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THE ROLE OF RESIDENTIAL GREEN SPACES IN ENHANCING WELL-BEING, BIODIVERSITY, AND SUSTAINABILITY: A CASE STUDY OF IAŞI, ROMANIA

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Abstract

Recent studies have painted a compelling picture of the beneficial impact of rigorously designed open spaces on quality of life and urban social cohesion. These spaces significantly influence community closeness, urban viability, safety, sustainability, and vitality. Inter-community interactions embedded in open spaces' planning and design process are vital in shaping and valuing them, influencing social interaction's level of use, value, and intensity. This study focuses on the impact of residential green spaces on the resident's well-being, urban biodiversity, and sustainability. Based on international examples, case studies, and rigorous local context analysis, we proposed a landscape design for the Tatarasi district in Iasi, Romania. The proposed landscape design offers multiple functional zones, such as recreational areas or community gardens, using sustainability principles and urban biodiversity. The results can guide urban planners and officials to create regions that benefit residents' well-being and foster a greener environment. This study employs a multi-method approach, integrating spatial analysis, biodiversity assessment, and case study comparisons to develop an adaptive landscape intervention.

Key words*: biodiversity, sustainability, urban design, well-being, landscape architecture.*

INTRODUCTION

The design of urban green spaces plays a pivotal role in enhancing the well-being of residents, with its benefits stemming from three primary factors: spatial characteristics, biodiversity and naturalness, and community involvement. These elements collectively influence mental and physical health, foster social connections, and contribute to overall life satisfaction in urban environments. This study extends beyond theoretical discourse by situating its investigation within the residential green spaces of the Tatarasi district in Iasi, Romania, aiming to propose actionable landscape interventions that align with contemporary urban sustainability principles.

The spatial characteristics of green spaces significantly affect residents' mental well-being. Research demonstrates that a more significant number and larger total area of public green spaces are associated with improved mental health outcomes, suggesting a dose-response relationship where increased green space availability leads to better mental well-being (Pascu et al., 2021; Wood et al., 2017). Moreover, partially open spaces with a high degree of naturalness offer restorative benefits, surpassing green spaces dominated by hard surfaces (Cojocariu et al., 2023; Linghan et al., 2022). Even small nature features, such as balconies or roof gardens, positively contribute to well-being, albeit to a lesser extent than larger green areas (Allard-Poesi et al., 2022).

Biodiversity and naturalness within green spaces further enhance their impact on mental and physical health. Spaces rich in biodiversity, including natural elements like trees and water, have been linked to improved mental health and stronger social connections (Reyes-Riveros et al., 2021). Less domesticated natural environments, such as forests and open fields, promote psychological well-being by encouraging calm and reflective activities while improving physical health through exposure to natural elements (Allard-Poesi et al., 2022). These natural features also support environmental restoration, positively affecting physiological and psychological health (Linghan et al., 2022).

Community involvement in the planning, design, and maintenance of green spaces adds another layer of benefit. Engaging local

communities in these processes has been shown to improve psychological well-being and enhance life satisfaction among residents. Furthermore, increased satisfaction with personal safety and a stronger sense of community belonging, bolstered by community participation, mediate the relationship between environmental quality and well-being. Integrating local stakeholders into the planning stages fosters a sense of ownership and connection to green spaces, amplifying their positive effects on urban communities (van den Bogerd et al., 2021).

Despite the well-documented benefits of urban green spaces, many cities, including those in Eastern Europe, face significant challenges in maintaining, revitalizing, and equitably distributing green infrastructure. The Tatarasi district in Iasi exemplifies these challenges, where existing green spaces suffer from fragmentation, underutilization, and inadequate biodiversity. Addressing these deficiencies requires a comprehensive approach incorporating spatial equity, ecological integrity, and community participation. This research investigates how best practices in green space design from India, China, and Canada can be adapted to improve urban well-being and sustainability in the local context. By synthesizing international insights with rigorous local analysis, this study aims to develop an evidence-based landscape plan that enhances ecological and social resilience in Tatarasi.

Building on these theoretical insights, this study applies these principles to the Tatarasi district in Iasi, Romania. By examining the spatial characteristics, biodiversity, and community engagement within the district's green spaces, this research proposes targeted interventions that align with global best practices while addressing local challenges.

MATERIALS AND METHODS

Site Description

The site analyzed in this research is located in the southern part of Iasi, on the Central-Eastern side. According to the measurements in the Green Register of Iași County, for the objective Green Space, Al. Gradinari, Tatarasi neighborhood, the site's total area is approximately 17,185 m^2.

