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Editorial

Urban Ecosystem Services: Advancements in Urban Green Development

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Urban ecosystems are under pressure as a result of rapid urbanization [1]. When compared to more profitable residential, commercial, and industrial land uses, such ecosystems are rarely economically competitive [1]. The research shows that the multifaceted wellbeing that people gain from nature has decreased as a result of the changing human–nature relationships in urban areas [2]. Thus, there is a need to incorporate nature in our urban environments to deliver several ecosystem services [3]. Addressing current urban challenges with nature-based approaches has the potential to enhance and restore ecosystem services [4]. The literature has defined "Urban Ecosystem Services" (UES) as those ecosystem services that are offered in urban and peri-urban regions by green infrastructure (GI), such as trees, wetlands, parks, lakes, street vegetation, allotment gardens, historical and botanical gardens, and green roofs [5,6]. Nowadays, UES is a key concept that is influencing how urban landscapes are planned, designed, and managed in the direction of sustainable and livable cities [7]. They are the benefits that people derive from the natural environment within urban areas. These services play a crucial role in promoting sustainability and wellbeing in cities, and their importance has been increasingly recognized in recent years [8]. Urban green development, which refers to the integration of green spaces into urban environments, has been identified as a key means of providing UES and promoting sustainability in cities [9]. For this reason, an emphasis of studying the urban ecosystem, particularly UES, is needed. After two previous Special Issues (SIs) on UES [10,11], we decided that there was a need for new studies that could contribute to the literature on sustainable urban green development. Therefore, this SI contains ten original articles and one review.

Lee et al. [12] developed a framework to diagnose and prioritize vulnerable areas of urban ecosystem regulation services that can be utilized in urban planning. In China, He et al. [13] investigated the internal scale law of the urban system at the municipal and district scales. Additionally, they carried out a spatial autocorrelation analysis using the landscape expansion index. They evaluated the connection between the urban scaling law and the compactness of urban morphological development in this way. China's urbanization process is unique, with uneven regional resource endowment and distribution impeding integrated city development [13]. Understanding the relationship between urban indicators and the size of an urban population is critical for understanding the size of a city, its state of urban economic development, and promoting the development of inter-regional macroeconomic co-urbanization [13]. Furthermore, the urban scaling law reflects the outcomes of numerous indicators such as nature, economy, and policy. It also depicts the process of urban evolution, reflects the future trend of the city's development, and broadens people's understanding of China's urbanization on a spatial scale. He et al.'s [13] findings indicate that the temporal scaling law on the city scale has a more significant linear law than the single-year scaling law. In the Global South, Brill et al. [14] evaluated how residents in the city of Cape Town understand and value the many cultural ecosystem services related to freshwater ecosystems that are provided by the various landscape features originating

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in an urban protected area [14]. The results show that both built infrastructure and blue infrastructure, which serves the demands of various user groups, are equally important in producing cultural services [14]. In Italy, [15] conducted a pilot study in the municipality of Lecce to analyze the amount of urban green areas at urban and suburban levels (i.e., at the district scale) using an Urban Green Index. The joint analysis of the spatial composition and configuration of urban green spaces was carried out through the integration of three landscape metrics and the Urban Landscape Services Index was estimated and mapped at the urban and suburban scale as a support measure [15]. Another study in Italy, by Oliveira et al. [16], evaluated the potential benefits of increasing tree coverage within the boundaries of the Metropolitan City of Naples. The integration of the i-Tree Canopy online tool and the life cycle assessment method were used for the quantification of ecosystem functions, including an economic perspective and pollution sequestration, to support future policies for projects and investments aimed at expanding urban green spaces [16]. The researchers evaluated the scenarios for current and potential tree coverage scenarios as well as the benefits related to them [16]. The findings showed that an additional 2.4 million trees might be planted, resulting in 51% more benefits for pollutant removal, carbon sequestration, and stormwater management [16]. In Poland, Durlak et al. [17] combined several non-invasive methods to assess the resistance of city trees' trunks to fractures as well as damage and cavities inside the trunks. This study also included a tree valuation method that is based on internal evaluations as well as comparative analyses of methodologies used abroad, notably in EU countries. The advantage of determining a tree's value is that it may be used to convey to city residents the economic benefits of monumental trees [17]. Moreover, Chen et al. [18], using physiological eye movement and heart rate variability data, looked at psychological information based on positive and negative emotional adjectives and virtual reality and photoplethysmographic technology to evaluate subject satisfaction with regard to urban green space plant community landscape scenes. The study showed that the impact of various plant community structures on people's satisfaction with urban green spaces varies. In particular, the single-layer grassland had the most visual appeal [18]. The research of people's satisfaction with urban green spaces is helpful for the sustainable development of their design and can raise people's awareness of environmental protection, according to the findings [18]. High vegetation cover in urban green spaces increased environmental satisfaction, and single-layer grassland and tree-shrub-grass composite woodland community areas improved people's physiological and psychological responses [18]. In Africa, Kabanyegeye et al. [19] assessed anthropogenic disturbances on green spaces along a Bujumbura urban–rural gradient. The research shows that Bujumbura's green spaces are primarily concentrated in urban areas, with cemeteries in peri-urban areas and sports green spaces visible all along the urbanization gradient. These green spaces are more vulnerable to trampling, which is more prevalent in administrative entities with a peri-urban morphological status than in administrative entities with an urban status. Finally, statistically significant pairwise associations of anthropogenic disturbances were found. The findings highlight the importance of protecting these green spaces from all types of anthropogenic disturbances by increasing the population's and municipal authorities' eco-responsible awareness [19].

