



Introducing Green Infrastructure into Urban Policy Documents – The Case of Croatian Cities

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Abstract: *More and more cities are coping with the challenges of unsustainable urbanization, degradation, loss of natural capital, climate change, and increased risk of natural disasters. Green infrastructure (GI) and especially urban green infrastructure (UGI) could have a key role in dealing with these development issues.*

The main goal of the paper is to evaluate the role of GI in development strategies, both on national and local levels. The role of GI as a policy tool is analyzed. In addition to national development strategies, the paper reviews the development strategies of several Croatian cities. The four biggest and most developed cities are selected: Zagreb, Split, Rijeka, and Osijek. As the most developed cities in economic terms, they are expected to base their development on new development patterns, including GI.

The paper is structured as follows. After presenting GI and the literature review, the third section discusses national regulation and urban policy documents related to GI. The final section presents some conclusions and some proposals for future research agenda.

1. INTRODUCTION

Urban areas, primarily cities, are the main drivers of economic growth, but at the same time, they also have the greatest impact on sustainable development. Since 75 percent of the European and 58 percent of the Croatian population live in urban areas it is important to improve the sustainability of urban areas, improve the environment, and increase the quality of life in cities.

More and more cities are coping with the challenges of unsustainable urbanization, degradation, loss of natural capital, climate change, and increased risk of natural disasters. Green infrastructure (GI) and especially urban green infrastructure (UGI) could have a key role in dealing with these development issues.

The main goal of the paper is to evaluate the role of GI in development strategies, both on national and local levels. The role of GI as a policy tool is analyzed. In addition to national development strategies, the paper reviews the development strategies of several Croatian cities. We select the biggest and the most developed cities: Zagreb (790.017 inhabitants), Split (178.102), Rijeka (128.624), and Osijek (108.048). As the most developed cities in economic terms, they are expected to base their development on new development patterns, including green infrastructure. Besides, these cities also formulate development strategies for urban agglomeration. The existence of specific strategies for GI development for Croatian cities is rare, so general development strategies are used.

The paper is structured as follows. After presenting GI and the literature review, the third section discusses national regulation and urban policy documents related to GI. The final section presents conclusions and some proposals for future research agenda.

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2. INTRODUCING GREEN INFRASTRUCTURE

There are different conceptual approaches to green infrastructure as well as its numerous classifications, while the concept is still evolving. GI is a very broad concept that can be interpreted in different ways. According to [Sandström \(2002\)](#), the concept of GI was introduced in the 1990s in the USA, but its implementation in Europe is growing, especially with the introduction of the EU's Green Infrastructure strategy ([EC, 2013](#)). GI plays a social, structural, and environmental role (function) in urban spaces. Therefore, [Maruani and Amit-Cohen \(2007\)](#) propose that definitions can be divided into two groups, those dealing with human needs and those dealing with environmental values.

The complexity of the concept was mentioned in academic literature and in policy papers formulated by different agencies and organizations, including companies and community groups ([Pauleit et al., 2011](#)). [Naumann et al. \(2011\)](#) analyzed green infrastructure predominantly from a policy perspective. It can be used as a tool or strategy to achieve sustainable development and smart growth ([Demuzere et al., 2014](#)). Therefore, the role of GI is especially emphasized in spatial planning while it encompasses multi-functional zones and includes different measures in land-use policies ([EC, 2012](#); [EU, 2013](#); [Sandstrom, 2002](#)).

The role of GI in planning development policy in Croatia is the focus of this paper. Hence, the insights of [Wang and Bazhaf \(2018\)](#) are the most valuable here. They highlight three main interpretations of GI based on “transferring or translation processes” ([Wang and Bazhaf, 2018: 760](#)). First, the link between humans and natural systems is to reach the balance of anthropocentric and eco-centric approaches. The second is a translation from the theory approach to the practical policy measure, and the third is the translation of the GI definition to understand its multifunctionality on different scales (local, urban, regional, and national). [Wang and Banzhaf \(2018\)](#) review six principles of green infrastructure, where multifunctionality is considered the most crucial one. The integral approach to green infrastructure functions, including environmental, social, and economic benefits, has to be applied to different scales and levels. According to [Sternlieb et al. \(2013\)](#) conceptual developments of green infrastructure should be related to the proper level of decision-making. [Garmendia et al. \(2016\)](#) emphasize the role of GI in spatial planning and argue that the concept of multifunctionality is more convenient for operationalization than the concept of sustainability. In addition, [Garmendia et al. \(2016\)](#) stress the importance of functional connectivity among policy planners, developers, and different disciplines.

