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LANDSCAPE-LED DESIGN FOR RESILIENT PERI-URBAN COMMUNITIES: INTEGRATING GREEN INFRASTRUCTURE FOR REGENERATION

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Abstract

One of the major problems facing urban development today is the accelerated expansion of major urban centres, specifically the tendency to concentrate this development in the central areas of the city. To address this trend, an opportunity that is still not sufficiently developed can be found in the modernization and strategic expansion of peri-urban areas, which would offer viable possibilities to reduce the pressure on a congested urban core as well as valuable contributions to the development of the resilience of some micro-communities. This study brings into focus an example in which landscape design can be incorporated in a relevant way, presenting a small-scale residential complex and how the creation of an appropriate and carefully planned green infrastructure can bring numerous benefits-urbanistic, ecological, and on human health. The findings demonstrate that the synergy between a built environment and a green landscape designed based on current ecological needs is a catalyst for the regeneration of underutilized areas that can be transformed into functional and high-performance community assets. The integration of green infrastructure into real estate developments is an essential principle for the development of future-oriented peri-urban residential communities.

Key words: *urban horticulture, plant-based, sustainability.*

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INTRODUCTION

Environmental policies are focused on a long-term vision of sustainability that integrates principles of the circular economy, green finance, digital transformation, and participatory governance (Pascu et al., 2022; Popek et al., 2024; Slobodnikova & Toth, 2025). Global trends, economic and environmental challenges, and crises all around lead to the need for a more sustainable way of existence. New environmental policy has to continue evolving as a dynamic governance instrument, able to manage uncertainty while ensuring that ecological security and human well-being remain central concerns for sustainable development (Janiszek & Krzysztofik, 2023; Macaione et al., 2024; Ozarchevici et al., 2024; Vladimir & Cojocariu, 2025).

In this context, there is a growing need to enable integrated initiatives to develop more participatory strategies to integrate solution-oriented approaches in green space planning and regeneration, including co-design, co-production, and co-management (Karrasch et al., 2017; Huba & Kascakova, 2023; Vladimir & Cojocariu, 2024). This reflects the wider trend to support sustainability in other areas of society, as research, urban planning, management, human resources, and all parties involved in social cohesion (Cojocariu et al., 2023; Pascu et al., 2019; Ioannou et al., 2025).

The restoration of green spaces must aim at restoring the earth's ability to self-heal. Thus, nature-based solutions represent an opportunity to transform current challenges into opportunities for urban regeneration (Kooijman et al., 2021; Pașcu et al., 2021; Zlati et al., 2024). Unlike traditional urban planning, where the shape of the city is imposed by the road network and underground infrastructure, landscape-led design places natural systems at the center of urban development. In this approach, elements such as watercourses, topography, vegetation, and ecological corridors become the primary framework upon which urban communities evolve, with resilience serving as a guiding principle. By prioritizing ecological processes and natural landscape structures, landscape-led planning promotes more adaptive and sustainable urban environments.

Green infrastructure manages climate risks much more efficiently and cheaply than "grey" engineering solutions (Vano et al., 2021; Chelariu et al., 2018).
The present study brings into focus an example of landscape-led design incorporated in a relevant way, presenting a small-scale residential complex and how the creation of appropriate and carefully planned green infrastructure can bring numerous benefits, as urbanistic, ecological, and wellbeing.

MATERIALS AND METHODS

The systematic framework for design decisions was imposed by the design objectives, which aimed to:
- ecological regeneration (species selection);
- hydrological resilience;
- social integration (community connection).

Starting from the premise that a "landscape-led" approach implies that the analysis of the landscape dictates the urban form, not the other way around, the spatial criteria for the organization of the site were based on connectivity, accessibility, and functionality.
The zoning was based on the intensity of use (food forest area, buffer or connection area, relaxation area, conservation area).
The selection of species was made according to ecological criteria, the ability to adapt to thermal variations and water stress (specific to peri-urban areas).
Location. Cameo Residence is located at 6 Ion Nistor Street, 707410 Iași (Figure 1).



