

## THE PLACE AND THE ROLE OF THE URBAN OXYGENATING AREAS IN THE URBAN LANDSCAPE RENATURATION

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**Abstract.** The green-blue infrastructure or urban oxygenating areas represent regions of particular importance in the urban ecosystem due to the benefits provided and positive implications for the inhabitants' state of health. This issue has gained particular importance as compared with the ascending dynamics of urban residents, thereby causing changes in the way land is used inside the urban area. The present study underlines the importance of oxygenating areas in the urban renaturation process, with the objective of maintaining the balance between the ecological systems and achieving the urban sustainability. The identification of the oxygenating areas categories and their functions is the method chosen in order to highlight the role and the place of the green-blue infrastructure at the level of the urban landscape, and the established area of study is represented by the Development Region of South-West Oltenia. The functions of urban oxygenating infrastructure (cultural, ecological, recreational and improving health) are the guarantor of the urban sustainability, therefore the structural and functional conservation of these areas is a binding approach that may only be achieved by conjugating the will of the political decision-makers to the existence and implementation of an appropriate legislation, but also by involving the residents.

**Keywords:** oxygenating areas, renaturation, urban landscape, South-West Oltenia Development Region.

**Rezumat. Locul și rolul suprafețelor oxigenante urbane în renaturarea peisajului urban.** Infrastructura verde-albastră sau suprafețele oxigenante urbane reprezintă areale cu importanță deosebită la nivelul ecosistemului urban prin beneficiile oferite și implicațiile pozitive asupra stării de sănătate a locuitorilor. Această problemă a dobândit o importanță deosebită în raport cu dinamica ascendentă a rezidenților urbani, fapt ce cauzează schimbări în modul de utilizare a terenului în interiorul intravilanului. Prezentul studiu evidențiază importanța suprafețelor oxigenante în procesul de renaturare urbană, având drept obiectiv menținerea echilibrului ecosistemic și atingerea durabilității urbane. Identificarea categoriilor de suprafețe oxigenante și a funcțiilor acestora este metoda aleasă spre a reliefa rolul și locul infrastructurii verzi-albastre la nivelul peisajului urban, iar zona de studiu stabilită este reprezentată de Regiunea de Dezvoltare Sud-Vest Oltenia. Funcțiile infrastructurilor oxigenante urbane (culturale, ecologice, recreative și de îmbunătățire a sănătății) reprezintă garantul durabilității urbane, de aceea conservarea structurală și funcțională a acestor suprafețe este un demers obligatoriu ce poate fi realizat doar prin conjugarea voinței decidenților politici, cu existența și implementarea unei legislații corespunzătoare, dar și prin implicarea rezidenților.

**Cuvinte cheie:** suprafețe oxigenante, renaturare, peisaj urban, Regiunea de Dezvoltare Sud-Vest Oltenia.

### INTRODUCTION

*Urban oxygenating areas* have been timidly addressed in the scientific geographic research in Romania, thereby circumventing their structural and functional assessment in relation to the inhabitants' state of sanogenesis and quality of the urban living. Identifying and applying a complex and objective methodology to quantify the ecosystem services and benefits provided by the urban oxygenating infrastructure may lead to the achievement of a vast database that integrates both the theoretical values and the way residents refer to these natural regions. The studied issue is a current and important one through the relationship developed with the urban topoclimate and its changes (the urban heat island phenomenon, the air and water pollution, etc.) in the sense of understanding the influence of the green-blue infrastructure on such phenomena having negative effects on the quality of life and living in the urban environment.

The importance of the study is also attached to the need for updated data which will help local and regional decision-makers to design and implement policies and good practices, with a view to achieving the objectives of the programme *Horizon 2030 for Sustainable Development*. These administrative and legislative measures may be integrated into urban planning projects, thereby maximizing the ecosystem services provided by the urban oxygenating infrastructure.

