NEYART
Magazine
ISSN: 2992 - 7161

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QUALITY IS EVERYWHERE: A RESEARCH PROPOSAL TO ASSESS ENVIRONMENTAL SUSTAINABILITY OF URBAN PARKS

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DOI: https://doi.org/10.61273/neyart.v1i2.119 | Received: 06/07/2025 | Accepted: 07/22/2025 | Published: 09/11/2025

Abstract: In addition to being perhaps the most refined form of public space, large-scale urban parks are catalysts for environmental improvement in urban areas, as they provide a multitude of services ranging from air purification to thermal and noise regulation. The literature reports that the environmental sustainability of urban parks has been a topic whose study has been fragmented, without a holistic consideration. The objective of this article is to present a research proposal to estimate the environmental sustainability of a large urban park. The proposal includes the development of an evaluation scheme that considers eight evaluation factors. For each factor, global indicators are developed, without the model delving into each one, as the focus of this work emphasizes breadth of coverage. The factors to be considered were: plant palette, surface type, protection against wind erosion, water consumption, thermal regulation, noise regulation, water collection capacity, and recycling of organic materials. A general discussion of the model is presented. Finally, the conclusions of the study are outlined and the limitations of the proposed model are acknowledged.

Keywords: ecosystem services, sustainability assessment, ecological footprint, green space management, urbicide.

Abstract: Besides being the most refined form of public space, large-scale urban parks are conceived as catalysts for environmental improvement in urban settings. These spaces provide a multiplicity of services, ranging from air purification to thermal or sound regulation. The related literature reports that the environmental sustainability of urban parks is a topic whose study has been atomized, without a holistic consideration. The objective of this paper is to present a research proposal for estimating the environmental sustainability of a large urban park. The proposal includes the development of an evaluation scheme that considers eight evaluation factors. For each factor, global indicators are developed, without delving deeply into each one, because the approach emphasizes breadth of coverage. The factors to be considered were vegetation palette, surface type, protection against wind erosion, water consumption, thermal regulation, sound regulation, water capture capacity, and recycling of organic materials. A general discussion of the model is presented. Finally, conclusions are drawn from the study, and the limitations of the proposed model are acknowledged.

Keywords: ecosystem services, sustainability assessment, ecological footprint, green space management, urbicide.

INTRODUCTION

Urban parks, particularly those of large scale, play a crucial role in urban settings. These entities are often considered the most refined format of public space due to the multifunctionality of their conformation. Urban parks rise to a wide variety of services related to naturalness, while promoting the encounter between heterogeneous social groups (Campbell et al., 2019).

Contemporary scientific conceptions of urbanism stress the undesirable consequences of urbanization processes when sustainable considerations and practices are not taken into account. In this sense, urban parks are conferred with the capacity to cope with the degradation derived from rapid urbanization. Moreover, it is recognized that urban parks have the potential to slow down, even halt and reverse the degradation processes that would eventually lead to urbicide, i.e., the death of the city (Carrión-Mena, 2023).

The evolution of research regarding the assessment of urban parks sustainability is still in its infancy. It was not possible to identify a comprehensive work in this area. To date, it has only been possible to identify a few publications that focus on conceiving an evaluation model. The pioneering conceptual contributions of Vélez-Restrepo (2009), García & Guerrero (2006), and Cranz & Boland (2004) are recognized in terms of suggesting plausible avenues for the study of the sustainability of urban parks.

An urban park is an entropic, complex, and multifunctional system that provides a wide variety of environmental, social, and economic services (Sandoval-Chávez et al., 2024). If the park is provided with the pertinent resources and proper management is exercised, the "park" system sets in motion several complex, intricate, and highly interacting processes, including hydrological, biochemical, social, and economic processes, to mention just a few. However, when attempting to approach the study aimed at estimating the level of sustainability of urban parks, the intense interaction between the environmental, social, and economic axes is often overlooked.

