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Theory and Practice for Outdoor Spaces of Urban Challenges: An Environmental Sustainable Design

Lina Kifah Kadhum[1*], Tahrir Taki Ali Almusawi[1], Ashwaq Fadhel Muhkaber Alomari[1], Awadh Ajeel[2], Zainab Qahtan Abd Alrazzaq Alkhayat[3],Luai Nuaman Andagani[4]

Architecture Engineering Department, College of Engineering, Mustansiriyah University, Baghdad, Iraq
[2]Faculty of Engineering and Built Environment, University Kebangsaan, Malaysia
[3]Sustainable Process Engineering Center (SPEC), Department of Chemical Engineering, Faculty of Engineering, University of Malaya, Kuala Lumpur, Malaysia
[4]Department of Civil Engineering, Faculty of Engineering, Universiti Malaya, Kuala Lumpur, Malaysia

[*]Email: linakifah33a@uomustansiriyah.edu

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Abstract

This article explores the idea of living in outdoor environmental design. It works to highlight the necessity of creating outdoor spaces that will simultaneously create positive physical and mental health effects while observing sustainable environmental practices that increase quality of life. In addition, it emphasizes the role such ideas can have in spreading environmental consciousness through society. The findings of the research may constitute a theoretical guidance to promote sustainable process design, but their implementation at the local scale is still scarce. In this paper, we examine how local government and community-based organizations are beginning to adopt standards for sustainable environmental design. It highlights the importance of climate-conscious, practice-based, and site-specific outdoor living design in global and local contexts as an effective means to advance environmentally sustainable design through best practices. The described work in this paper also proves, however, that the Sustainable-Based Design approach with local context intelligence can directly contribute to the change of social, economic, and environmental conditions. Findings underscore the importance of community-based approaches for minimising social and psychological fallout from wars, terrorism, and pandemics that interrupt behaviour patterns and collective identity.

Keywords: Architectural Practice, Bio- Climatic, Eco-Friendly experimentation, Environment, open spaces developments. Sustainable Architecture Design.

1. Introduction

Outdoor areas serve as the inherent extensions of an urban environment. Consequently, it is essential to preserve the natural environment and consider the surroundings of outdoor areas. Protecting species diversity, including flora and fauna, is critical. It has been stressed recently how important it is to achieve harmony between the built and natural environments. When designing outdoor areas, it is essential to strike a balance between human needs, both psychological and physiological, natural systems, and interaction with others. The preservation of ecosystems and the enhancement of knowledge of the tangible aesthetic elements inherent in outdoor places contribute to urban life while offering utilitarian, aesthetic, and ecological benefits. The wide variety of natural shapes shows that there are many ways to mimic nature and use the energy that is already there in a certain place or model. In addition to facilitating human movement and communication, one of the primary goals of architectural design is to create a balance between man-made structures and their natural surroundings [1].

The study highlights the absence of visible standards that test the local application of micro-determinants within the framework of sustainable environmental design, as well as the integration of these tools with external project design tools. This research aims to investigate the role of government and community organisations in setting up standards for sustainable environmental design at the local level. It considers environmental and community impacts when assessing these requirements. The objectives of the research are:

- Analyze effective instances of outdoor space design integration with the environment and juxtapose them with local experiences.
- Identify deficiencies in implementing environmental factors at the local scale and provide suitable remedies .
- Encourage environmentally responsible design on a local level; it is critical to direct lawmakers and decision-makers toward the implementation of sustainable environmental regulations.

2. The Comprehensive Theoretical Framework

2.1. A Literature Review

The reviewed literature in this section was selected because they comprehensively cover the relationship between environmental sustainability and outdoor open spaces, illustrates the role of environmental design in promoting biodiversity, ecological resilience, public health, and the preservation of cultural identity. The selection of articles was based on recent and diverse examples that support the theoretical and practical framework of the study. The ecological dimension of sustainability and its effect on open outdoor spaces is explored through a collection of important previous studies. This is done in either a direct or indirect way, with the goal of defining the research challenge and revealing the main and supporting terms of the study. The importance of eco-design in preserving the functionality, productivity, and resilience of natural ecosystems is emphasized in by Saleh [1], bringing attention to the fact that all living things affect the places they call home ..Ecosystem services, biomass, nitrogen cycling, decomposition, pollination, and hydrologic regulation are some of the markers that can be used to measure environmental design. While incorporating a biophilic design into space may improve its immediate surroundings, the overarching objective is to foster the growth of a naturally resilient and self-sufficient community. Biophilic eco-design not only has an environmental benefit but also has psychological, physiological, and behavioral benefits. Physiological benefits range from getting more measurable physical fitness, low blood pressure, and a general feeling of well-being for many active individuals. From a mental point of view, results showed that people have been happier and more motivated, less anxious and stressed, better at problem solving, and more creative. Social benefits include positive interactions with others, less aggressive and hostile behavior, enhanced focus and concentration, better ability to cope with challenges, and improved task mastery [1].