Figure 1. Site location
(https://cameoresidence.ro/)

Cameo Residence builds blocks to the NZEB (Nearly Zero-Energy Building) standard.
It assumes a building with very high energy performance, whose energy consumption is close to zero. The actual situation of the project is in progress (Figure 2).

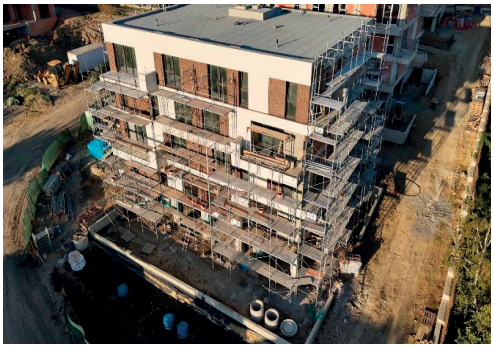

Figure 2. Site curent stage

The planning proposal is in line with the concept of regeneration and urban resilience.
The central theme of integrating green infrastructure for regeneration is built around landscape-led design for resilient peri-urban communities. Cameo Residence consists of three blocks and the integrative green space around. Buildings have reduced-height regimes, designed for those who want a balanced, discreet, and modern lifestyle. With a limited number of apartments, the project emphasizes privacy, tranquility, and functional efficiency, without compromising safety and aesthetics.
The optimization of the space aimed at maximizing the connectivity of the habitats.

Planting material

Species selection was not dictated mainly by aesthetic preferences, but by a three-step filtering protocol: compatibility with the soil type identified in the field phase (a low-fertility soil, specific to construction sites), adaptability and resistance to the urban heat island effect, and synergy between woody and herbaceous species to maximize stratified biodiversity.
Peri-urban communities often suffer from rapid concreting. Species selection directly influences the microclimate through the rate of evapotranspiration. Species with a large leaf surface and an active metabolism (*Acer, Liriodendron, Magnolia, Liquidambar*) pump water from the soil into the atmosphere, cooling the surrounding air.

Another important criterion was crown density. Species that provide dense shading reduce ground temperature by up to 10-15°C, protecting infrastructure and reducing energy consumption for cooling homes (Pașcu et al., 2019).
Also, the proposed variety of species (Table 1) offers decor throughout the year through flowering plants that bring diverse color and fragrance, structure through the use of bark and leaves, or fruits that persist on branches even in the cold season (Negrea & Zlati, 2011; Bernardis et al., 2022, 2024; Zlati & Pascu, 2021).

Table 1. List of used woody species

Specie name
Acer palmatum "Atropurpureum"
Acer platanoides "Drummondii"
Acer rubrum "October Glory"
Aronia melanocarpa
Berberis thunbergii "Atropupurea", "Aurea"
Ceanothus pallidus "Marie Simon"
Cornus sanguinea "Midwinter Fire"
Corylus avellana
Cotoneaster dammeri radicans
Crataegus spp.
Daphne mezereum "Rubra"
Deutzia gracillis
Euonymus alatus
Euonymus Aureomarginata *(espalier)*
Fagus sylvatica "Darwick Purpurea"
Fragaria spp.
Ginkgo biloba
Hedera helix
Hibiscus syriacus
Hydrangea macrophylla "Endless Summer"
Hydrangea spp.
Juniperus squamata "Blue Carpet", "Blue Star"
Juniperus virginiana "Blue Arrow"
Lavandula angustifolia
Liquidambar styraciflua
Liriodendron tulipifera
Magnolia x 'Cameo'
Ocimum basilicum
Photinia "Red Robin" *(espalier)*
Philadelphus hybrida "Dame Blanche"
Pinus mugo "Carsten's Wintergold"
Platanus acerifolia
Potentilla fruticosa "Blink"
Prunus laurocerasus
Prunus cerasifera "Nigra"
Pyracantha coccinea "Red Cushion"
Rhododendron "Dr. H.C. Dresselhuys"
Ribes spp.
Rubus fructicosus
Salvia officinalis
Spiraea japonica "Golden Princess"
Vaccinium corymbosum
Viburnum plicatum "Wanabee"
Viburnum opulus "Compactum"
Vitis vinifera
Weigela florida "Victoria"

We used this wide range of species to contribute to a lively, fresh, and optimistic atmosphere that supports residents' quality of life, the ensemble's sense of identity of the ensemble and, nevertheless, the sustainability of the investment.