### METHODS

#### *Considerations on the concept of renaturation of the urban landscape*

The European Landscape Convention defines *landscape* as *part of the territory perceived by the population, the characteristics of which derive from the action of natural and / or human factors and their interrelationships*. The *urban landscape*, on the other hand, is defined as the *object and subject of the human-nature interactions within a given area*, according to human needs (LOISEAU et. al., 1993). The term of *renaturation* is used in urbanism, architecture and ecology and should be understood as a process, an action modifying a portion of area, neighbourhood, landscape, parcel or territory by extending the natural elements of flora, fauna, surface water flows (MURATET et. al., 2007). This process follows the anthroposis and in the context of the urban landscape, it means a sort of planning in such a way that it is effectively perceived as an element contributing to the functioning of the urban system (PENONE et. al., 2012; PECH, 2013). MURATET et al. (2007) consider *renaturation* as capable of creating new ecosystems, perceived as islands of biodiversity in the urban tissue.

### *Urban oxygenating areas and the process of urbanization*

The renaturation of the urban landscape is often achieved by expanding or creating new urban oxygenating areas. The green infrastructure, together with the blue one, form the *urban oxygenating areas*, whose role is to improve the quality of the urban life, people's state of health (NIȚĂ, 2016) and urban environment. This category must include, on structural, functional and aesthetic levels, all the elements of a natural and semi-natural landscape (DEMUZERE et al., 2014) such as lakes, urban rivers, parks, forest vegetation, gardens that are private and public property, sports fields and street alignments, as well as riparian vegetation. The extent and quality of these oxygenating areas is conditioned by the size of the city, but also by the period in which it has achieved this rank.

The urbanization process in Romania has, in many cases, been made by the political decision-makers who decided to change the status of the rural settlements in urban areas (BADIU, 2016). This phenomenon took place immediately after the change of the governance regime in 1989, when the transition from communist authority to democratic freedom was accomplished. In the case of this transition from rural to urban, no account has been taken of the existence of a specific infrastructure or the capacity to adapt to the changes imposed by the new status. In this respect, a very important aspect is represented by the land-use change (\*\*\*) UNITED NATIONS, 2008), in response to the need of expanding the residential, industrial or commercial areas, most often at the expense of the green areas and blue infrastructure (KUEMMERLE et al., 2009; GAVRILIDIS et al., 2015).

There are many ecological aspects of the use and change of urban lands with direct implications for the climate change (BLANCO et al., 2011), the level of the land sealing and major changes in storm drains (KAMMEN & SUNTER, 2016). The use of land at the urban level shall be subject to the approval of many decision-makers such as: the existing legal, planning, administrative and fiscal systems, and the land estate markets enabling transactions by regulating the demand and supply (BLANCO et al., 2011). Through the accepted and agreed treaties and norms both internationally and nationally, it is currently desirable to implement coherent and holistic measures in order to promote the achievement of the urban environment sustainability standard (\*\*\*) UNITED NATIONS, 2016).

The analysed area, involving case studies, coincides with the historical region of Oltenia, which is located in the South-West of Romania and comprises 5 counties (Mehedinti, Dolj, Gorj, Olt, Vâlcea) and 40 cities (Fig. 1). To establish the role of oxygenating areas in the urban landscape renaturation, we identified the categories of such areas existing at the level of each administrative-territorial unit by vectoring on the orthophotoplan for the year 2008 and we compared the results with the General Urbanistic Plans of each city. Then, we determined the ecosystem functions of the green-blue infrastructures and their impact on the urban ecosystem and residents.