An Australian study conducted by Beller et al. [2] in 2018 investigated the impact of parks and outdoor spaces, along with it being a new year. Researchers investigated how the ecologies may be able to preserve essential processes, such as the conservation of biodiversity and landscape process sustainability, amid changing environmental conditions. The study pointed to the importance of these fundamental environmental characteristics that are available to use in parks, gardens, and open spaces. In addition, it focused on the effect of dynamic design that can be delivered through green infrastructure. This, in turn, ensures a close affinity with nature and belonging by seamlessly integrating the surrounding outdoor areas with biodiversity. The research also identified communication, variation, load, repetition, spatial orientation, and user functions as essential study components.

Koren and Rus [3] empty spaces into three categories: open, green, or wasted. The primary goal of this research was to understand the extent to which various urban open spaces play a role in establishing city resiliency. Researchers sought to learn more about what made these regions distinctive in the face of emergencies or natural disasters. They found that different open spaces are better suited to addressing certain emergencies than others. Nigg et al. [4] suggested that resilient urban ecologically built forms (with differentiation) should be preferred. Resilient urban forms rely on the provision of open spaces outside, public access to them by means such as wide streets where there are no impeding or obstructing barriers, and linear pathways act in the material ways that are expected of lines but are flexible enough to respond to heterogeneous circumstances or specific preferences. Other basic characteristics are also important, including modular designs, infrastructure, and diverse environmental systems. These factors enhance the concepts of resilience and flexibility for adaptation. The COVID-19 pandemic significantly affected people's mental health and health-related habits. Much data was collected on the effects of environmental factors on human health and illness outcomes during pandemics. Nature was important in reducing the harmful effects of COVID-19 [4].

Natural settings improve public health and resilience, to live well in everyday life, and, most importantly, to lessen the impact of crises on people's emotional and physical health. The pandemic has facilitated participation in physical activity, benefiting mental and physical health.

Estévez [5] suggested that from an ecological perspective, addressing the environmental dimension of sustainability with an emphasis on design and landscaping of open spaces has been widely recognized to be key in increasing ecosystem services and resilience to environmental changes. Estévezhas highlighted the role of integrating eco-design principles in maintaining biodiversity and initiating natural environmental mechanisms, as well as its impact on promoting and enhancing mental and physical health and enhancing quality of life by generating more balanced urban environments that are more integrated with nature.

2.2. The General Concept

2.2.1. Eco-friendly architecture.

Sustainable design maintains a balance between the built and natural environments. It minimizes energy consumption by providing high-quality lighting from artificial and natural sources. It also conserves resources and reduces waste, enhances indoor environmental quality, and improves quality of life (QOL) for the human occupants. In addition, it protects water purity inside and outside the building. It is a design approach based on the organic way of designing. It is, unlike post-modernism, not a new style per se but a design philosophy that prioritises environmental concern over many of today’s more prevalent and wasteful practices when it comes to

buildings and energy use. Yang et al. [6] defined sustainable design as the consideration of a building system through its life-cycle to include environmental quality, acceptance, and suitability with an ecosystem framework.

By implementing energy, water, and material conservation in sustainable design, financial benefits can be expanded, and operational costs, maintenance expenses, and other related expenditures can be reduced. Mother Nature exemplifies sustainable design. Nature is undeniably functional and efficient, as it produces without any waste to implement new sustainable design processes. All products and processes must be thoroughly evaluated from a "new" perspective, considering the potential implications for both human and environmental health. Using top-tier, eco-friendly materials in creating outdoor areas is an example of sustainable design, which aims to balance human needs with those of the natural world. Its functioning ought to generate maximum efficiency, longevity, and enhanced adaptability when required [7].

2.2.2. Landscapes with an ecological focus

Oikos, meaning "home," and Logos, meaning "the area concerned," are the Greek roots of the idea of ecology, which defines natural principles and their connection to environmental systems. It is the study of how the organisms and their physical and biological components interact within an ecosystem [8].

Creating eco-friendly outdoor spaces requires taking into account both the areas themselves and the ecosystems around them. Oikos viewed environmental design as an all-encompassing method for creating outdoor areas, one that considers the natural environment's ecosystems and their functions while emphasizing the need to study ecosystems to understand how they interact with human-made systems and how best to incorporate design into them. It also considers both the environment's inorganic (physical) and organic (biological) components when concluding how to proceed with design and decision-making. On the other hand, Oikos added that environmental factors at the project site frequently cause designers to be overlooked in many projects [8].

Hence, modern architectural and urban trends and movements aimed at outdoor areas need to move beyond simplistic approaches and instead plan for a complicated, organized, and strategic ecological environment to encourage participation. Various factors should be incorporated into the strategies devised by ecological planners to facilitate decision-making during an area's growth [9].

