Government of Serbia (Figure 7). While this income level is lower than that of developed countries, it is higher than the average earnings in neighboring Balkan nations. This financial status may impact residents' ability to prioritize health and environmental concerns, as individuals with higher incomes often have greater access to green spaces and healthier lifestyles compared to those with limited financial resources.

Figure 7: Respondents according to income and frequence of visiting UGS



The survey results indicate that the majority of Niš residents prioritize their health, with 56.4% of respondents visiting green spaces daily or several times a week. However, a small percentage (7.7%) reported visiting these areas only rarely (Figure 7).

When asked about their preferred green spaces, the majority (61.5%) stated that they frequent parks, making them the most popular choice. The second most-visited location was the riverbank (20.5%), highlighting the community's strong connection to nature and preference for outdoor environments.

Methodology

In our study, the data is measured on an ordinal scale, making the Structural Equation Model (SEM) the most suitable analytical approach. SEM is particularly effective for examining complex relationships between different types of variables, including latent, control, and observed variables.

To begin, we define and construct the latent variables, which represent underlying concepts that cannot be directly measured. These include (Table 1: Selection of latent variables):

- Community Well-being (CWB)
- Environmental Justice (EJ)
- Urban Green Spaces (UGS)

By using SEM, we can analyze the interactions between these variables and better understand their influence on community well-being and environmental justice. The choice of SEM is supported by recent work demonstrating its ability to capture both direct and indirect effects in socio-ecological systems (Tuominen et al., 2022; Park, 2023; Bonilla-Bedoya et al., 2020). Furthermore, optimization-based frameworks are increasingly applied to identify spatially equitable UGS placements, providing methodological inspiration for future research (Pinto et al., 2025).

Table 1: Selection of latent variables

Community well-being (CWB)		Environmental Justice (EJ)	
X1	UGS contribution to well-being	Y1	Barriers faced by some group
X2	How UGS improves quality of life	Y2	Obstacles to visit UGS
X3	Problems / Barriers to visit UGS		
Urban Green Spaces (UGS)			
Z1	Number of visits	Z3	Distance to nearest UGS
Z2	Reason to visit UGS		

Source: Authors

We define the hypothesized relationships between latent constructs using a SEM approach. The relationships are represented as follows:

$$CWB=\beta 1\cdot UGS+\varepsilon_1 \quad (1)$$

Here, β_1 represents the effect of Urban Green Spaces (UGS) on Community Well-being (CWB), while ε_1 is the error term, capturing the unexplained variance.

$$EJ=\beta 2\cdot UGS+\varepsilon_1 \quad (2)$$

In this equation, β_2 indicates the effect of UGS on Environmental Justice (EJ), and ε_2 is the corresponding error term.

$$CWB=\beta 3\cdot EJ+\varepsilon_1 \quad (3)$$

Here, β_3 represents the impact of Environmental Justice on Community Well-being, with ε_3 as the associated error term.

In our model, observed variables are linked to their respective latent variables, with λ serving as the factor loading. The measurement equations are as follows:

For Community Well-being (CWB):

$$X1=\lambda 11\cdot CWB+\delta 1 \quad (4)$$
$$X2=\lambda 12\cdot CWB+\delta 2 \quad (5)$$
$$X3=\lambda 13\cdot CWB+\delta 3 \quad (6)$$

where λ_{11}, λ_{12}, and λ_{13} are factor loadings for CWB, and δ_1, δ_2, and δ_3 represent measurement errors.

For Environmental Justice (EJ):

$$Y1=\lambda 21\cdot EJ+\delta 5 \quad (7)$$
$$Y2=\lambda 22\cdot EJ+\delta 6 \quad (8)$$

where λ_{21} and λ_{22} are factor loadings for EJ, and δ_5 and δ_6 represent measurement errors.

For Urban Green Spaces (UGS):

$$Z1=\lambda 31\cdot UGS+\delta 9 \quad (9)$$
$$Z2=\lambda 32\cdot UGS+\delta 10 \quad (10)$$
$$Z3=\lambda 33\cdot UGS+\delta 11 \quad (11)$$

where λ_{31}, λ_{32}, and λ_{33} are factor loadings for UGS, and δ_9, δ_{10}, and δ_{11} denote measurement errors.

To enhance the model's accuracy, we introduce control variables such as Gender, Income, Occupation, and Locality, resulting in the following equations:

$$CWB=\beta 1\cdot UGS+\beta 4\cdot Income+\beta 5\cdot Occupation+\varepsilon_1 \quad (13)$$
$$EJ=\beta 2\cdot UGS+\beta 6\cdot Gender+\beta 7\cdot Locality+\varepsilon 2 \quad (14)$$

By integrating both structural and measurement models, we obtain the following framework:

$$CWB=\beta 1\cdot UGS+\beta 3\cdot EJ+\beta 4\cdot Income+\beta 5\cdot Occupation+\varepsilon_1 \quad (15)$$
$$EJ=\beta 2\cdot UGS+\beta 6\cdot Gender+\beta 7\cdot Locality+\varepsilon 2 \quad (16)$$

With the corresponding measurement equations:

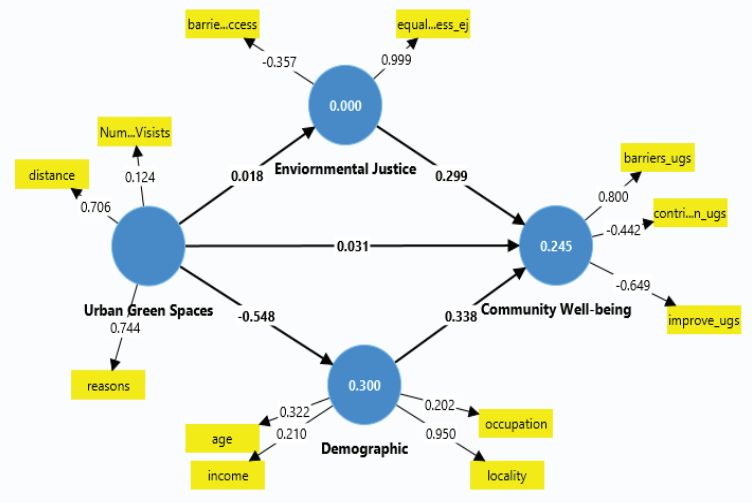
$X1=\lambda 11 \cdot CWB+\delta 1$, $X2=\lambda 12 \cdot CWB+\delta 2$, ...
$Y1=\lambda 21 \cdot EJ+\delta 5$, $Y2=\lambda 22 \cdot EJ+\delta 6$, ...
$Z1=\lambda 31 \cdot UGS+\delta 9$, $Z2=\lambda 32 \cdot UGS+\delta 10$, ...

Results

We used SmartPLS for the analysis, and the results presented in Figure 8 reveal several key insights. The path coefficient between Urban Green Spaces (UGS) and Community Well-being (CWB) is 0.031, which is very weak. This suggests that UGS alone does not have a strong direct impact on CWB in our study. Instead, its influence may be mediated through Environmental Justice (EJ), requiring further investigation. The coefficient between demographic factors and UGS is -0.548, indicating that certain groups, such as lower-income individuals and rural residents, may have reduced access to UGS. These findings are consistent with empirical studies documenting systematic disparities in green space access for disadvantaged populations (De Vries et al., 2020; Csomós et al., 2021; Zhang and Luo, 2024; Hoseini et al., 2025), supporting the robustness of our SEM-based analysis. For example, people living in rural or suburban areas may have fewer green spaces nearby or need to travel longer distances to reach them. Likewise, individuals with lower incomes might prioritize other basic needs over accessing UGS, highlighting demographic disparities in green space availability. The path coefficient between Environmental Justice (EJ) and UGS is 0.018, suggesting that the mere presence of UGS does not guarantee environmental justice. Similar studies in Belgrade and elsewhere emphasize that UGS quality – not just quantity – matters for well-being (Simović et al., 2023). Moreover, recent work has confirmed that psychological and physical activity pathways critically link green space accessibility and mental health (Dong et al., 2024).

This finding underscores the existence of barriers – such as inequitable distribution, accessibility issues, or socio-economic constraints – that prevent certain communities from fully benefiting from UGS. The path coefficient between CWB and demographic factors is 0.338, indicating that age, income, locality, and occupation significantly impact community well-being. This means that individuals with higher incomes or those living in urban areas generally experience greater well-being advantages compared to disadvantaged groups. Lastly, the path coefficient between EJ and CWB is 0.299, demonstrating that equal access to UGS and the removal of barriers positively contribute to community well-being. This finding highlights the importance of addressing obstacles to UGS access to enhance overall well-being in urban communities.

Figure 8: SmartPLS results



Source: Authors

The study indicates that while UGS alone does not strongly influence CWB, ensuring equitable access and removing barriers related to environmental justice can significantly improve community well-being. Policymakers should focus on reducing disparities in access to green spaces to promote a more inclusive and sustainable urban environment.

Conclusion and Recommendations

The results indicate that Urban Green Spaces (UGS) do not have a significant direct impact on Community Well-being (CWB) or Environmental Justice (EJ). Instead, their influence is indirectly mediated by factors such as demographic characteristics and environmental justice. This suggests that policies aimed at improving community well-being through UGS should prioritize equitable access and address demographic disparities.

To enhance both environmental justice and well-being, policymakers should focus on: ensuring accessibility of UGS for low-income and rural residents, improving the quality and safety of green spaces, and involving communities in decision-making processes to better align UGS development with local needs.

The strong negative relationship between UGS and demographic factors highlights the need to eliminate barriers that prevent certain groups from accessing green spaces. Targeted interventions could include: enhancing transportation to UGS for residents in remote or underserved areas, creating new green spaces in neighborhoods with limited access, and designing inclusive programs that address the specific needs of diverse demographic groups.

The moderate positive relationship between Environmental Justice and Community Well-being underscores the importance of fairness and inclusivity in UGS

planning. Policies should focus on: ensuring equal access to green spaces for all residents, addressing barriers such as safety concerns, poor maintenance, and lack of amenities. By prioritizing equity in UGS planning and reducing access disparities, policymakers can significantly enhance both environmental justice and overall community well-being.

Recent research underscores that participatory governance frameworks can help achieve fairer outcomes in UGS planning (Xia et al., 2024; Zhang & Kumar, 2024). Moreover, evidence from Balkan and global contexts shows that economic inequality shapes both the expansion and distribution of green infrastructure (Huang et al., 2023). Optimization-based planning tools provide new opportunities for policymakers to balance efficiency and equity in green space provision (Pinto et al., 2025).

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