The literature suggests that a systemic conception of public space is needed. Indeed, public space is a superordinate concept, that is, a suprasystem to which urban parks belong. The above constitutes a premise to identify and understand the factors that affect the sustainability of these spaces and how the interaction between the many processes takes place (Jansson & Lindgren, 2012; Chan et al., 2018). A Mexican standard highlights the enormous importance of conceiving public space in terms of a systemic entity and has made explicit its requirements and characteristics (SEDATU, 2021).

From an environmental standpoint, several studies have attempted to address the factors affecting the sustainability of urban parks. To mention just a few, the role of vegetation has been addressed in depth, in particular issues related to the conformation of trees and other forms of vegetation, species inventory, surface area covered, or allergenicity of species (Guillen-Cruz et al., 2021; Cariñanos et al., 2017; Daniels et al., 2018). Air purification, perhaps the most recognized environmental service of vegetation, has also been studied in depth. The advent of systems such as i-Tree Eco, ENVI-met, or CFD renewed the study of the ability of vegetation in urban parks to remove, filter, or intercept pollutants, as well as to capture and deposit carbon and particulate matter (Lin et al., 2019; Meissner et al., 2019; Rackley, 2017). Regulation services, including thermal comfort (Kumar & Sharma, 2022; Wei et al., 2022; Aram et al., 2020), as well as acoustic comfort (Mohammadzadeh et al., 2023; Ren, 2023). Other environmental factors in urban parks, such as soil quality, wind protection, or recycling practices, have received less attention (Ranasinghe et al., 2019; Pan et al., 2019; Chifari et al., 2017).

Charoenkit & Piyathamrongchai (2019), Parés-Franzi et al. (2006) and Oke et al. (1989) conducted studies to assess the overall environmental sustainability of urban parks. The scope of these studies was limited to a specific set of indicators and restricted by the particularities of the case studies presented. Thus, so far, research efforts aimed at estimating the environmental sustainability of urban parks are perceived as isolated and fragmented.

Not much has been published on a comprehensive scheme of indicators to assess the environmental profile of an urban park. The study of this topic seems to concentrate on monodisciplinary issues. The available studies delve deep into a particular factor, or at most a small set of factors, without a systemic appreciation. Given the importance of the urban park system as a multifunctional space, it is somewhat perplexing that the study of the environmental sustainability of this relevant format of public space is lagging behind. The perceived inertia in the evolution of the subject can be explained by the fact that the "urban park" system is a very complex entity conceived as a non-spontaneous space of naturalness in which, just from an environmental perspective alone, several disciplines would be involved in the study of this multifaceted space. Within this framework, this paper aims to establish a research proposal for the development of a model to estimate the level of sustainability of a large-scale urban park.

Method

A prospective research proposal is put forward. This proposal considers a scheme for an eventual cross-sectional study through a dual inductive-deductive approach. The proposal goes through three phases. In the first phase, a group of seven experts from the following disciplines was formed: architecture, agronomy, sociology, and administration. In the second phase, environmental sustainability indicators and their relative importance were identified and agreed upon. Finally, in the third phase, the evaluation framework with the proposed model is established.

Results

A panel of experts held three sessions to discuss the research team's proposal. After several suggestions and adjustments, the group of experts reached an acceptable degree of agreement (Friedman's ANOVA, $p < 0.240$). Table 1 shows the eight agreed indicators of environmental sustainability.

Table 1. *Indicators for estimating the environmental sustainability of urban parks.*

Indicator	Description	Variable/attribute	Level or unit	References
Vegetable palette	Species and number of plant elements	Suitability for the region.	Ordinal categories via weighting algorithm	Vegetable palette
State of conservation	Ordinal categories via weighting algorithm	Morales-Vasquez, et al. (2018), Bae and Ryu, (2015a),	of each type	State of conservation
Wind protection	Presence of protective barriers	Type of barrier	Level of protection	Ranasinghe et al. (2019).
Consumption de agua	Volume of water for irrigation	Treated water	Water consumption	Volume of water for irrigation
Thermal regulation	Gradient	Internal/external temperature (air)	Temperature in °C	Brown, Vanos, Kenny, and Lenzholzer (2015), Avdan

				and Jovanovsk (2016).
Sound regulation	Indoor/outdoor gradient	Internal/external sound pressure	Sound pressure level in dB	Lee et al. (2018), Cohen and Castillo (2017)
Rainwater harvesting	Permeable and impermeable surface radius	Type of coverage	% permeable coverage	EPA (2007), Lancaster (2014). Haaland and van den Bosch (2015).
Recycling of organic matter	Ability to close the nutrient cycle	Type of recycled material	Volume of recycled material	Chifari et al. (2017).