The foundation of environmental design is "in situ planning" and the study of interactions among natural and artificial elements of an ecosystem. This field also considers existing and future features, types of biological communities, circulation, and the density of plant groups. Additionally, the field endeavors to determine the importance of communities and species, linking them to crucial biological and physical processes, as well as ecosystem conservation, shortening the impact on the environment involves making planning and design decisions considering many factors [10]. In sum, an ecological perspective to outdoor spaces entails considering the functions of ecosystems as an entree into design processes, which outline how a site is designed and connects to both biological and physical components of place, as well as to the social and cultural contexts reflected in such places.

2.2.3. Ecosystem

Biological processes should be the priority over outside design elements when really taking a closer look at an ecosystem.

Therefore, a comprehensive analysis of the ecosystem in any location or project is necessary to understand its components, processes, and design adaptability [8]. It is not enough to know how to measure these indicators, but also be knowledgeable of their levels, combinations, and complicated combinations within ecological outdoor spaces [10]. The ecological unit is exemplified by the functional link that connects society and its natural surroundings. Dadvand went on to list many characteristics of this unit :

- A community composed of both living and nonliving entities interacting with the natural environment established the system.
- The system encompasses both living and nonliving organisms.
- Natural environments and communities coexist at all scales of ecology, including small ensembles, present-variety variability, and species-environment interactions. An ecosystem's functional complexity can thus foretell the growth in species richness, diversity, and taxonomy, as well as the complexity within the natural environment's vertical and horizontal planes [11], [12].

2.2.4. Ecological aesthetic

Ecological aesthetics manifested in the latter half of the twentieth century, paralleling a similar drive to address and care for nature. The notion of ecological aesthetic is thought of as a contemporary movement in the philosophy of beauty. The principles of ecological aesthetics are grounded in those of formal aesthetics. The first principle is inspired by European parks and plazas. The second does focus on the sublimation of natural form. The third principle involves photography as a means to see and understand ecological beauty [13]. Owen [13] defined ecological beauty as a combination of enjoyment and the responsibility to maintain the planet's habitability by protecting ecological health, biodiversity, ecosystem services, and aesthetics within its ecological context. There are three primary ways to achieve ecological beauty in outdoor spaces: by focusing on the ecological scene, by making the area functional, and by bringing joy to people. Individuals' vitality, sense of place, and their ability to convey the pre-urban beginnings of natural processes are all interconnected with the ecological landscape's orientation toward the idea of connecting with nature. The accessibility, permeability, waste disposal, rehabilitation, and maintenance features of the outdoor area, along with their integration, all play a crucial role. Schaafsma[14] elaborated that people's happiness is contingent upon their ability to define themselves and meet their needs about aesthetics, the past, safety, and health as they relate to their immediate surroundings and places of recreation.

It is possible to connect ecological outdoor space indicators with aesthetically pleasing visual characteristics. This method

aims to figure out how outdoor spaces are used. Integrating aesthetic indications with ecologically conscious outside environments is the aim of design. It can be achieved by referencing the following ideas through the connected indicators and dimensions of exterior spaces:

- Individuals recognize aesthetic values through witnessing the framework and its associated treatment, which is part of the place's maintenance.
- Peace refers to the degree to which various components depend on each other, the proximity of these components, and the length of the outdoor areas.
- Size about location plays a significant role in shaping ecology by quantifying elements' sizes and giving attention to species' migration and interdependence; conversely, it influences one's visual personality by considering a scale attuned to what is open and visible.
- Natural or inherent simplicity refers to a state of preservation devoid of intrusion.
- The ability to convey the variety that continues levels of vegetation competing with uses of land associated with evident cultural and historical values is what historicism refers to.
- The temporary natural environment refers to the degree to which systems undergo seasonal fluctuations. According to ecologists, constant change is a part of every living thing's biological system, and this is especially true when considering the project's aesthetic worth [15], [16].

As a result of the above, we can say that environmentally friendly attractiveness in outdoor areas is the merging of aesthetic preferences with the requirement to preserve ecosystems through the integration of natural, design, and civilization dimensions; this is done to support and enhance the human experience while also preserving outdoor spaces.

2.2.5. Planning a green outdoor area

All types of outdoor areas, as the concept of sustainability spreads to every industry, should be considered. The sources cited below provide key understandings of sustainable outdoor spaces. Outdoor areas are deemed sustainable if they harmonize with physical and climatic contexts while catering to the needs of those who utilise them.

Utilisation and friendly. By adapting to their immediate surroundings in terms of function, resources, water, soil, and internal energy conservation, outdoor spaces can positively impact human behavior and the environment [17].

The initial objective in creating a sustainable outdoor space should have been to create a peaceful, lovely, and attractive place to spend time outdoors that does less damage to the environment and the climate and is more beneficial for people's health and well-being, particularly in the social context. Therefore, it focuses on enhancing these areas' living standards by promoting healthy and proper practices [18], [19].

The following measures are recommended for the upkeep of environmentally friendly outdoor areas: Conducting constant and frequent inspections and assessments of outdoor areas. Increase awareness about environmental responsibility and the management of green areas. Reduce the use of harmful substances. One natural composting strategy involves using containers in space, while another involves using treated or rainfall instead of usable water for agriculture. Devices that rely on electricity as fuel rather than kerosene are used more frequently in manual processes [20].