RESULTS AND DISCUSSIONS

Unlike conventional planning, where the landscape occupies the "leftover" spaces between buildings, the landscape-led approach allowed the use of topography as a structural skeleton. The result is not only aesthetic, the functional being a priority. Thus, the green infrastructure dictated the built density, ensuring that the "unproductive" areas remain unbuilt but serve as connection and restoration areas.
While the current model of peri-urban expansion fragments ecosystems through rigid street networks, the proposed design solution uses green corridors as development axes. This landscape-led approach ensures habitat continuity, an ecological benefit superior to standard parceled development.
The idea for the central theme of the landscape proposal was primarily seen as a change of perception, meaning that the landscape is no longer seen as a simple decoration, but as a form of connection between the built area and the human component, being at the same time the primary infrastructure (Figure 3).

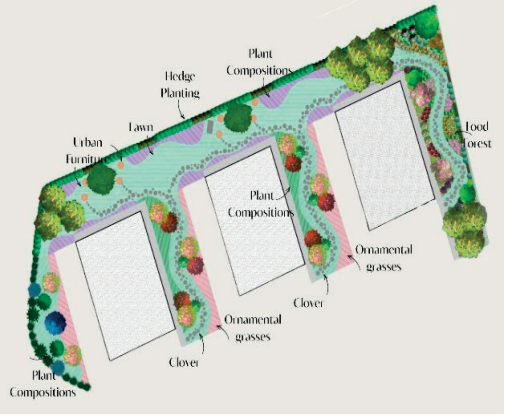

Figure 3. Proposed design plan

Table 2 presents a series of the proposed design benefits. The main functional benefit consists of the creation of a network of ecological corridors

that link the urban spaces, increasing the connectivity index of fragmented habitats. Through the proposed design, 90% of the residents in the area are less than 500 meters from a node of green infrastructure.

Table 2. The evaluation of the proposed design benefits

Resilience pillars	Design intervention	Arguments
Functional	Ecological corridors network that link the urban spaces	Increasing the connectivity index of fragmented habitats
Ecological	Hydric resilience	Used species reduces the rate of water runoff without expensive infrastructure
Social	Peri-urban community gardens	Creating local "micro-economies" and spaces for social interaction

The green space is designed as a contemporary, integrative landscape system based on principles inspired by the Food Forest concept in a modern composition (Figure 4). The proposed vegetation supports the quality of life of the residents, the identity of the ensemble, and the long-term value of the investment. Thus, beauty meets functionality and community becomes part of the garden. Floristic diversity, by increasing the number of native species introduced, has the effect of increasing ecosystem resilience in the face of pests.



Figure 4. Food forest integration within the landscape design

The integration of green infrastructures in the regeneration of urban areas is based on the idea that green spaces have not only an aesthetic contribution but also a social one, by reconnecting isolated fragments of the habitat, allowing biodiversity to develop and circulate, and giving inhabitants access to recreational activities.

At the main entrance of the complex, a distinctive planting composition is introduced in order to create a recognizable and memorable landscape element that reflects the identity of the development. Due to the name of the residential complex's name, the entrance area is marked by specimens of *Magnolia "Cameo"*, which function as a symbolic and visually striking feature within the landscape design. Their seasonal flowering creates a strong visual accent and contributes to establishing a welcoming and representative image of the site (Figure 5).



Figure 5. *Magnolia* "Cameo" as a landmark element

The planting composition is further structured through a balanced combination of evergreen and deciduous species. Conifers provide year-round structure and visual continuity during the winter months, while deciduous species contribute seasonal variation through foliage color and flowering dynamics (Figure 6).



Figure 6. Entrance landscape composition

The transition from a drab landscape used in the past, dominated by species such as *Buxus* or *Thuja*, to a layered vegetation system (herbaceous, shrubby, arboreal) increases biological resilience by diversifying ecological niches. Together, these elements form a layered and dynamic landscape composition that enhances both the aesthetic quality and the ecological value of the entrance area.

