A Multidisciplinary peer-reviewed Journal www.ijsrtjournal.com [ISSN: 2394-7063]

Sustainable Urban Landscape Design - Concept, Purpose, Maintenance and Management

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ABSTRACT

In order to create environments that are socially good, economically feasible, and ecologically responsible, sustainable landscape design has become essential. The concept, goal, and maintenance management techniques related to sustainable landscape design are examined in this review study. The idea places a strong emphasis on how landscape planning and architecture may incorporate environmental sustainability concepts like biodiversity enhancement, resource conservation, and climate resilience. The article goes on to address the goals of sustainable landscapes, which include minimizing negative effects on the environment , enhancing human welfare , promoting a balance coexistence of natural and constructed settings. Effective maintenance management techniques are also emphasize in order to guarantee these landscapes long term sustainability and functionality. In addition, the paper looks at a number of case studies, best practices, and difficulties in applying sustainable landscape design in various settings. The ultimate goal of this paper is to present a thorough sustainable landscape design ,which can also support environmental, economic, and social sustainability.

Keywords: Landscape, Planning and Design, sustainable

INTRODUCTION

The city is a major human achievement that has been studied extensively, and landscape science has emerged as a new environmental science discipline. This article uses a descriptive-analytic method to review theorists' thoughts and identify theoretical aspects of the landscape, while also presenting ideas about the city. However, the lack of absolute stabilization in landscape literature has led to different perceptions and contradictions, especially in the term "urban landscape," which has been used widely in various disciplines, necessitating the development of theoretical frameworks for urban landscapes. (Reza Keshtkaran 2019) People with a relevant professional understanding of architecture, plants, aesthetics, literature, etc. can use landscaping design as a planning approach and thought process to intentionally alter the natural environment based on classical garden philosophy. Through landscape design, the environment can guarantee ecologically sustainable development, serve daily purposes, and have aesthetic appreciation value. This study examines a multisource big data fusion-based

approach to urban landscape design and maintenance management. Enhancing the variety and resources of plant landscapes, combining practical conditions, learning about the latest technologies and application forms of plant landscape maintenance both domestically and internationally, and continuously exploring and innovating plant landscape maintenance methods and related maintenance technical issues are all necessary. (Lijuan Zhu 2019) Urban garden landscapes are crucial in urban construction, as they adapt to development and meet the needs of urban residents. To achieve a poetic place, original urban landscape design must be carried out. maximizing value. Conservation-oriented societies advocate for regionality and sustainable design methods. Landscape design should aim for larger green areas and better design effects with less investment. Original ecological elements should be respected, and terrain, vegetation, and other elements should be used to achieve design purposes. Comprehensive site analysis involves analyzing natural elements, regional characteristics, and cultural landscape, providing guidance for planning and

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



incorporating original elements into the design. (Lijuan Zhu 2022) Urban open spaces, such as parks and public breathing spaces, are crucial for a city's atmosphere and cater to the needs of communities and urbanites. The character of these spaces varies regionally and is essential for designing a town or municipality. However, there is a lack of work on preserving and improving public open spaces in small urban centers like Jeisore, where future development will impact their use and preservation. This research focuses on selected public open spaces in Jesore town, such as Pauro Park Jessore and Munshi Meherulla Moidan. (Arfanara Najnin 2009) The study aimed to improve human comfort and ecological aspects of wind effects in urban areas. It focused on the relationship between design and wind effects, focusing on Duzce city. The research used meteorological data and city maps to analyze wind effects and design approaches. The study explored how structural and vegetational elements affect wind function, highlighting outcomes that provide optimum wind conditions and comfort for people. The research aimed to improve the quality of life and contribute to urban ecology. (M.K. AK*S OZDEDE 2017)

1(a). Landscape Definition and Scope

The intricacy and meaning of the landscape have prompted academics to employ a variety of methodologies. They seek to research a holistic paradigm using a holistic methodology and to lessen the divide between subjectivity and objectivity. Depending on who is viewing or discussing it, the term "landscape" can indicate several things. They can be defined as a shared perceivable area of the Earth's surface, a geographical unit typified by certain patterns of ecosystem kinds, or a backdrop to human activity. According to the European Landscape Convention, a landscape is an area that people see as the outcome of the interplay and action of both natural and human causes. According to some scholars, national or cultural units are the primary focus of landscape analysis and comprehension. (Reza Keshtkaran 2019)

1.(b). Urban Design Definition

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2.Identity concept in urban and landscape

