Prioritization of Urban Green Infrastructures for Sustainable Urban Planning in Ploiesti, Romania

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1 ABSTRACT

Urban green infrastructures are increasingly being used as instruments for achieving a sustainable urban planning due to their multifunctionality represented by the numerous economic, social and environmental benefits. Selecting the most appropriate type of urban green infrastructure to be developed in a certain city is most of the times an important challenge for planners.

In our analysis, we developed a model for a multi-criteria evaluation of the components of urban green infrastructures using structural, functional, administrative and economic criteria. We used as a case study the city of Ploiesti, an industrial city of Romania, focused on oil processing. Ploiesti is one of the main engines of the Romanian economy with a tradition of over 100 years of oil industrial activity being characterized by a significant expansion of the build-up areas (especially industrial and technological site) in the outskirts of the city and a decrease of urban green area per capita. Policies and strategies to increase the density of the existing urban green infrastructure and to sustainably manage the existing ones represent a challenge for local authorities and other local actors and stakeholders as the balance between economic development and the city's livability has to generate a proper quality of life for its inhabitants.

Our results can drive to a more efficient urban planning and the use of the correct and appropriate urban green infrastructures elements in improving the quality of life and the environment. The analysis can be used for sustainable planning of urban green infrastructures in other cities lacking a proper amount of green areas.

2 INTRODUCTION

In the context of continuous expansion of urban areas, often manifested through urban sprawl (Bruegmann 2005), the demand of green areas is constantly increasing, therefore the need of an efficient urban green infrastructure (UGI) network has become an important challenge. A planned and systematized urban expansion drives a natural expansion of the existing UGI, but in the case of the sprawling cities, UGI planning may face some difficulties. Sprawl is defined in terms of "undesirable" land-use patterns—whether scattered development, leapfrog development (a type of scattered development that assumes a monocentric city), strip or ribbon development, or continuous low-density development (Ewing 2008).

In the context of sustainable city policy it should be recognised that cities are not passive spatial units victimised by anonymous global environmental developments, but may play an active role in producing sustainable development in a multiplicity of relevant fields, such as housing, employment or environmental quality (Camagni, Capello, and Nijkamp 1998). The achievement of sustainable urban development requires tools to assess the current status of an urban issue (Gavrilidis et al. 2016; Van Herzele and Wiedemann 2003; Iojă et al. 2014) but also tools to assess the potential effects of a certain urban policy or strategy (Ducom 2005; Jabareen 2013).

The aim of the current study is to develop a methodology to assess what types of UGI are the most efficient and sustainable in different urban fabrics using a multi-criteria analysis. Multi-criteria analysis can be useful for supporting a strategy team tasked with designing and selecting strategic options (Zopounidis and Pardalos 2010). Sustainable UGI planning in sprawling urban areas represents an issue that can be tackled using a multi criteria analysis. The study focused on achieving three main objectives: 1) weight attribution for the selected criteria, 2) calculating the suitability degree of different UGI and 3) selecting the best UGI for several urban areas based on their function or socio economic aspects.

3 METHODOLOGY

The methodological steps coincide with the study's objectives, meaning there were three methodological steps needed to be fulfilled in order to complete the study. The first one was to attribute weights to all of the nine criteria selected for the potential planning of an UGI, the second one was to establish a suitability score for the 27 UGI chosen, based on the criteria selected and the Romanian patterns and planning tradition and, in the end, it was established which of the selected UGI are proper for different urban areas and functional zones. The first criteria used to analyse the urban areas was the functional zones of the city and the second one was based on socio economic aspects of the city's districts. The analysis was conducted using the Delphi method in which were involved experts working in research project and universities in domains related with geography, urban planning, environmental assessment, biology, landscape ecology, green infrastructure planning and remote sensing analysis.