Figure 1 shows the objective's zoning, with Chimiei Boulevard and Bahlui River representing the spatial delimitations on the South side, Vasile Lupu Street on the West side, and Gradinari Street in the North. Near the site, there is green space, which Tatarasi Park represents.

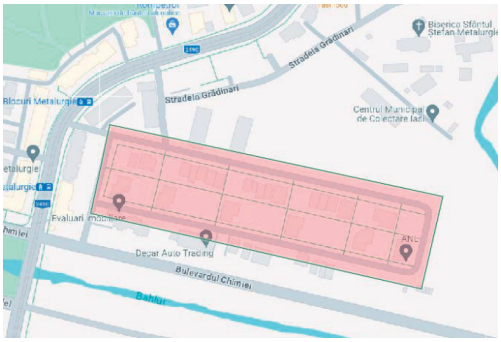

Figure 1. Urban placement of the site within Iasi

Table 1 presents the distribution of space in the studied site. The site, spanning 17,185 m^2, integrates various functional areas. The dominant greenspace, covering 12,232 m^2 (71.18%), is crucial in biodiversity conservation. Complementing this, the floristic amenity, extending over 227 m^2 (1.32%), enhances the landscape with decorative plant species, adding aesthetic and ecological value. A playground of 1,471 m^2 (8.56%) fosters recreation and social interaction, strengthening community engagement. Meanwhile, the infrastructure, consisting of roads, sidewalks, and driveways, occupies 3,232 m^2 (18.80%), ensuring seamless connectivity and accessibility throughout the site.

Table 1. Distribution of spaces on the study site

Sym.	Category	Surface m^2	Percentage %
FL	Floral landscaping	227	1.32
BU	Buildings	23	0.14
PL	Playground	1,471	8.56
RO	Roads, sidewalks, driveways	3,232	18.80
GS	Green space	12,232	71.18
Total land		17,185	100
Of which green area (FL+GS)		12,459	72.50

Research Approach

This study adopts a multi-method approach combining site analysis, international case study comparisons, and sustainability-driven design

principles (Booth & Hiss, 2011; Istrate et al., 2023). The research integrates geospatial analysis, biodiversity assessment, and participatory urban planning methodologies to propose a comprehensive landscape intervention.

Selection of Design Elements

The proposed intervention design drew insights from international precedents:

- Godrej Rivergreens from India (Figure 2) is a model for biodiversity integration and ecological resilience, demonstrating the effectiveness of native plant species in enhancing local ecosystems (StudioPOD, 2023).

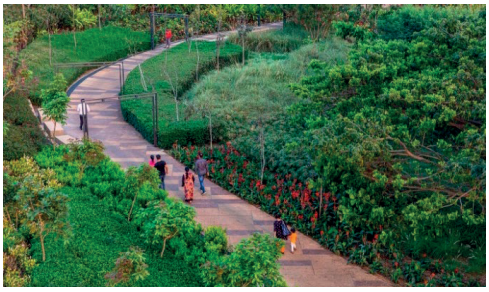

Figure 2. Godrej Rivergreens (StudioPOD, 2023)

- Oriental One from China (Figure 3) offers inspiration for multifunctional space design, focusing on the harmonious integration of green spaces into high-density urban environments (Gillespies, 2023).

Figure 3. Oriental One (Gillespies, 2023)

- Ketcheson Park from Canada (Figure 4) is a reference for sustainable infrastructure and stormwater management, showcasing advanced water retention and green infrastructure solutions (PWL, 2021).

Figure 4. Ketcheson Park (PWL, 2021)

These case studies were selected based on their relevance to the challenges faced in Tatarasi. Godrej Rivergreens exemplifies biodiversity conservation in an urban setting, Oriental One demonstrates the successful integration of green spaces in high-density environments, and Ketcheson Park highlights innovative approaches to stormwater management and sustainable infrastructure. The proposed interventions will enhance ecological and social resilience in the study area by adopting these strategies.

RESULTS AND DISCUSSIONS

Current Green Space Analysis

The existing landscape of the residential green spaces in the Gradinari area of Tatarasi, Iasi, presents a combination of functional and dysfunctional elements that impact residents' well-being, urban biodiversity, and sustainability. The site assessment highlights the accessibility, infrastructure conditions, vegetation composition, and existing amenities within the green spaces.