Man-made and artificial surroundings are valuable because of the human innate urge to find his identity (Atashinbar, 2009). Relph (1976) emphasized the need for place identification in his book "Place and Placelessness" by writing: "A deep human need exists for associations with significant places." Lynch Identity is also defined as "the degree to which an individual can identify or remember a location as being different from other locations" (1981). Our perception of urban landscapes is entwined with the public identity of the city. The way of life of the people, their contacts and activities, their values and beliefs, and the city's connections to time, space, climate, economy, society, and politics are all reflected in the urban environment (B. Aminzadeh, 2015). As previously said, human behavior and the environment interact to create the complex paradigm that is the urban landscape. Thus, three aspects of society—culture, economy, and society-are impacted by this relationship (Kaymaz, 2013). Consequently, urban landscape identity and urban identity are a shared idea and have a common ancestor known as the city. Several definitions make this subscription of meanings and concepts evident. (Reza Keshtkaran 2019)

3.Opportunities for Increasing Urban Health Levels

Urban landscapes, including therapeutic ones, are crucial for modern lifestyles and health hazards. Intermittent green spaces, wide water bodies, and tree species offer health benefits. Nature-based solutions should incorporate public health and wellbeing, as unplanned development increases environmental dangers. A green city requires public green space and urban design that allows access to sizable green spaces. Smart growth concepts can promote physical activity and reduce obesity rates. (Alexandru Gavrilidis, ETAL 2023)

4.Urban Design Objective

Urban design objectives aim to create and enhance the advantages of a good city. However, achieving these objectives in practice is challenging due to social and economic conditions. Poor urban planning and design strategies, particularly in developing countries, result in inadequate policies, networks, excessive zoning, and lack of accessibility. These objectives are also variable according to context and other aspects of urban development, such as economic development, laws, racial and ethnic variations, cultural norms, and political authority. (Ahmed S. Abd Elrahman, Moureen Asaad 2020)

5. Interactive Genetic Algorithm (IGA)

Designing recreational areas involves careful consideration of principles to create safe, enjoyable, and functional spaces. Common design principles include proper zoning, accessibility for all ages and abilities, and incorporating natural elements. Adequate lighting, signage, and surveillance systems contribute to a safe environment. Safety should be prioritized by minimizing hazards and risks, using appropriate materials and equipment. Layout and landscaping should reduce hiding spots and increase visibility for security. Activities should be planned and designated for different user groups, considering children, adults, and the elderly. Design should be done with sustainability in mind, using environmentally friendly materials and energyefficient lighting. Water conservation measures and green spaces should support local wildlife and biodiversity. (Seiki Koma 2017)

6. Opportunities and Challenges to Achieve Sustainable Urban Open Green Space

There are advantages and disadvantages to sustainable urban open green spaces. Size, facilities, public accessibility, and lively areas encircled by crowded neighbourhoods with active land uses are examples of physical characteristics. While smaller spaces can sustain outdoor activities, larger green spaces are home to many animal and plant species. In order to uncover underlying trends and the causes of residents' use or lack thereof, public accessibility is essential. Particularly for low-income, minority, and vulnerable groups residing in crowded neighbourhoods with limited recreational opportunities, access to open green spaces is crucial. By drawing pedestrians and fostering lively public areas, urban open green spaces can support social difference, cultural diversity, and safety. A balance between natural and geometrical design can be achieved, guaranteeing linkages for creatures, DNA, energy, and materials beyond limits. Ecological principles can contribute to urban open green spaces, offering aesthetic characteristics and ecological services in shrinking habitats. (Mehdi Rakhshandehroo 2016)

7.Urban Landscape Characterization

Roads, bridges, buildings, and landscaping are all abundant in urban environments. They are impacted by history, politics, the economy, and culture and have several meanings. The dispersal of different states, groupings, or jurisdictions is made possible by the shifting boundaries of metropolitan environments. Spatial mobility is produced by the mix of features and building height. Urban landscapes balance geometric and natural design as cities grow and cultural legacies are passed down. Urban open green spaces benefit from ecological principles by providing both ecological services and aesthetic qualities. (Z.Sabir 2024)



8. Designed Urban Ecosystem: Case Studies

Study Restoring a dune habitat along S. Pietro beach in Valledo-ria, Sardinia—a coastal region known for its high volume of seaside tourism—was the project's main goal. In order to rebuild and revegetate the natural dune habitat, the project required demolishing a road, parking lots, and retaining walls. Deeply ingrained usage of the coastal region were significantly altered by the intervention, since pedestrian access took the place of direct automobile access. However, disputes developed between beachgoers and the local government, who contested the decision to alter procedures. Lack of knowledge about the inherent dynamism of the recently restored dune ecosystem also caused problems for the project. Notwithstanding these problems, the project used particular operational and spatial strategies to effectively resolve disputes and promote social acceptance of the region. While allowing visitors to perceive and appreciate the newly formed ecosystem, the project sought to protect it from overtourism. Visitors were able to appreciate the biological benefits and scenic quality of the restored dune environment thanks to the wooden pathway. (Emma Salizzoni 2021)