As a result, outdoor space sustainability is the key to a win-win situation: it must be comfortable for users while simultaneously reducing the strain on the environment and its natural resources. Thus, it achieves several significant advantages for space use and the environment.

2.2.6. Outdoor life and its ecology

Historically, ecological outdoor space design has developed along two main trajectories: the European tradition and the American ideology. One of the key principles of the European School is the established system, which has a lengthy history predating ecological concepts. The school also stresses typology and modularity [21].

The United States School has a relatively short history, having been founded recently. It emerged in the early 1980s, following a workshop at Ellerton Park that stressed the need for outdoor environmental spaces to engage with the cultural realm, unlike the European school, which prioritizes natural and quasi-natural orders [22]. The benefits of an outdoor sustainable environment include reducing pollution and resource waste while maintaining a comprehensive perspective. To enhance wildlife and protect biodiversity, an atmosphere that promotes health, we need to implement sustainable water conservation strategies to preserve our water resources. It is crucial to make better use of rainfall to lessen its drainage from wet regions and encourage people to engage with nature properly and scientifically while considering sustainability. This involves minimising the sacrifices made to preserve volume. Environmental comfort and a 30–50% reduction in heating and cooling costs are both within reach. Reduce the level so as to preserve the natural energy that is present [23].

3. The General Framework

The theoretical framework shown in Table 1 defines a set of concepts such as open spaces, ease of movement, clarity, diversity, flexibility, continuity, coverage, and identity. They were derived from previous theoretical studies on open spaces and sustainable design. Each concept acts as an important component of social, environmental, or sustainability. To make those concepts operational, certain indicators/values were identified and selected from the related research literature and were applied in this research to analyse the case studies.

Table 1. Framework of Study.

	The Main Issue	Possible Values	
1	open spaces	Attractive open spaces	Environmentally friendly materials: Recycled paper, glass, and plastic; the wood; Stones and pebbles; Reduce waste
			sculpture arts
			Water fountains design
2	Ease of movement	Providing spaces and movement paths for the activities of the elderly and people with disabilities	
		Easy access and mobility	Design of pedestrian paths - bicycles - ramps
			Integration of land uses
3	Clarity	Clarity of the image of spaces and their functional purpose	
		Providing written symbols, signs, or symbols to infer within the spaces	
4	Diversity	pollinator gardens	With variegated flowers rich in nectar to support environmental health
		Region diversity	sports
			toys
			Recreational
			Relax and meditate
			Pedestrians and bicycles
		biological	plants
			animals
		Hydrological	Rainwater management
			Water conservation (artificial lakes)
		lighting	LED use
			solar energy
			natural lighting
		Chromatic	Cool colors for relaxation
			Warm colors for physical activities
5	Flexibility	The ability to change according to economic and social conditions	
		technology	Animated shaders
			energy-saving equipment
6	Continuity and coverage	Define public spaces for private activities to meet needs	
7	ID (identity)	Belonging through the overlapping of place elements	
		Preserving the historical elements that enhance the identity of the Outdoor space	

4. Research Methodology

The research methodology was conducted to provide an understanding of the impact of sustainable design on outdoor spaces. The research samples were selected, including three global and three local areas in Iraq. The indicators were prioritised according to the relative importance within the sustainable design literature and their applicability to both local and global contexts. The indicators were categorised under one of the four main sustainable dimensions: social, functional, and aesthetic. The authorisation was assigned based on frequency of use in past research, expert consultation, evaluating relevance, and existing sustainable outdoor projects.

An analysis was performed according to the descriptive analytical method to measure and test the main and secondary indicators extracted from the previous literature of the theoretical framework of the research.

They represent thirty indicators to achieve ecologically sustainable external space. The paragraphs were collected, and the comparison between the highest and lowest values of the samples was selected for the study. Each indicator represents one point (*), which in total will be 34 points.

4.1. Case Studies

The international case studies were selected based on their sustainable design practices that align with the analytical framework of this paper. The examples were chosen for their international significance in incorporating social, ecological, and technological sustainability principles into outdoor public spaces. These projects are considered valuable benchmarks for the assessment of the sustainability indicators, such as accessibility, clarity of spatial identity, environmentally friendly materials, and landscape diversity**.** These are used throughout diverse social and climatic conditions.