Accessibility and Pathways

The residential area is accessible from three main directions: from the south via Chimiei Blvd, from the west via Vasile Lupu Street, and through an internal connection via Gradinari Street. As seen in Figure 5, these access points provide good connectivity, yet specific pedestrian pathways require maintenance due to overgrown vegetation encroaching on walking spaces. The predominant paving material for pedestrian alleys is concrete, ensuring durability; however, localized sections show deterioration, necessitating cleaning, and minor repairs.

Figure 5. Accessibility and pathways

Sports Facilities

A notable feature within the green space is a 450 m^2 sports field. However, the facility is in a state of advanced degradation, with visible wear on the playing surface and perimeter infrastructure (Figure 6). This degradation negatively impacts its usability and reduces the green space's aesthetic quality. The lack of proper maintenance and rehabilitation limits its potential as a recreational and community engagement space.

Figure 6. Sports facilities

Public Furniture and Play Equipment

The existing urban furniture, consisting of benches and children's play equipment, exhibits various degrees of deterioration (Figure 7).

Figure 7. Public furniture and play equipment

The materials, mainly wood and metal, have suffered damage due to environmental exposure and prolonged use. Moreover, the furniture is not integrated harmoniously within the green space, affecting functionality and visual appeal. The absence of designated seating areas or shaded resting zones further reduces user comfort.

Vegetation and Biodiversity

The site's vegetation includes a diverse mix of tree, shrub, and flower species, contributing to ecological richness. The green space hosts over 30 species of trees and shrubs, such as *Acer platanoides* (Norway maple), *Fraxinus excelsior* (common ash), *Tilia tomentosa* (silver linden), and *Prunus armeniaca* (apricot). Most plant species exhibit good viability, yet the landscape appears unkempt due to insufficient maintenance practices. The distribution of vegetation is somewhat disorganized, reflecting a lack of structured landscape planning. Overgrown plants and excessive tree density in certain areas contribute to an unbalanced visual composition and reduce the perceived openness of the space (Figure 8). The presence of allergenic species, particularly the high number of linden trees, raises concerns regarding potential health impacts for residents sensitive to pollen.

Figure 8. Vegetation distribution

Identified Issues and Required Interventions

Several dysfunctions have been observed that require targeted interventions to enhance the green space's usability and sustainability:

- Overgrown vegetation on pedestrian pathways, making circulation difficult and requiring regular maintenance.
- Degradation of benches and playground equipment, demanding refurbishment or replacement to improve functionality and aesthetics.
- The poor condition of the sports field diminishes recreational opportunities and requires surface restoration.

- Inadequate lighting, which compromises security in the area during night-time hours.
- Lack of structured vegetation management, leading to an untidy appearance and reduced biodiversity value.

Addressing these issues through a comprehensive landscape design strategy will enhance the green space's overall sustainability, biodiversity, and well-being benefits. Proposed interventions should integrate maintenance plans, structured planting schemes, and improvements to recreational infrastructure to foster a more functional and visually appealing environment for residents.

While the proposed interventions offer substantial benefits, their implementation may face several challenges. Limited maintenance funding, potential resistance from local stakeholders, and the need for long-term community engagement could hinder sustainability. To address these challenges, collaboration with local authorities, securing external funding for green infrastructure projects, and establishing community stewardship programs will be essential.

Proposed Interventions

Functional Zoning for Inclusive Public Use

Based on Lefebvre's (Lefebvre, 1991) spatial theory, the proposed interventions transition the green space from a fragmented, underutilized area (perceived space) to a well-integrated and socially engaging environment (conceived space). The design includes functional zoning, as seen in Figure 10, to maximize the use of green spaces for all residents.

- Relaxation and Socialization Zones

Several spaces will be dedicated to relaxation and social interaction, featuring comfortable seating arrangements, shaded spots, and diverse vegetation to create a tranquil atmosphere. These areas will serve as gathering points where people can socialize, read, or enjoy the natural surroundings. The carefully designed layout will ensure these spaces are easily accessible and interlinked through well-maintained pathways (Figure 9).

Figure 9. Proposed relaxation area

Small rest areas will be developed for residents who prefer quieter, more secluded spots. These spaces will be surrounded by lush vegetation, providing privacy and immersion in nature. Benches and shaded structures will be integrated to enhance comfort and usability, encouraging people to spend more time outdoors.