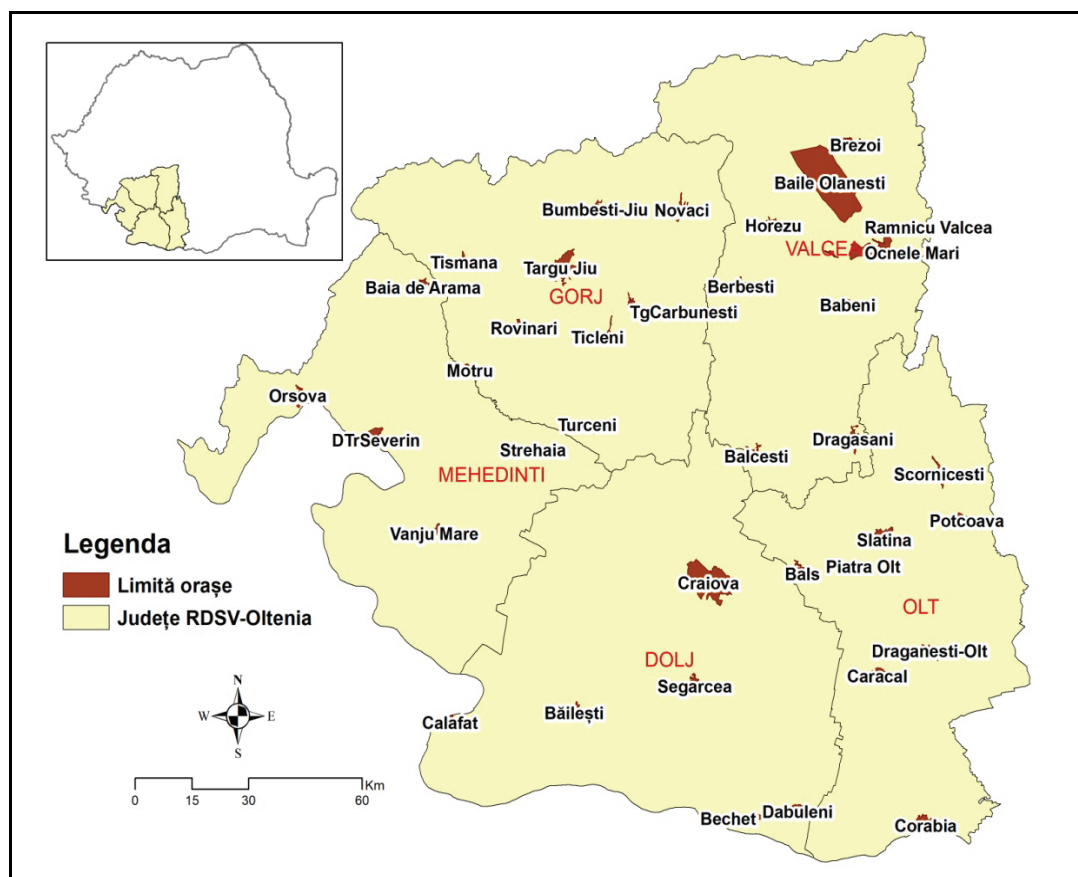


Figure 1. Spatial distribution of selected cities within the SV Oltenia Development Region for the assessment of urban oxygenating areas (original).

## RESULTS AND DISCUSSIONS

The urban green infrastructures include, structurally, the following green areas: *urban parks, gardens of public institutions, squares, street alignments, gardens that are private or public property, cemeteries, sports fields, riparian vegetation, green roofs, green vertical walls, urban forest*. On the basis of the legislation in force, we have established 11 categories of urban oxygenating areas having a role in the urban topoclimate. These categories may be identified at the level of the cities in the Development Region of South-West Oltenia (Table 1).

Table 1. Categories of the urban oxygenating areas identified within the cities of the S-W Oltenia Development Region.