In addition, the inclusion criteria ensured that each case study had an appropriate amount of information for a comparative study. They also discussed issues pertinent to their own local context; in particular, social inclusivity, urban noise, and ecological fit. The study will compare the Iraqi examples to determine which design principles are relevant and evaluate how sustainable practices can be implemented in different economic and cultural conditions**.**

4.1.1. Case study A: La Mexicana Park

La Mexicana Park opened in 2017; it is the newest park in Santa Fe, Mexico City. Spanning an impressive 28 hectares (approximately 69 acres), this outstanding park offers unique landscaping work by the famed landscape architect Mario Schectman with a focus on technology-driven and sustainable methods. Green Flag Award PARQUE LA MEXICANA awards an important recognition to the park and promotes ecological practices. The international award is a challenge acceptance for parks worldwide that show excellence in sustainability and green initiatives. It takes into consideration a number of different elements, including park maintenance, biodiversity, community involvement, and sustainability projects. As the second Mexican park to receive this prestigious distinction, Parque la Mexicana now sets a standard for green spaces across the country. This acclaim further cements the park's reputation as a top attraction. These kinds of success stories reinforce the importance of protecting and improving green spaces in cities – benefiting not only community health but environmental health for all, as exemplified in Figs. 1 and 2.

4.1.2. Case study B: Gardens by the Bay stands

One of the largest garden projects in the world, Gardens by the Bay spans a total of 101 hectares and comprises three gardens – Bay South, Bay East, and Bay Central. In 2005, the Singapore government launched the Bay Gardens concept, a visionary policy aimed at turning an urban desert into a green paradise.

This project aimed at enhancing the general quality of life in the city by bringing generous green areas and thick foliage, an urban relief for its citizens to rest and relax in. The Bay Gardens project is an outstanding example of persistence to sustainability, with its iconic "Super trees," which are vertical gardens that also serve as environmental engines and social hubs. Enabling the harnessing of renewable energy, the Super trees are also installed with solar panels, acting as air exhausts for the conservatories in the park. In particular, the park has also reduced the dependence and increased the use of rainwater harvesting systems instead of potable water for other purposes. As of 2015, in November, the Gulf Gardens had recorded more than 20 million visitors who visited the rare experience, as exemplified in Fig. 3.

4.1.3. Case study C: Meixi Lake Park

Meixi Lake Park, also known as Meixi Lake Ecological Park, is a popular resort in Changsha, the capital city of Hunan Province, in China. The park surrounds the beautiful Meixi Lake, which is really quite something and an incredible central feature for the district.

It was constructed as part of the new Hunan Provincial Government Building Project and contains the Lake Meixi International Culture & Arts Centre at its heart. Ecological Security and Environmental Protection: Sustainable Landscape Planning Safeguarding the Earth." The design of Meixi Lake Park pays attention to harmony and balance between ecology protection and sustainability, so that it maintains beautiful wetlands, green fields, as well as various plants to provide a good atmosphere for both city development and natural preservation." Those who travel to the park come to enjoy the serene scenery of Meixi Lake at dusk and dawn, hoping for quiet and peace in Mother Nature's arms.

Figure 1. Project Parque La Mexicana source.

Figure 2. Diversity of Areas According to Physical Activities and Various Sports.

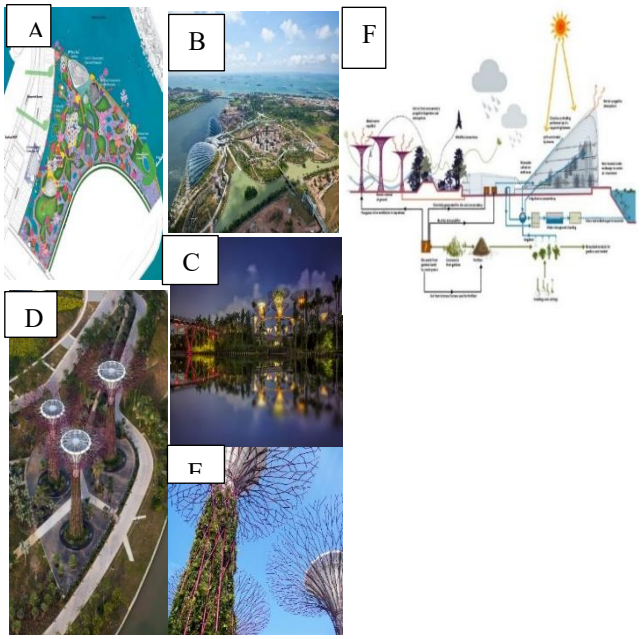

Figure 3. Components of environmental sustainability (A, B) Distribution of green zones and activities, (C, D, E) Integration of nature with technology (F) Elements of ecological sustainability.

Lake M Meixi Park caters to the needs of residents and tourists alike, offering many recreational activities such as boating on the lake, cycling along marked paths, picnics in designated areas, and outdoor sports. In addition, Lake Meixi Park hosts the vibrant Lake Meixi International Center for Culture and Arts, where a range of cultural events, exhibitions, and performances are organized throughout the year, encouraging artistic expression and appreciation. In this way, Lake Meixi Park has become an integral part of the community's social fabric, providing a sanctuary for residents and visitors alike to relax, engage in physical activities, and enjoy the wonders of nature in the heart of the bustling city, as shown in Figs. 4 and 5.

Figure 4. Meixi Lake Ecological Park.

Figure 5. Meixi Lake Ecological Park--The diversity of regions according to the activities.