In the midwestern United States of America, the study by Davis and Stoyko [20] aimed to identify the barriers of planting various pollinator-friendly plants in private yards, as well as to determine which incentives to plant these native plants might be the most persuasive. It also sought to ascertain whether there are any procedural knowledge gaps regarding how to plant, care for, or where to buy these pollinator friendly plants [20]. The findings indicated that the respondents do not have a strong intention to plant these native species, particularly *Asclepias syriaca*. Surprisingly, the intention to plant these does not statistically differ when assistance with prices, labor, or the availability of online resources is offered [20].

Amani-Beni et al. [21] conducted qualitative field studies in six recognized Persian gardens in four provinces of Iran using socio-cultural guidelines derived from a literature

review. The findings suggested that combining elements of formal landscape design, non-edible decorative plants, and traditional artwork would increase the attractiveness of Persian gardens [21]. The study concluded that there would be an increase in ecosystem services including provisioning and cultural services if urban agriculture were implemented in Persian gardens [21]. Finally, Mokhtari et al. [22] developed a theoretical framework to better understand the interactions between social–biophysical patterns and processes that contribute to the Urban Heat Island (UHI). They conducted a theoretical review to define UHI complexity by employing the concept of dynamic heterogeneity of pattern, process, and function in the UHI phenomenon [22]. Furthermore, as a model template, a hypothetical heterogeneity spiral (i.e., driver–outcome spiral) related to the UHI was conceived. The adopted theoretical framework can provide a comprehensive view of the UHI, aiding in the understanding of UHI spatial variations in long-term studies [22].

In conclusion, it should be stressed that urban green spaces, such as parks, gardens, and green roofs, provide numerous UES, including air and water purification, climate regulation, and recreation. Urban green spaces can help to remove air pollutants and improve air quality, reducing the health impacts associated with exposure to pollutants [23,24]. They also play an important role in reducing the UHI effect, which can raise temperatures in cities to levels that are uncomfortable and even hazardous for human health [25,26].

Moreover, urban green spaces provide habitats for wildlife and can contribute to biodiversity within cities [8]. One of the key advancements in urban green development is the integration of GI into the built environment. GI refers to the network of green spaces and natural features that provide UES within urban areas. This approach to urban planning and design aims to connect and enhance existing green spaces, as well as to create new ones. The integration of GI into the built environment can adopt many forms, such as green roofs, permeable pavements, and living walls [27]. In all, urban green spaces provide a wide range of UES that are essential for promoting sustainability and wellbeing in cities. The integration of GI into the built environment and the use of sustainable design techniques represent important advancements in urban green development. These developments demonstrate a growing recognition of the importance of urban green spaces in promoting sustainability and provide a roadmap for the creation of more livable and sustainable cities in the future.

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