3.1 Study area

For this study it was chosen an urban area from south-east Romania, the city Ploiesti. Ploiesti is one of the biggest cities in the country, being an important industrial centre focused on oil processing. It has been permanently developing since the mid-19th when Ploiesti and its surroundings was one of the world's leading oil production centres. The planning policies of the cities were very much influenced by specific principles of the political regimes that ruled the country (Gavrilidis et al. 2015) leading to a lack of green infrastructures and a surplus of industrial sites and infrastructures, from which some of them, not related with oil processing activities, became brownfields after 1990 (Gavrilidis, Ioja, and Saghin 2011). Therefore the city's build up areas expanded in the suburban areas of Ploiesti, mainly by commercial sites, industrial sites and residential sites. The former industrial units that were closed are representing a valuable resource for future green infrastructure (Saghin et al. 2012) but there is a need of proper planning of these infrastructures in order for them to be efficient and respond to the current need of life quality and environmental challenges.

3.2 Criteria selection

A number of nine criteria were taken into consideration for the potential planning of an UGI. Each criteria is explained in table 1.

Criteria	Acronym	Explanation
Management costs	man	The total expenses required to mantained the UGI at a proper level of quality, including wages, required suplies for maintenance, costs in case of accidental degradation etc
Building easiness	bld	How easy is to build a certain UGI, refering to: if it requires a long time to build and high costs to build, if it requires a large surface of land and complicated bureaucratic procedures to start the building of the UGI
Popularity of the infrastructure in Romania	pop	It refers to how popular is the certain UGI in Romania; if there are exemples of particular UGI in other urban areas
Climate change combat eficency	cce	If the UGI is an efficient infrastructure in the combat of climate change issues
Air quality improvement efficency	aqi	If the UGI is an efficient infrastructure to improve the local air quality
Economic profitability	epr	The UGI can generate income for the local authorities or for a private actor
Biodiversity benefits and conservation	bdb	The UGI contributes or improves the bidoviersity conservation levels
Social network stimulation	sns	The UGI stimulates outdoor activities, stimulating human interaction
Specificity	spf	The UGI can be built or managed only in specific cases (depending on natural or cultural condition) or it can be built or managed wherever no mater the case

Table 1: Criteria explanations

The "management costs" were selected as criteria because it is an important aspect in UGI planning due to the low amounts of funds allocated by public authorities to this sector (Iojă, Nita, et al. 2011). "Building easiness" its however complementary with "management costs" but it was treated separately because land availability is a high valuable resource in urban areas and the accessibility to unused land is often scarce, especially for UGI development (Grădinaru et al. 2015). The "popularity of a certain UGI in Romania" was selected because the local decision makers usually follow a similar known pattern when planning UGI for their cities (Cicea and Pirlogea 2011). "Climate change combat efficiency" and "air quality improvement efficiency" were selected because global climate changes and urban air quality represent important

environmental issues and many studies and public reports emphasized the role of UGI in the combat of these issues (Carter 2011; European Commision 2012; EEA 2012). Most of the local authorities avoid developing the local UGI network as there is not a type of land use that generates immediate income to local budget as the commercial, industrial or other built infrastructures do (Sýkora and Ourednek 2007; Ioja et al. 2011). That's why "economic profitability" was chosen as a criterion. Biodiversity has been an important issue in the last decades due to species vulnerability towards extinction. Therefore the need to create friendly urban areas for species of plant and animals represent a challenge to be responded by planners and policy makers (Hostetler, Allen, and Meurk 2011; Jabareen 2013). UGI, especially large ones such as parks or urban forests have a great contribution to social inclusion and networking, thus UGI's can combat segregation and bring together in one place people from different social categories, different religion or ethnicity (Iojă, Rozylowicz, et al. 2011; Wolch et al. 2011; Thompson, Roe, and Aspinall 2013). Some UGI are strictly dependent on some natural characteristics. For instance watershed forests or riparian vegetation is dependent on the presence of a water course. Thus, the "specificity" criterion was selected to cover the situations which some UGI can face.