4.1.4. Case study D: Abu Nawas park (Iraq)

Located east of Baghdad and adjacent to the Tigris River is Abu Nawas Park. It boasts two captivating monuments: one honoring the poet Abu Nawas, designed by Iraqi sculptor Ismail Fattah al-Turk in 1972, and the other dedicated to Scheherazade, the legendary storyteller of Shahryar's tales, crafted by the talented Iraqi sculptor Muhammad Ghani Hikmat. Following the American invasion of Iraq in 2003, the park's access street was temporarily removed, but it was later reopened in 2008. Unfortunately, the park suffered neglect due to its location. However, it is now undergoing a remarkable transformation, with reconstruction and development. Look at Figs 6 and 7.

Figure 6. Abu Nawas Park shows a variety of areas for different activities.

4.1.5. Case study E: July 14 park (Iraq)

Located in Baghdad's Al-Kadhimiya district, the renowned July 14 Park is a green haven with a history tracing back to 1958. What makes it special is the presence of a holy religious shrine nearby, highlighting its regional importance. After years of neglect, the park experienced a significant renovation in 2007, with extensive restoration work covering fifty thousand square meters. Greenery now covers an impressive 82% of the total area. Visitors encounter a beautiful landscape featuring well-maintained lawns, evergreen trees, and decorative plants such as dodonia**.** It also offers the visitors a range of facilities, e.g., a children's Playground, a driving course, and an area for teaching traffic rules. In this attractive place stands an architectural gem- a beautiful building where people can read and learn in tranquility. July 14 Garden continues the legacy of Baghdad's historic gardens, a serene oasis where beautifully landscaped natural surroundings inspire visitors to indulge in literary and intellectual pursuits, as shown in Fig. 8.

4.1.6. Case study F: The national park (Iraq)

The national park is located in central Baghdad, the capital city of Iraq, and beautifies the Eastern Gate area. It's an enchanting garden with fountains and tranquil lakes, while countless trees

provide scenery that is nothing short of stunning. As a cultural and heritage center, it is home to multiple important memorials such as the distinguished Freedom Monument made by the renowned fine artist Jewad Selim, the emotional mother statue memorialized by Khaled Al-Rahal, and the touching artwork of Faeq Hassan. Regrettably, the park was neglected, which resulted in the Iraqi conflict caused by the US invasion in 2003, when there were many car bombings and explosions.

Figure 7. Abu Nawas Park shows some symbols that facilitate access to and use of spaces.

Figure 8. A, D, E Playspace, B entry, F Travelling through rushes.

Left uncared for during prolonged periods, the nation's garden lost some of its former glory. However, thanks to the efforts of the Baghdad Municipality Department, this once-neglected sanctuary experienced a renaissance. On December 25, 2008, the garden's gates were reopened, as shown in Fig.9.

4.2. Practical application

The theoretical framework indicators obtained here are applied to the validation model, Preparation values in Table 2, and how to achieve the values for the selected samples A, B, C, D, E, and F.

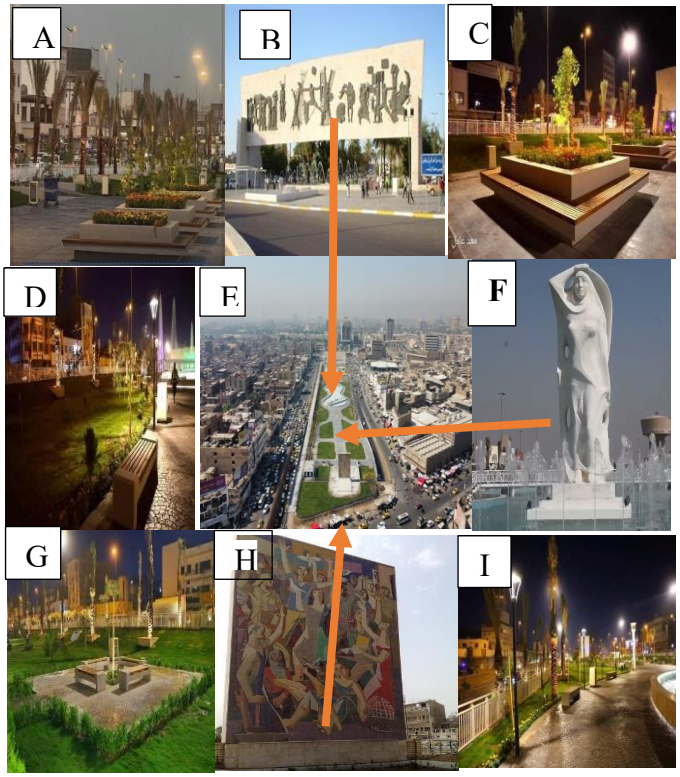

Figure 9. E The Nation's Garden, B The liberation monument, F The Statue of the mother, H The artistic moral, A, D, G, C The various seating areas, and I Traffic and pedestrian walkway.