City name	Lake	River	Private property gardens	Urban forest	Public gardens	Parks	Riparian vegetation	Cemetery	Gardens of public institutions	Squares and street alignments	Sports fields
1. Băbeni	x	-	x	x	x	x	-	x	x	x	-
2. Baia de Aramă	x	x	x	x	x	-	x	-	x	-	-
3. Băile Govora	-	-	x	x	x	x	-	x	x	x	x
4. Băile Olănești	x	x	x	x	x	x	x	x	x	-	x
5. Băilești	x	x	x	-	x	x	x	x	x	x	x
6. Bălcești	-	-	x	x	x	-	-	x	x	-	-
7. Baș	x	x	x	x	x	x	x	x	x	x	x
8. Bechet	-	x	x	x	x	x	x	x	x	x	-
9. Berbești	-	x	x	x	x	-	x	x	x	x	x
10. Brezoi	x	x	x	x	x	x	x	x	x	x	x
11. Bumbești-Jiu	x	x	x	x	x	-	x	x	x	x	x
12. Calafat	x	x	x	x	x	x	x	x	x	x	-
13. Călimănești	x	-	x	x	x	x	x	x	x	x	-
14. Caracal	x	-	x	x	x	x	-	x	x	x	x
15. Corabia	x	x	x	x	x	x	x	x	x	x	x
16. Craiova	x	x	x	x	x	x	x	x	x	x	x
17. Dăbuleni	x	x	x	x	-	-	-	x	x	x	-
18. Drăgănești	x	-	x	x	x	x	-	x	x	x	x
19. Drăgășani	x	x	x	x	x	x	x	x	x	x	x
20. Drobeta Turnu Severin	x	x	x	x	x	x	x	x	x	x	x
21. Filiași	x	-	x	x	x	x	x	x	x	x	-
22. Horezu	-	x	x	x	x	x	x	x	x	x	x
23. Motru	x	x	x	-	x	x	x	-	x	x	x
24. Novaci	x	x	x	x	-	-	x	x	x	x	x
25. Ocnele Mari	x	x	x	x	-	x	x	x	x	-	-
26. Orșova	x	x	x	x	x	x	x	x	x	x	x
27. Pietra Olt	x	x	x	x	x	x	-	x	x	x	x
28. Potcoava	x	x	x	x	x	-	x	x	x	x	-
29. Râmnicu Vâlcea	x	x	x	x	x	x	x	-	x	x	x
30. Rovinari	-	x	x	-	x	x	x	x	x	-	x
31. Scornicești	x	x	x	x	x	-	-	-	x	x	x
32. Segarcea	x	x	x	-	-	x	-	x	x	x	-
33. Slatina	x	x	x	x	x	x	-	x	x	x	x
34. Strehaia	x	x	x	x	x	x	x	x	x	x	x
35. Târgu Cărbunești	x	x	x	x	x	x	x	x	x	x	-
36. Târgu Jiu	x	x	x	x	x	x	x	x	x	x	-
37. Țicleni	x	x	x	x	x	x	x	x	x	x	x
38. Tismana	x	x	x	x	-	-	x	x	x	-	-
39. Turceni	x	x	x	x	x	-	-	-	x	x	-
40. Vânju Mare	x	x	x	x	x	x	-	x	x	-	-

x=presence, -=absence,

Source: the processing of the Orthophotos 2008

The lack of a certain category of oxygenating areas is not only an absence at the structural level but also at the functional level, with direct implications on the urban metabolism and the residents' health state. To this end and to highlight the role of the green-blue infrastructure at the urban level, we carried out an assessment of their ecosystem functions by categories of oxygenating areas.

***The importance of the ecosystem functions of the urban green infrastructure***

A complex analysis concerning the perception of the ecosystem functions generated by the green categories which are components of the urban green infrastructure in our country highlights the importance of the *urban parks* and *forests*, recognizing the ability of trees to absorb from 60 to 90% of the radiation received (LESIUK, 2000). The urban parks in the Development Region of South-West Oltenia are populated with thermophilic and meso-thermophilic shrub and arboreal species, to which grass vegetation is added, fulfilling *recreational functions* in all seasons of the year. This

category of green area has multifunctional valences, such as: *increasing the value of the urban landscape, representing an area for recreational and sports activities* (PĂTROESCU & IOJĂ, 2004; McCORMACK et al., 2010), *a social area* and an informal setting to perform cultural activities.

The *urban forests* depend, in terms of surface and species, on the location of the urban settlements at the level of the relief units in our country and they have mainly ecological functions: reducing the land surface erosion, improving the climate, shading (BOLUND & HUNHAMMAR, 1999), ensuring the habitat for local fauna, filtering the suspended particulate matter and exhaust emissions. The *squares and street alignments*, populated with native arboreal species, but also with acclimated ornamental vegetation, provide benefits related to the air quality, climate and landscape aesthetics (BADIU, 2016). Ornamental plants are characteristic of the gardens belonging to public institutions (schools, kindergartens, churches, cultural institutions having administrative functions), as they offer a certain aesthetics to the urban landscape, tolerating a very large temperature range and being easy to maintain. The ecosystemic importance of these green structures lies in preserving a good physical and mental state of health of the inhabitants (OZER, 2006), contributing, at the same time, to the connectivity of the green infrastructures as a whole (IOJĂ et al., 2014), but also to the relationship with the vegetation in the urban and extra-urban peripheries.