3.3 UGI selection

In order to establish what UGI are proper to be developed in different urban fabrics a list of 27 infrastructures were chosen. The infrastructures were chosen in accordance with the UGI typology proposed by the European Environment Agency (2011) in the technical report Green Infrastructure and territorial cohesion.
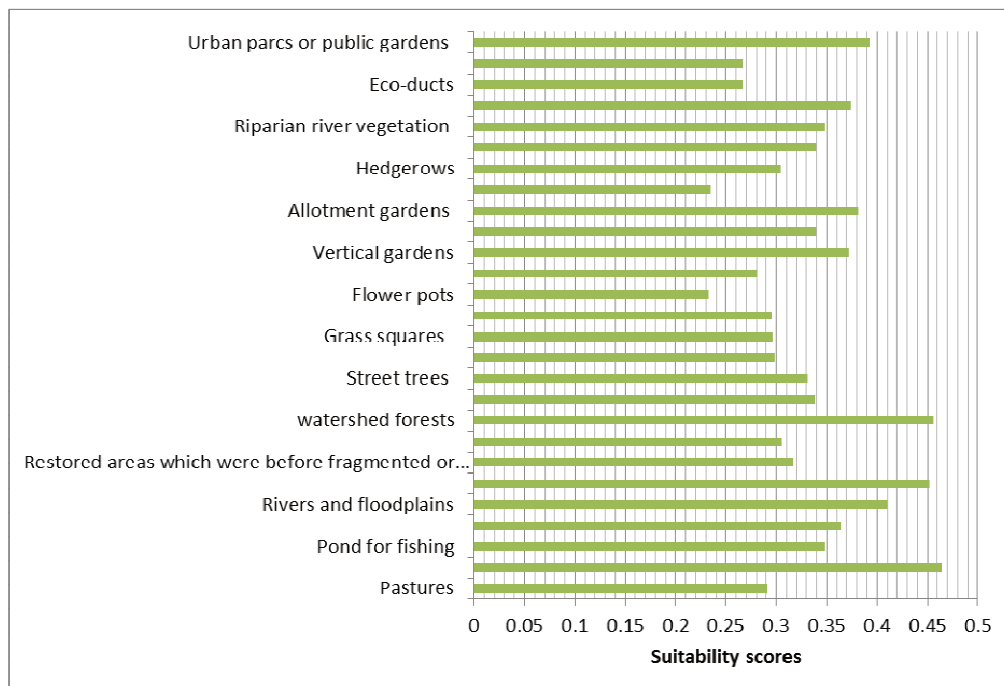

Fig. 1: Suitability scores for the 27 selected UGI in Romanian urban areas

4 RESULTS

After the weight attribution process the "pop" criterion recorded the lowest values and the "bdb" criterion recorded the highest value. Also "cce" and "aqi" criteria recorded high scores. When establishing the suitability of the UGI types, urban forests, rivers and floodplains, local nature reserves and watershed forests proved to be the most suitable UGI for the Romanian cities (fig.1). The analysis to establish wich UGI is proper for different urban functional zones showed that for the urban areas with agricultural characteristics the best UGI are rivers with floodplains, high nature farmlands, orchards and transitional ecosystem from cropland, grassland and forests. For the industrial areas of the cities the proper UGI are protection forests and street trees. For comercial urban areas the best UGI were considered the street trees, singular trees and urban parcs or public gardens. The residential areas were divided in multidweling housing and individual housing. In best cases the proper UGI resulted to be urban parcs and public gardens and street trees. The socio economic analysis concluded with the fact that in neighbourhoods populated by poor people with social

problems, the best UGI to be planned are street trees, allotment gardens and parcs, and on the other side, in the neighbourhoods populated by rich people with high income and wealth, the best UGI are urban forests and public parcs.

After the analysis was completed, a map of potential UGI was procesed for Ploiesti, taking into consideration the availability of land. It emphasized what UGI are proper to be planned by local authorities using the multicriterial analysis results.

5 DISCUSSION AND CONCLUSION

The main finding of the study was the ability to make a hierarchy of the UGI that can be implemented in a Romanian city and a Romanian context (legal aspects, traditional planning, funds availability etc). In order to confirm the results of the curent study future researched are going to be focused on public perception towards UGI mixed together with the assessment of local authorities perception and companies representatives' perception. After that we will be able to have the entire picture of UGI planning in Romania and we will be able to deliver the best solution for this issue.

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