The other concept which is closely related to green infrastructure is the urban green infrastructure (UGI) which was introduced to position green areas in urban environments using processes, approaches, and selected policy themes ([Davies & Laforteza, 2017: 94](#)). Notions of UGI as a planning process are strategic, inter-and transdisciplinary, and socially inclusive planning. Concepts of UGI as a planning approach are connectivity (creating networked geographical areas), multifunctionality (different functions including ecosystem services), integration, and multi-scale. UGI policy themes are climate change adaptation, green economy, human health, social cohesion, biodiversity, and ecosystem services ([Davies & Laforteza, 2017: 94](#)).

Recently, the concept of GI is associated with the term blue infrastructure (rivers, streams, ponds, lakes, etc.) which today is considered the pillar of UGI.

The benefits of GI are numerous and diverse. They are presented in Table 1.

Table 1. Potential benefits of the GI

Environmental benefits	<ul style="list-style-type: none"> • Provision of clean water • Removal of air pollutants • Protection of soil erosion • Rainwater retention • Increased pest control • Mitigation of land take and soil sealing
Social benefits	<ul style="list-style-type: none"> • Better health and human well-being • Creation of jobs • Diversification of the local economy • More attractive, greener cities • Higher property values and local distinctiveness • More integrated transport and energy solutions • Enhanced tourism and recreation opportunities
Climate change adaptation	<ul style="list-style-type: none"> • Food alleviation • Strengthening ecosystems resilience • Carbon storage and sequestration • Mitigation of urban heat island effects • Disaster prevention (storms, fires, landslides)
Biodiversity benefits	<ul style="list-style-type: none"> • Improved habitats for wildlife • Ecological corridors • Landscape permeability

Source: EC, 2013.

Environmental benefits encompass improving the functions and resilience of ecosystems, conservation of biodiversity by connecting existing natural areas, and preservation of natural habitats by preventing their fragmentation (Schäffler & Swilling, 2013). Providing multi-functional outdoor spaces and creating safe spaces that encourage activity are the principal social benefits. Protection of significant landscapes and natural heritage that affect the local identity in combination with fostering the inclusion of the community's environmental action are significant.

Economic benefits entail the creation of favorable conditions for the sustainable development of agriculture, tourism, and leisure industries. Well-planned and high-quality urban spaces increase land and real estate values. All of that can result in creating new jobs (Rutt & Gulsrud, 2016).

The most perceived barriers to the development of GI are conflicting interests of different stakeholders, physical barriers in the case of private areas, and institutional barriers. Among the major barriers, institutional barriers must be emphasized. According to Biernacka and Kronenberg (2018) institutional barriers affect the availability, accessibility, and attractiveness of GI. Implementation barriers range from legislation to a lack of cooperation, knowledge, and awareness, including a lack of communication between different stakeholders.

3. CROATIAN GREENSPACE PLANNING AND POLICY DOCUMENTS ANALYSIS

3.1. National Regulation and Policy Documents

A policy document analysis and a desk study were the main methods used for this article. The desk study of relevant literature and documents (development strategies for cities, and urban agglomerations) had been conducted to provide insight into whether or how different approaches and policy themes were considered in planning.

GI is defined in Croatian legislation. The term GI is defined by the *Law on Spatial planning*, which states that “green infrastructure is planned green and water surfaces and other nature-based spatial solutions applied within cities and municipalities that contribute to the conservation, improvement and restoration of nature, natural functions and processes in order to achieve the environmental, economic and social benefits of sustainable development”.