Source: own elaboration based on expert consensus

a. Vegetation would be surveyed during the active stage considering two factors: a) species suitability and b) conservation status. Basic and standard dendrometry-based practices and appreciation techniques would help assess both factors (USDA, 2018). The census would include trees whose diameter at breast height (1.30 m) was equal to or greater than 0.10 m (Lin et al., 2019; Nowak & Crane, 2000). Applicable characteristics and quality attributes of shrubs and herbs would be reported.
b. Three forms of surface area would be studied in relation to the park's total area: natural, protected, and impervious vegetation. To measure these ratios, the Google Earth© satellite platform would be used and on-site inspections would be carried out.
c. This indicator would be based on Meissner et al. (2019) and NSW (2017), and the quality of wind protection of the surrounding areas of the park in the west, west-southwest, south-southwest, and south orientations would be simplified into four categories. A photographic record of each windbreak would be maintained.
d. This variable would be studied in conjunction with the annual volume of treated water supplied by the city's water utility, if any.
e. At least six points adjacent to city avenues or streets and six non-adjacent points of the park would be studied. A visual inspection would allow the selection of points to be studied. Air and soil monitoring strategies would be combined.

f. Sound pressure levels (dBA) would be monitored at the same points as above. A calibrated digital sound level meter would be used to take sound pressure readings in accordance with current regulations.
g. The ratio of permeable to impervious surfaces would be determined and a photographic record would be maintained.
h. The volume of recycled organic matter and type would be monitored. Also, the capacity to produce organic mulch to close the biological cycle of natural materials would be evaluated (This is Agriculture, 2018).

Discussion

The proposed indicators are feasible to investigate, their operational definitions do not involve highly specialized measurements. The proposed scheme tends to consider a wide variety of environmental sustainability factors rather than delving deep into each of them.

The vegetal palette factor focuses on defining general but relevant aspects of vegetation and does not go into depth on the characteristics that determine other more specific aspects, such as the quantification of carbon sequestration or pollutant seepage. These indicators can be quantified via the adoption of the iTree Eco system. Similarly, an indicator for rainwater capture capacity is suggested without going into depth to study the texture of existing soils in particular or conducting complex edaphic studies. Environmental protection barriers can be studied by visual inspection and classified on an ordinal scale, without falling into particularities derived from plant species. For its part, the factor related to water consumption does not consider factors such as field capacity, nor does it make infiltration studies necessary; it only concentrates on the characterization of permeable and non-permeable surfaces. Factors related to thermal and sound regulation are addressed in a simple and practical manner, without the complications indicated in current standards that stipulate the use of specialized equipment. Finally, the recycling of organic materials is left open to include pruning products, leaf litter, and in general other residues that can form organic mulch, an essential element to preserve supporting ecosystem services in urban parks (EEA, 2018; Tolk et al., 1999).

The proposed indicator scheme allows for an approach to the environmental determinants that identify areas in which a park is sustainable, while providing the opportunities to address the lags. The model is adaptable to any geographic area, as it is founded in general terms, rather than specifics. The usefulness of this will be clear, conditioned on an understanding that this does not take considerable time away from the primary purpose.

Conclusions

Based on the results, it is possible to conclude that a research proposal to study the environmental sustainability of large-scale urban parks is plausible. This proposal aims to approach the estimation of environmental sustainability in urban parks through a synthetic vision that privileges a general view, giving less attention to a particular environmental indicator.

Limitations

This research proposal was limited to outlining a sustainability assessment scheme for large-scale urban parks. Other types of urban parks, such as community or neighborhood parks, were not considered. Likewise, the factors suggested are general in nature, without going into depth in the study of each one of them. Finally, it is recognized that sustainability consists of three axes (environmental, social, and economic), however, this work only focuses on the environmental axis.

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