As regards the gardens that are public and private property, it must be underlined that their arrangement depends on the degree of interest of the holder, and there may even be situations of soil pollution. The role of these green areas in the urban landscape is to *preserve the biodiversity* (DAVIES et al., 2009) and *recreational environment*. Cemeteries are considered to be valuable green areas in the urban infrastructure with a role in *preserving native arboreal species*, but without performing social or aesthetic functions (NIȚĂ et al., 2014), being perceived even as having negative connotations (TUDOR et al., 2013). Moreover, the location of such areas near residential areas causes a decrease in the value of buildings, being considered a restrictive factor in increasing the value of the urban landscape aesthetics. The biodiversity at the level of cemeteries is proportional to their age (BARRETT & BARRETT, 2001).

#### ***The importance of the ecosystem functions of the urban blue infrastructures***

The urban blue infrastructure or the hydraulic system (DUCHESNE, 2000; BRUN, 2011) include the urban rivers and lakes, and their existence at the level of the urban metabolism has an optional value. The urban lacustrine ecosystems are distinguished by their recreational, educational, fishing, water supply and flood control benefits that they perform at the level of the city (HENNYA & MEUTIAB, 2014).

The importance of urban lakes also results from improving the air quality, managing waste, regulating the urban microclimate, supporting physical, intellectual or spiritual interactions (\*\*\*. CCMESI, 2018), and the degradation of the urban aquatic ecosystems poses a serious threat to the sustainable urban development (CHEN, 2017). The vulnerability of lakes to environmental changes is directly proportional to the impact of the urban development in the surrounding areas (HENNYA & MEUTIAB, 2014), through actions such as the land-use change or landfill.

The rivers, through the provision of food and water resources, represented the forger and the catalyst of urban areas. At present, the urban aquatic landscape is positively perceived by residents due to its naturalness and high accessibility (STEPNIEWSKA & SOBCZAK, 2017), but also through the recreational benefits that it offers: walking, cycling (KONDOLF & PINTO, 2017), the pursuit of sporting or contemplative activities. The practice of sport fishing, diving and canoeing (KONDOLF & PINTO, 2017) or other water sports should also be added, depending on the water quality level. The urban rivers also fulfil ecosystemic functions with ecological benefits such as the adjustment of the air temperature, as a natural source of cooling (DUA & LI, 2017).

With all these ecosystemic functions, the rivers located in the urban areas have been associated with water quality problems due to the practice of dumping untreated domestic and industrial waste into the water bodies (AIINOORHOSSEINI et al., 2017) or storing the waste in water or on shore.

## **CONCLUSIONS**

Urban oxygenating areas represent important pawns in the effort to provide durability and sustainability to the urban environments, but also have a direct impact on the people's health state. In this respect, ensuring the thermal comfort inside the dwellings and diminishing the phenomenon of urban heat island are strategic objectives at the level of the urban metabolism, the fulfilment of which may only be achieved by conjugating the will of the political decision-makers to the existence and implementation of an appropriate legislation, but also by involving the residents.

The functions of the urban oxygenating infrastructures (cultural, ecological, recreational and improving health) are the guarantor of the urban sustainability, therefore the structural and functional conservation of these areas represents a binding approach. Although there is complementarity between the ecosystem functions of some categories of green-blue infrastructures, we consider the lack of any of these areas not only a structural absence, but also a functional one. Another aspect to be highlighted is the quality of the oxygenating areas. Pollution of any kind or at any level affects the green-blue areas and diminishes their ecosystem functions.

Understanding the importance of these areas at the urban level is considered to be a proof of an optimal level of education for the decision-makers and residents with favourable effects on the cities' attractiveness now and in the future.

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