The Construction Act stipulates the need for the formulation of *The Program for the Development of GI in urban areas*. The Program for the Development of GI in Urban Areas for the period 2021-2030 was prepared by the Ministry of Physical Planning, Construction, and State Property and adopted by the Government of the Republic of Croatia in December 2021. According to the EU documents, the Program defines objectives and measures for the development of green infrastructure in urban areas to establish sustainable, safe, and resilient cities and settlements through increasing the energy efficiency of buildings and construction areas, developing green infrastructure in buildings and urban transformation, and urban rehabilitation. It is in accordance with the *National Development Strategy of the Republic of Croatia until 2030*, which is an overall strategic document that defines the national development vision, strategic objectives, and priority areas. *Strategy for Adaptation to Climate Change* in the Republic of Croatia for the period up to 2040 with a view to 2070 and *Integrated National Energy and Climate Plan* for the Republic of Croatia 2021-2030 highlight the importance and role of GI in achieving the objectives of sustainable development with the nature-based solutions. GI Development Program is also essential for the reduction of energy consumption and therefore it is related to the *Long-term Strategy for the renovation of the national building stock by 2050* and to the *Strategy for Low-Carbon Development of the Republic of Croatia by 2030* with a view to 2050. The GI Development Program is in accordance with *The Spatial Development Strategy*² which is a guiding document implemented on the national, regional, and local levels. One of the priorities stated in the Strategy emphasizes the importance of strengthening natural capital by planning the development of GI.

Reviewing the national strategy documents reveals that the importance of GI in the planning and development of urban areas has already been recognized. This paper questions the presence of GI approach in lower spatial scales. The urban development strategies for the four biggest cities (Zagreb, Split, Rijeka, and Osijek) are selected and analyzed.

3.2. Urban Development Strategies

For the purpose of this article the following urban strategies are analyzed: *Zagreb development strategy for the period up to 2020 (ZAGREBPLAN)*, *Zagreb urban agglomeration development strategy for the period up to 2020*³, *City of Rijeka development plan 2021-2027*⁴, *Osijek development strategy – from industrial to intelligent city 2016-2020*⁵, *Osijek urban agglomeration*

² Croatian system of physical planning could be classified as the continental style of planning in combination with a comprehensive integrated approach (Katuric et al., 2018).

³ Zagreb Urban Agglomeration contains 7 cities and 20 municipalities (within Zagreb County, Krapina-Zagorje County, Karlovac, and Sisak-Moslavina County). They have common interests related to environmental and natural protection, as well as cultural resources and heritage. In April 2022 the development of the new Zagreb Urban Agglomeration Development Strategy for the period up to 2027 has begun.

⁴ Strategic objectives are harmonized with the five objectives of the new regional and cohesion policy of the European Union for the period 2021-2027 (Smarter Europe, Carbon-free Green Europe, A more connected Europe, A more social Europe, and Europe closer to citizens). A Green infrastructure strategy for the City of Rijeka was adopted in 2020.

⁵ The City of Osijek is a member of the Intelligent Cities Forum.

development strategy for the period up to 2020⁶, Split development strategy for the period up to 2020, and Split urban agglomeration development strategy for the period up to 2020⁷.

These are fundamental strategic documents of regional development policy for selected cities. Documents were developed in accordance with the Law on Regional Development of the Republic of Croatia (Official Gazette, OG 147/14) and the Guidelines of the Ministry of Regional Development and EU funds for the development of county development strategies, monitoring, and evaluation of their implementation from September 2015. The development strategies are also aligned with the Regional Development Strategy of the Republic of Croatia until the end of 2020 (OG 75/17) and the spatial planning documentation for selected cities. All development documents, except the strategic document for the City of Rijeka, expired in 2020. And that's one of the limiting factors of analysis.

In reviewing documents, the focus was on the *selected green areas approach*, *objectives* related to green areas, *actions* for achieving these objectives (strategy), and *indicators*.

The *green areas approach* is questioned by the presence of GI in urban strategies. The first finding was that green areas are rarely present as a stand-alone chapter (section) in the strategies of selected cities and most commonly they are included within broader environmental sections. The exception is the development strategy for the City of Rijeka. In analyzed documents, there is no definition of GI concept, and there is a lack of theoretical characteristics associated with UGI. The most prevalent occurrence of GI is its description. All selected strategies include so-called flagship categories of GI such as parks, forests, gardens, cemeteries, and street greenery which are managed by urban authorities and located on public land. In addition, there is no sufficient planning of public green spaces within the new settlements. Roof terraces and vertical gardens are recognized as a great potential for improving the quality of housing and life. Urban Strategies of Rijeka and Split pay more attention to blue infrastructure, compared to Zagreb and Osijek. In the development document of Rijeka, the broader context of GI is applied, and concepts of green growth (including green jobs) and green public procurement are introduced. The idea of a circular economy as well as the principles of the doughnut economy are mentioned (Raworth, 2017). The urban strategy of Rijeka is the most ambitious one and the goal is to become a regional hub for Southeast Europe for developing and implementing smart solutions in urban management.