5. Results and discussion

This section shows results comparing global and regional open space case studies and their impact on sustainable environmental design. Beyond just listing observations, the discussion interprets findings, explains their importance, and connects them to existing research on sustainability, urban open spaces, and human well-being.

5.1. Comparative Analysis Results

Analysis used sustainability and quality indicators from prior research: open space quality, movement ease, clarity, diversity, flexibility, continuity/coverage, and identity (ID). These were applied to three global (a, b, c) and three regional (d, e, f) case studies.

- **Open Spaces:** To achieve the usual level of quality in open spaces, the international example (a) used natural materials for furnishing, provided art and visual drawings, designed fountains, and used committed paths for seniors and individuals with disabilities. It also used recycling. For example, (b) achieved four quality attributes for outdoor spaces, while example (c) achieved five. Contrarily, regional instances (d) and (e) failed to accomplish both ideals in attaining a few features; examples (f) accomplished just one feature—the usage of wood furniture—and examples (d) and (e) accomplished just two.
- **Ease of Movement**: (a), (b), and (c) were characterized by their ability to facilitate ease of movement, access, and

activity throughout their open spaces. This was achieved by designing pathways for people walking by and bicycles, creating ramps to assist seniors and those with disabilities, and incorporating various land uses. Landing functions for open spaces were not integrated locally in examples (d) and (e).

Table 2. Theoretical framework application.

	The Main Issue	Possible Values			A	B	C	D	E	F
1	open spaces	Attractive open spaces	Environmentally friendly materials	Recycled paper, glass, and plastic	*		*			
				the wood	*		*	*	*	*
				Stones and pebbles	*	*	*			
				Reduce waste	*	*	*			
				sculpture arts	*	*	*		*	
				Water fountains design	*	*	*	*		
		Providing spaces and movement paths for the activities of the elderly and people with disabilities			*					
2	Ease of movement	Easy access and mobility	Design of pedestrian paths - bicycles - ramps		*	*	*	*	*	
			Integration of land uses		*	*	*			
3	Clarity	Clarity of the image of spaces and their functional purpose			*	*	*		*	
		Providing written symbols, signs, or symbols to infer within the spaces			*	*	*	*		
4	Diversity	pollinator gardens	With variegated flowers rich in nectar to support environmental health		*	*				
		Region diversity		sports	*	*				
				toys	*	*		*	*	
				Recreational	*	*	*	*	*	*
				Relax and meditate	*	*	*			
				Pedestrians and bicycles	*	*		*		
		biological		plants	*	*	*			
				animals	*					
		Hydrological		Rainwater management	*	*	*			
				Water conservation (artificial lakes)	*	*	*			
		lighting		LED use	*	*	*	*	*	*
				solar energy	*	*	*			
				natural lighting	*	*	*	*	*	*
		Chromatic		Cool colors for relaxation	*	*			*	
				Warm colors for physical activities	*	*	*	*	*	*
5	Flexibility	The ability to change according to economic and social conditions			*	*	*		*	*
		technology		Animated shaders	*	*	*			
				energy-saving equipment	*	*	*			
6	Continuity and coverage	Define public spaces for private activities to meet needs			*	*				
7	ID(identity)	Belonging through the overlapping of place elements			*	*	*			
		Preserving the historical elements that enhance the identity of the Outdoor space			*	*	*	*	*	*
	The sum of the example values				32	30	26	11	12	7
	Total indicators						34			

- **Clarity**: In the global examples (a), (b), and (c), the spaces and their functions were depicted with the help of indicative drawings and signs. In the local example (d), however, while the inferential drawings helped, the visual representation of the spaces and their functions still needed to be clearly defined. Alternatively, in Case (e), inferential symbols that would otherwise improve clarity are absent, while the spaces are clearly depicted.
- **Diversity**: Both worldwide examples (a) and (b) have attained ecological diversity via the use of self-pollinating landscapes for plants and the provision of spaces for a variety of activities, including but not limited to children's play, exercise, and relaxation, as well as the biodiversity of domestic animals and plants. Rainwater, on the other hand, has been used and managed flawlessly. It was characterized by a color diversity that enhances comfort and activity, and it integrated sustainability and ecological aspects into its lighting systems to reduce energy consumption. The local examples (c) did not meet the biodiversity criterion in most respects; for example, they needed self-pollinating gardens, playgrounds for children, or bike lanes.
- **Flexibility**: Examples from worldwide (a) and (b) demonstrate how technological methods and advanced solutions can lead to energy conservation and meet the

adaptability requirement in technological design. Regional instances (e) and (f) lacked technological adaptability and energy efficiency.

- **Continuity andCoverage**: The creation of varied areas that cater to the requirements of those who use open spaces has led to success on a global scale. This criterion was absent from local examples because activity areas were not defined or clarified according to user needs.
- **ID (Identity):** All the global and local examples were realized by incorporating the place's history and heritage. However, the local examples failed to fully embody the place on a global and local scale because the design elements were not harmonious and overlapping. This stood in stark contrast to the global examples.