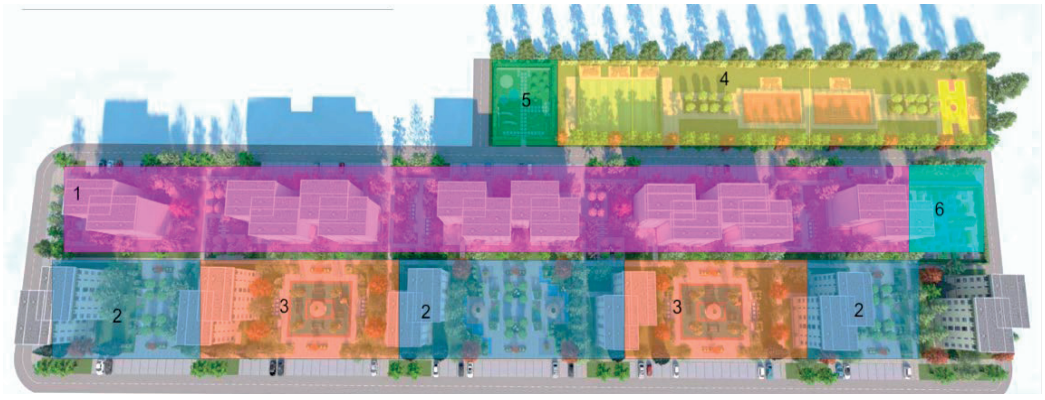

Figure 10. Proposed functional zoning:

1 - Small relaxation areas; 2 - Large relaxation areas; 3 – Playgrounds;
4 - Sports facilities; 5 - Dog park; 6 - Community garden

- Dedicated Play Areas

The playgrounds will undergo significant improvements, incorporating child-friendly, durable equipment designed to foster physical activity and creative play (Vladimir & Cojocariu, 2024). The materials will be safe, weather-resistant, and environmentally friendly, ensuring a sustainable long-term solution. The playgrounds will be positioned strategically within the green space, allowing caregivers to have clear sightlines while seated in nearby relaxation zones (Figure 11).

Figure 11. Proposed playground

- Community Garden

The proposal includes creating a community garden where residents can participate in urban gardening initiatives (Figure 12). This space will encourage sustainable practices, provide fresh produce, and foster a deeper connection with nature. A community garden will also strengthen social ties among neighbors as residents collaborate on shared gardening projects and workshops (Grecu et al., 2023; Hangan et al., 2023).

Figure 12. Proposed community garden

- Sports Facilities Rehabilitation

The existing sports field will be restored with upgraded surfaces, seating, and perimeter improvements to encourage active recreation (Figure 13).

Figure 13. Proposed sports facilities

- Pet-friendly Area

A dedicated pet-friendly zone will allow pet owners to enjoy outdoor time with their companions without interfering with other recreational activities. The space will include designated walking trails, agility equipment, and shaded seating, ensuring both pets and owners have a pleasant experience. Proper waste disposal facilities will be installed to maintain cleanliness and hygiene (Figure 14).

Figure 14. Proposed dog park

Vegetation Management and Biodiversity Enhancement

Inspired by Godrej Rivergreens (India), which prioritizes ecological resilience, the intervention will emphasize the importance of a well-maintained and diverse plant ecosystem. The project will introduce structured vegetation management strategies to enhance the site's ecological value while ensuring a visually appealing and sustainable landscape.

Pruning and restructuring efforts will improve tree health, increase sunlight penetration, and enhance plant vitality. Existing trees will be maintained, with special attention given to species contributing to urban cooling and air

purification. The inclusion of flowering plants such as *Syringa vulgaris* (common lilac), *Hydrangea macrophylla*, and *Spiraea japonica* 'Anthony Waterer' will not only enhance the visual appeal but also support pollinator populations by attracting bees and butterflies.

To improve natural cooling and create a comfortable microclimate, strategically placed trees like *Acer platanoides* (Norway maple), *Fraxinus excelsior* (common ash), and *Tilia tomentosa* (silver linden) will provide ample shade throughout the space. These species are well-adapted to urban environments and will contribute to reducing the heat island effect, making the green space more pleasant during warmer months.

The project also includes improvements to ground cover using resilient, moisture-retaining species such as *Carex oshimensis* 'Evergold' and *Pennisetum alopecuroides* 'Little Bunny'. These plants stabilize the soil, reduce erosion, and improve water absorption. Their drought-resistant properties will ensure the landscape remains lush and green with minimal irrigation requirements.

Multifunctional Green Spaces

Incorporating information from Oriental One (China), the intervention prioritizes creating multifunctional spaces that cater to diverse activities and user needs. The project envisions open, adaptable green areas that serve different purposes, allowing residents to use the spaces according to their preferences.