The *benefits* of GI, the associated *problems*, and potential *barriers* to future development for GI are elaborated on in all selected urban documents. All development strategies for selected urban agglomeration consider the benefits of functional and physical networks. These benefits were generally referred to as either environmental (biodiversity) or social (recreation). All urban agglomeration documents emphasize the importance of connectivity and multifunctionality (provision of multiple functions and services) which are the essence of GI.

Urban strategies are seen as an umbrella concept for reviewing future development plans in terms of *objectives*, *actions* to achieve them, and *indicators* for monitoring. The general objectives identified in the analyzed document are increasing the surface of green areas, protection and conservation, and better management of existing GI.

⁶ Out of 19 local self-government units that make up the Osijek Urban Agglomeration, 18 of them are in Osijek-Baranja County and one in Vukovar-Srijem County.

⁷ It consists of 12 local self-government units within Split-Dalmatia County. In October 2020 Split began the formulation of the Action plan for the green city according to EBRD and OECD methodology.

Specific Croatian development issues presented in urban strategies are the unresolved property status of green spaces, illegal construction, and expansion of other objects into the greening area, inconsistent standards for the design, regulation, and protection of GI components, as well as management and detachment of competent authorities in the planning and implementation of GI process. As the most urgent challenges, cities identified design of an appropriate model of a multifunctional network of GI, mapping, and inclusion of GI in other planning acts and spatial planning documents, just to name a few⁸. Urban agglomerations stress the lack of communication between competent authorities and inadequate vertical coordination among the members of agglomeration. The cities within urban agglomerations are preparing for a new generation of programs funded as integrated territorial investments for urban agglomerations, and a stronger emphasis on joint and big strategic projects.

Sound policies and strategies should be based on quantitative data describing UGI showing the availability and accessibility of GI, including their values and costs of management. A green atlas of the City of Zagreb is prepared, including the indicator of green area per inhabitant. More detailed data on green areas for the City of Zagreb are under construction, including the number of square meters per capita. Rijeka formulated indicators for monitoring the achievements of key strategic goals, including the surface of parks and other green areas till 2030. Although, there is no data on green area surface per inhabitant. Osijek prepared a Green cadaster and is expected to prepare it for agglomeration. In the Split urban strategy, quantitative indicators for planning and building new public green areas are presented. The creation of green cadaster is also planned.

To conclude this section, it is necessary to point out that all selected documents emphasize the sustainable spatial development of the urban agglomeration as one of the development priorities. To achieve this goal, integral spatial planning is one of the most important activities. It includes establishing the appropriate model of the multifunctional network of GI of the agglomeration, with mapping and valorization of the area, the inclusion of green determinants infrastructure into spatial plans, and other planning development documents. Participation of key stakeholders is a prerequisite for sustainable spatial development, and it assumes the involvement of key stakeholders (at all levels) and the public in the planning and implementation of development plans (spatial plans, green infrastructure plans).

4. CONCLUSION

GI is a significant and influential concept, but it is not fully recognized in Croatian urban planning. By reviewing selected urban development strategies, it is evident that implementing the GI concept has many challenges, including its integration into the physical planning process.

It can be concluded that Croatian cities show moderate commitment to GI development. The most demanding task is to find an appropriate mix of solutions for urban specificities which is also in line with previous European research (Andersson, 2016; Wagner, 2016; Garcia, 2017).

Why Croatian cities are not greener? Authorities are predominantly focused on a part of green areas for which they are responsible, and still, there is a lack of a coherent basis for GI research.

⁸ The need for the participation of key stakeholders in the processes, educational programs related to GI, and effective use of ESI funds in the next period are also highlighted.

An effective policy requires data on GI, and a database of existing public green spaces established in the GIS environment will improve the management of public green spaces.

The future research agenda includes the following issues - is green infrastructure viewed differently by different user groups; what are the future opportunities for GI development; how to quantify intangible benefits of GI, etc.

In addition to further research, the implementation of information campaigns and educational programs are required.

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