Food Forest is a landscaping concept inspired by the natural structure of a forest, where the vegetation is organized on several complementary layers. Reinterpreted in the urban environment, this concept becomes a sustainable, valuable solution that combines edible and ornamental species in a pleasant, orderly, accessible, and highly aesthetic landscape.

The composition includes fruit tree species and shrubs, but also perennials and ornamental grasses. Edible species used are as follows: *Corylus avellana, Crataegus* spp., *Vitis vinifera, Rubus idaeus, Vaccinium corymbosum, Ribes* spp*., Aronia melanocarpa, Fragaria* spp., *Rubus fructicosus, Salvia officinalis, Ocimum basilicum* and *Lavandula angustifolia,* and are exemplified in Figure 7.



Figure 7. Examples of proposed plant species

Species we chose are easy to recognize, easy to maintain, and offer fruits, much appreciated by young people. Aromatic species add variety and special freshness to the garden, creating at the same time a pleasant environment, while low and cover plants help protect the soil, maintain moisture, and help control weeds.

Low, cover vegetation and ornamental grasses chosen to be placed between buildings create calm, green areas that filter the view, improve the microclimate, and complement the architecture in such a discreet and elegant way (Figure 8).

For sloping land, ground cover plants work as a natural drainage system by reducing the rate of water runoff without expensive infrastructure.

Integrating water retention areas directly into public spaces transforms hydrological risk into a design element, demonstrating greater functional efficiency than 'grey' engineering solutions (pipes, channels), which have limited adaptability.



Figure 8. Compositions that include ornamental grasses

Relaxation areas, located in the shade of birch trees, complete the green space while offering a pleasant and protective natural setting, perfect for rest and daily use (Figure 9).



Figure 9. Relaxation area exemplification

Furniture elements for this project are specifically designed to support climbing plants. In addition, it provides additional shade while enhancing the decorative character of the space-exemplification in Figure 10.

We found that numerous research shows that green spaces help maintain the quality of life by reducing stress levels, supporting concentration, and promoting the development of emotional intelligence from a young age (Gradinariu et al., 2007; Negrea & Zlati, 2010; Zlati et al., 2022; Cojocariu et al., 2022). It is known that people who carry out their activities in a natural setting are calmer, more receptive, and show greater involvement in interpersonal relations. It is also

known that interacting with greenery, activities outdoor activities stimulates curiosity, supports exploratory learning, and contributes to the formation of a positive, lasting bond with the environment. Exactly in this context, the plan for Cameo Residence was conceived as a sustainable complex, where nature becomes an active, living partner for residents' well-being and the community.



Figure 10. Furniture elements for the resting

„Green concept" was further extended into the complex's interior spaces through the use of indoor species, clearly selected for this type of environment. These species are well adapted to low lighting conditions, a characteristic of interior spaces. Using indoor greens ensures both aesthetic continuity and long-term viability of the decor. Thus, the vegetation becomes an integrating element of the overall spatial experience (Figure 11).



Figure 11. Extending the greening concept into the interior of the complex.

Over the all, the proposed design facilitates social regeneration by creating points of interest based on natural elements, which encourage the community to approach the peri-urban territory, often perceived as a space of transit without identity.

CONCLUSIONS

The integration of green infrastructure in the plan of urban regeneration is based primarily on the idea that green spaces have not only an aesthetic contribution, but also a social one, aiming the reconnection of the isolated fragments of habitat, allowing biodiversity to develop and flourish, and providing inhabitants with access to recreational activities.

The green space surrounding Cameo Residence was designed as a contemporary, integrative landscape system based on principles inspired by the Food Forest concept in a modern composition. Species we chose are easy to recognize and easy to maintain. They offer fruits, much appreciated by children. Aromatic species also add variety and special freshness to the garden, creating at the same time a pleasant environment, while low and cover plants protect the soil, maintaining its moisture and helping in weed control.

The design idea we propose facilitates social regeneration by creating points of interest based on natural elements, which encourage the community connection to approach the peri-urban areas, often perceived as a space of transit with no clear identity.

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