Figure 1: Beach in S. Pietro before to interventions. The native dune habitat had been totally destroyed by the road, which allowed direct vehicle access to the shore. Criteria s.r.l., 2013, Maurizio Costa, photo





Figure 2:S. Pietro Beach after to Interventions. The new dune habitat and the walkway. Image courtesy of Criterion S.R.L., 2019 by Maurizio Costa

In the smart-cities challenge, the Ministry of Urban Development, Government of India, shortlisted Bhopal as a candidate. The Indian government's Smart Cities model is an innovative sustainable urban-development solution thatuses information and communication technologies and other means to improve quality of life, the efficiency of urban operation and services, and competitiveness while ensuring that it meets the needs of present and future generations with respect to economic, social, and environmental aspects. Current urbanization patterns and their effects on city health must be examined in order to establish a set of strategic and operational research techniques and systems solutions that meet the needs of the Bhopal developing sectors. The objective of this chapter is to measure the spatiotemporal patterns of urban growth and how they relate to land-surface temperature (LST), a key metric for assessing the health of the city in Bhopal. LST and the urban land-cover pattern obtained from Landsat TM/ETM satellite data were used to study the process for 20 years (1995–2015). In this study, the four major land-cover classes mappedinclude (i) built-up areas, (ii) water, (iii) vegetation, and (iv) others. Three primary urban land-use classes were characterized using three spectral indices: (1) built-up areas were characterized using the normalized difference built-up index (NDBI); (2) open water was indicated by the modified normalized difference water index

(MNDWI); and (3) green vegetation was represented by the soil-adjusted vegetation index (SAVI). For 1989, 2006, and 2010, the kappa coefficients for landuse and land-cover (LULC) maps created with the NDBI, MNDWI, and SAVI were 0.8726, 0.8455, and 0.8212, respectively, and the overall accuracy was 90, 88, and 86%. There is a positive link between LST and NDBI, a negative correlation between LST and SAVI, and a completely negative correlation between NDBI and MNDWI when these changes are ascribed to the research region's rising surface temperature. (Anuj Tiwari, Prabuddh Kumar Mishra 2019) The urbanization situation of Delhi, a megacity, is presented in this chapter. The coupling of space remote sensing inputs, geospatial analysis, and statistical analysis is used to explore the changing land use and land cover (LULC) and numerous environmental variables. Urban land use and the percentage of green cover-two essential elements of LULC-are crucial for illustrating how the urban landscape is evolving and how this affects environmental quality. Remote sensing data can be used to extract environmental quality variables such as bareness, moisture intensity, imperviousness due to built-up intensity, and greenness. There is a general tendency toward less green space, particularly at the outskirts of the city where the amount of moisture is decreasing. The city's moisture levels have drastically decreased in the north due to new industrial

developments, while they have slightly decreased in the southwest due to urban expansion. In certain instances, this is accompanied by an increase in bareness and imperviousness in the same areas. Using Delhi as an example, the chapter describes in depth the intricate relationships between various land uses as urbanization progresses. In the end, LULC and environmental variables and their change statistics are also used to explain the causes of environmental degradation and the creation of Urban Heat Island (UHI) in the city. Thus, the process and effects of urban land transformations in a developing country's metropolitan area—in this example, India—are presented in this chapter. (Richa Sharma, P.K.Joshi 2014)

9.Urban Landscape Aesthetics

Cities are vital sources of an active aesthetic life because of their potent context, which might provide an opportunity to spark our creativity. People's everyday lives and the aesthetics of urban landscapes are strongly intertwined, and numerous studies have been conducted to understand public preferences for landscapes (Chen et al., 2016). In actuality, landscape patterns influence how people see their daily surroundings (Ode et al., 2009), and landscape aesthetic theories recommend using the patterns to comprehend landscape preferences (Tveit et al., 2006). As a result, the value of landscape aesthetics has become one of the most important socioecological research topics and has also garnered significant public recognition. According to Nassauer (1995), human aesthetic experience is influenced by a few closely related processes, including perception of the landscape, cognition, and values. Since the 1960s,

studies and research on landscape aesthetics—more especially, landscape preference—have been conducted. Various methodologies have since been put forth to investigate the aesthetics of urban landscapes. (Reza Keshtkaran 2019).

10. Urban landscape ecology

One may argue that the new concept known as urban landscape ecology is the result of the merging of landscape ecology and urban ecology. "Cities are spatially extended, complex adaptive systemswhich we call landscapes." Undoubtedly, cities are the main place of the future of human life, so inevitably, most of the landscape ecological studies will be on the cities. Wu et al. (2013) state simply that urban landscape ecology and the study of landscape ecology in urban environments are the same thing. "More specifically, it is the science of studying and improving the relationship between urban landscape pattern and Ecological processes for achieving urban sustainability." Wu et al. (2013) suggested three essential elements-urbanization impacts, urbanization patterns, and urban sustainability-to define the study regions in urban landscape ecology (Figure). In this context, Muderere et al. (2018) looked into relevant literature and research from 1986 to 2016 to determine the focus of attention in urban landscape studies. They then extracted the most commonly used terms in these studies, which included landscape ecology, landscape structure, landscape change, biodiversity, approaches, gradient, vegetation, GIS, and remote sensing. (Reza Kestakaran 2019).