Indicators and values, the world recorded the highest quality sample, accounting for 32% of the total. Item B received a score of 30. Component c, on the other hand, scored 26. Item d received eleven points, item e twelve, and item f seven points at the regional level. The effect of the indicators shown in Fig.10

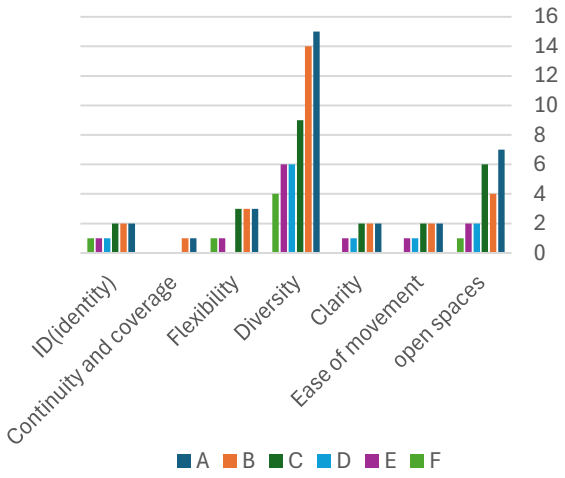

Figure 10. The effect of the indicator of the theoretical framework on the selected samples A, B, C, D, E, and F.

5.2. Discussion

Global examples implement sustainable design indicators more thoroughly than regional ones. This shows that sustainability requires not only awareness but also proper implementation, management, and local adaptation. The study reveals how local factors like hot and dry climates affect sustainability indicators when applied from global to regional contexts. This clearly reiterates the necessity of a climate-sensitive design over imitating international norms. Inadequate management and incomplete implementation impede the function of regional open spaces.

Unlike past research, which has mostly considered environmental aspects, this paper illustrates the connection between environmental sustainability, social behavior, and disturbances such as war and COVID-19. Such factors alter the use of space and also compound sustainability issues.

To be more specific, the results focus on how ecological diversity can be integrated with accessibility and technological adaptability in open spaces in Iraq. Healthy and vibrant outdoor spaces promote health, socialization, and urban resilience. Urban green coverage will need the support of native plants, well-designed water systems for more efficient usage, recycling, and energy-saving technologies, and they should then be integrated into urban planning as a priority.

Limitations are: unavailability of case studies and use of qualitative evidence, entailing quantitative scoring. Future studies should use a larger sampling pool, incorporate user questionnaires, and measure performance aspects like energy consumption and diversity. This study offers a basis to address sustainable open space design in difficult conditions, with the constraints of this study.

6. Conclusions

This study examined the implications of sustainable environmental design for park and open space establishment and maintenance. Recent studies have been conducted to indicate that ecologically sound land use planning is a key factor in the struggle for biodiversity conservation and overall sustainability. Outdoor areas should be created to benefit people's health and happiness. That means building places where people can relax, get outside, and engage with one another. The use of appropriate materials and good practice when constructing and erecting such environments, while aesthetic design seeks to make these places attractive and inspirational, so that people are more likely to want/wish to use them. So it's not just about the look of things but also about doing them in a way that is sustainable.

Indicators were compiled from the literature on 'eco-friendly design of outdoor spaces' and then applied to cases at global and regional scales. Important findings were that local contexts, such as a hot, dry climate, have a substantial impact on the sustainability of these indicators when applied in a local area. Misuse and mismanagement of these indicators as well can jeopardize the environmental sustainability openness. This study also explored the impact of behavioural changes during war, terrorism, and health crises such as the COVID-19 pandemic, which further challenge environmental sustainability efforts.

The study focused on three main areas: rainwater management, recycling, energy saving, and carbon emission from material reduction. It also emphasized the need to combat low-level green area coverage in cities. Here, environmental sustainability and its relation to human well-being have become increasingly apparent. particularly important in urgent times, as experienced by Iraqi society.environmental challenges. Results emphasize the need to orient Iraqi policy towards the environment and society. urban green open space through sustainable design approaches that can enhance the physical and psychological health of the population.

Similarly, today's city planners give preference to re-establishing the ecological and social value, equilibrium, and conserving the survival of native plant species. This Inclusion

necessitates a comprehensive strategy to construct the public realm's aesthetic, social environment, and health. factors. The study recommends that administrative and school and indoor environments in Iraq shall comply with environmental sustainability standards. Future research on this theme could be used to enhance the Iraqi educational and OLLOWE theme: HIGHLOW. economic areas that could enhance the nation's sustainable development efforts.

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Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

Author Contribution Statement

Lina Kifah Kadhum proposed the research problem, conducted the initial writing, performed data analysis, and provided overall supervision of the research.

All authors contributed to discussing and interpreting the results, ensuring the validity and efficacy of the findings, and contributed to revising the manuscript.

Awadh Ajeel compiled and formatted the tables and contributed significantly to the final version of the manuscript.

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