Small seating areas will be introduced to foster cultural engagement and creativity. These spaces will provide a venue for outdoor performances, poetry readings, educational talks, and community meetings. Designed with comfortable seating and natural shading, these areas will encourage spontaneous social interactions and cultural events that enhance the neighborhood's vibrancy (Figure 15).

Figure 15. Small seating areas

Another key feature will be thematic gardens, which will highlight local biodiversity and educate visitors about sustainable landscaping practices (Figure 16). Informational signage will be placed throughout these gardens, offering insights into the ecological role of various plant species and their benefits for urban ecosystems.

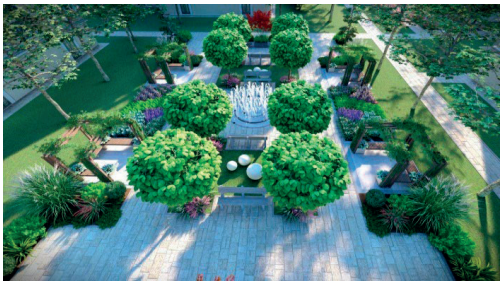

Figure 16. Thematic gardens

Strategically placed shaded seating areas will enhance user comfort, particularly near playgrounds and active zones (Figure 17). Parents and caregivers will have access to comfortable spots to supervise children while enjoying the benefits of green space. The seamless integration of these elements will create a holistic environment that serves the community's diverse needs.

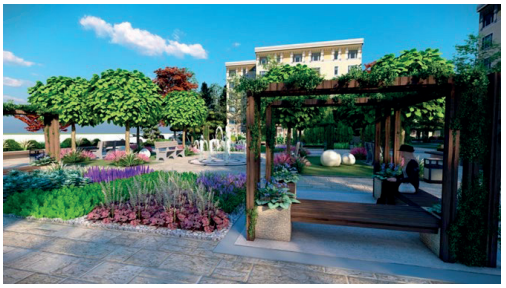

Figure 17. Shaded seating areas

Community Engagement and Social Inclusion

Taking inspiration from Ketcheson Park (Canada), the proposal highlights the significance of community-driven green spaces, ensuring that residents play an active role in shaping and maintaining their urban environment. This participatory approach fosters a sense of ownership and pride, making the green space a more cherished part of the neighborhood.

Residents will be encouraged to participate in urban gardening initiatives through designated plots to cultivate flowers, herbs, and vegetables. These gardening spaces will serve as educational hubs where workshops on sustainable agriculture, composting, and native plant species can be conducted. The initiative will strengthen community relationships while promoting environmental awareness.

To ensure meaningful community participation, structured engagement initiatives such as workshops, neighborhood meetings, and participatory design sessions will be organized. These platforms will allow residents to voice their preferences, contribute ideas for seasonal plantings, and participate in maintenance programs. Additionally, partnerships with local schools and environmental organizations can help integrate educational programs that promote sustainable practices within the community.

To accommodate diverse user groups, outdoor seating areas will be designed to encourage intergenerational interaction. Features like storytelling corners and shaded benches will create welcoming spaces for younger and older residents. These elements will enhance social inclusion and provide opportunities for meaningful exchanges across generations.

To maintain the space's vibrancy, flexible-use areas will be designated for pop-up art exhibitions and cultural festivals. These spaces will adapt to changing community needs, ensuring the green space remains relevant and actively used throughout the year. Public involvement will also extend to participatory landscaping initiatives, where residents can contribute ideas for seasonal plantings and temporary design installations.

Improved accessibility features, including smooth pathways, wheelchair-friendly seating, and clear signage, will ensure that the green space welcomes individuals of all abilities. By prioritizing inclusivity, the design aims to create a space that truly belongs to everyone in the community.

CONCLUSIONS

This study highlights the essential role of residential green spaces in improving well-being, biodiversity, and sustainability, focusing on the Tatarasi district in Iasi, Romania. Through spatial analysis, biodiversity assessment, and case study comparisons, the research demonstrates how well-planned green spaces enhance urban life and ecological resilience.

Key findings reveal that functional zoning, sustainable vegetation management, and community involvement are crucial for maximizing green space benefits. The proposed design - incorporating relaxation areas, playgrounds, a community garden, and sports facilities - creates an inclusive and multifunctional environment. Drawing from international best practices, this intervention balances social and ecological needs, fostering urban sustainability.

Green space planning directly contributes to mental and physical health, biodiversity conservation, and environmental resilience. Community engagement strengthens social cohesion and long-term maintenance, ensuring lasting benefits. These insights offer a practical framework for urban planners and policymakers to create greener, healthier, and more sustainable urban environments.

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