11. Gardening and urban landscape design

In addition to being appreciated, urban landscapes have positive effects such as enhancing the climate of an urban region, cleaning the air, lessening the "heat island effect," and more. The development of urban ecological civilization and urban landscape design is an essential component of the development of urban environmental civilization and urban landscape design, and it serves as the foundation for the creation of livable cities. This trend is unavoidable given the improvement in people's living conditions and the significant harm to the urban ecosystem. Strengthening the green plant arrangement in urban landscape design can reflect the city's cultural and historical evolution process and has a positive significance for the promotion of the city's history and culture. The urban landscape serves as a city's business card, primarily representing the city's image. (Z. Sabir 2024) The project, completed in 2003, is located in Said-ul-Azaib, Delhi, covering an area of 8.09 Hectares and was supervised by Pradeep Sachdeva Design Associates and Arvind Gupta Consultants.

Aim: To create a public urban leisure area that is accessible to people from all socioeconomic situations.

Project Overview: The Garden of Five Senses is a distinctive public area with a variety of activities, such

as food courts, specialty shops, theme gardens, an amphitheater, and a solar energy park.

Project Specifics: Planting and development have been limited to the lower periphery, leaving the ridge's natural characteristics, including its striking rocks, in their original state.

Procedure: The location offers a breathtaking view of the 800-year-old Qutab Minar and is close to it. Delhi Quartzite stone and Red Sandstone were used in the structures and boundary walls because of the architectural context created by the area's close proximity to the Mehrauli Archaeological site.

Highlight: A wide variety of plants, including rare tree specimens, fragrant and herbal plants, and exotic and native species, are displayed in the garden. There are sculptures and other works of art by artists and craftspeople scattered throughout the area. from all throughout the nation. With pieces by more than 25 artists, it is one of the biggest public art commissions in India.

Challenges: Working with the site's general topography proved challenging. It is challenging to survey and design around the rocky outcrops and dense Keekar trees that usually make up the site's middle portion. (National Institute of Urban Affairs, New Delhi 2022)





Kurinji Garden Park, completed in April 2019, occupies 2,107 sq. m. in Selvapuram South, Coimbatore, Tamil Nadu, and is a client of JS Associate Development India.

Goal: This smart city project was implemented to address the dearth of appropriate outdoor space and provide children and their caregivers with opportunities to spend meaningful time outside of their homes.

Overview of the Project: People wanted parks and playgrounds that could accommodate people of all ages.

Project Specifics: Walking and jogging paths, kidfriendly play equipment, an indoor and outdoor gym, fountains, seaters, and more are examples of accessibility amenities. With an eye toward the environment, features like LED lighting and rainwater harvesting have been added to conserve energy and water. All of these characteristics enhanced the visitor's bodily and mental health in addition to their social well-being. **Procedure:** The project was successfully finished in the allotted period and had a positive outreach and impact on the neighbourhood.

Highlights: This garden boasts several special features, such as a yoga platform, rainwater collecting structure, drinking water RO plant, CCTV cameras, LED lighting throughout the park, and workout equipment for older citizens and ladies with floor platforms.

Difficulties: It cost Rs 99 lakh to construct the amenities.

Results: After this project was finished, it was recognized that the neighbourhood should have all the facilities necessary to strengthen the bonds that bind neighbours and family members as well as between people and the natural world. (National Institute of Urban Affairs, New Delhi 2022)





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CONCLUSION

Numerous studies and disciplines are included in the multidisciplinary idea of the urban landscape. Four methods have been introduced to this dynamic and developing concept: artistic, functional. perceptual/contextual, and sustainable. The research, which spans fields from the humanities to engineering and the arts, attempts to offer a thorough understanding of the urban landscape framework, elucidating its goals of aesthetics, function, identity, and ecology. This facilitates the navigation of urban environments' ambiguous meanings by academics and designers. This group conducts interdisciplinary research with an emphasis on building and urban scales. With an emphasis on urban environment challenges, graduate courses prepare professionals for careers in public administration, architecture. planning, landscape architecture, and nongovernmental organizations. The next undergraduate course connects various fields and draws students for further study.

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HOW TO CITE: Purvi Dabhi*, Isha Pandya, Bharat Maitreya, Sustainable Urban Landscape Design -Concept, Purpose, Maintenance and Management, Int. J. Sci. R. Tech., 2025, 2 (4), 470-479. https://doi.org/10.5281/zenodo.15253762

