

**DEVELOPING A FRAMEWORK TO DESIGN
SUSTAINABLE URBAN COMMUNITY PARK IN THE HOT
AND ARID ENVIRONMENT - A CASE STUDY OF
AL - KHOBAR**

BY

SARA QWAIDER

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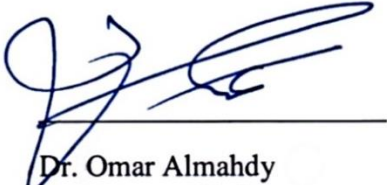
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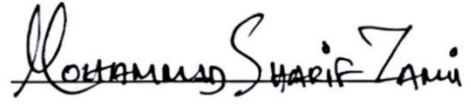
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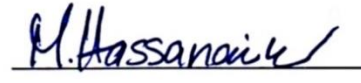
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Dr. Omar Almahdy
Department Chairman


Dr. Suliman Al Homidan
Dean of Graduate Studies

Date


Dr. Mohammad Sharif Zami
(Advisor)


Prof. Mohammad Hassanain
(Committee Members)


Dr. Baqer Al-Ramadan
(Committee Member)



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I dedicate this achievement to those who have the audacity to dream and the courage to pursue them

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LIST OF ABBREVIATIONS

SDGs	:	Sustainable Development Goals
UN	:	United Nation
UOS	:	Urban Open Space
POS	:	Public Open Space
UNESCO	:	United Nations Educational, Scientific and Cultural Organization
QOL	:	Quality of Life
UGS	:	Urban Green Space
MOMRAH	:	Ministry of Municipal and Rural Affairs and Housing
IOT	:	Internet of Things
AI	:	Artificial Intelligence
ICT	:	Information and communication technology
MCIT	:	Ministry of Communications and Information Technology
SWB	:	Subjective Well-Being
NUD	:	National Union of Domestic Employees
IMD	:	International Institute for Management Development
SGI	:	Saudi Green Initiative

ABSTRACT

Full Name : Sara Qwaider

Thesis Title : Developing A Framework to Design Sustainable Urban Community Park in The Hot and Arid Environment - A Case Study of Al-Khobar

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Urban community park serves as a designated public space in a city, catering to residents' needs for recreation, relaxation, and social interaction. These parks are vital for enhancing the quality of life (QoL) by providing opportunities for physical activity, mental well-being, and community engagement. In Saudi Arabia, particularly in alignment with Vision 2030 objectives that emphasize urban livability and landscape improvement due to the high urban population concentration, there are limited studies on designing sustainable community parks and a lack of guidelines. This investigation seeks to fill this gap by developing a framework for designing sustainable urban community parks in hot and arid environments, with a specific focus on Al-Khobar city. The research methodology incorporates a combination of qualitative and quantitative data collection methods from diverse sources, including secondary data, case studies, naturalistic observation, surveys, and in-depth interviews. Initially, a conceptual framework had been established through an extensive literature review and applied to evaluate effectiveness and quality of four parks in Al-Khobar (Dhahran Hills Park, Ithra Park, Shells Park, and Prince Ibn Jalawy Park). Subsequently, the framework was refined and enhanced through the observation and analysis of the four parks to assess sustainable landscape elements, design conditions, and their influence on human behavior. User satisfaction and Subjective Well-being (SWB)

assessments to determine overall happiness levels within these parks were conducted via surveys. Furthermore, in-depth interviews were conducted to validate the framework and address any challenges encountered in implementing sustainable community park design practices. The research concludes with recommendations for designing sustainable urban community parks in Al-Khobar. Future studies could focus on spatial analysis and regional surveys to evaluate community parks in Al-Khobar city using the proposed framework.

Keywords: Public open spaces, community park, quality of life (QoL), sustainable development, community engagement.

ملخص الرسالة

الاسم الكامل: سارا قويدر

عنوان الرسالة: تطوير إطار لتصميم حديقة مجتمعية حضرية مستدامة في البيئة الحارة والجافة - دراسة حالة الخبر

التخصص: العمارة

تاريخ الدرجة العلمية: جمادى الأولى ١٤٤٦

تعد حديقة المجتمع الحضري مساحة عامة في المدينة تلبي احتياجات السكان من الترفيه والاسترخاء والتفاعل الاجتماعي، وتُعدّ أساسية لتحسين جودة الحياة من خلال فرص النشاط البدني، وتعزيز الرفاهية النفسية، والمشاركة المجتمعية. في المملكة العربية السعودية، ومع أهداف رؤية ٢٠٣٠ التي تركز على تحسين قابلية العيش في المدن وتنمية المناظر الطبيعية، هناك حاجة ملحة لوضع استراتيجيات تضمن استدامة الحدائق المجتمعية. تهدف هذه الدراسة إلى سد هذه الفجوة من خلال تطوير إطار لتصميم الحدائق المجتمعية المستدامة في البيئات الحارة والجافة، مع التركيز على مدينة الخبر. تتبع منهجية البحث مزيجاً من البيانات النوعية والكمية عبر مصادر متنوعة، بما في ذلك الدراسات الثانوية، ودراسات الحالة، والملاحظة، والاستطلاعات، والمقابلات المتعمقة. تم وضع إطار مفاهيمي من خلال مراجعة الأدبيات واستخدامه لتقييم فعالية عدة حدائق، ثم تم تحسينه من خلال تحليل أربع حدائق في الخبر حديقة تلال الظهران، حديقة إثراء، حديقة الأصداف، وحديقة الأمير ابن جلوي لتقييم تصميمها المستدام وتأثيرها على السلوك البشري. تم قياس رضا المستخدمين عبر تقييمات الرفاهية الذاتية لمستويات السعادة العامة. كما أُجريت مقابلات للتحقق من صحة الإطار ومعالجة التحديات في تطبيق التصميمات المستدامة. ينتهي البحث بتوصيات لتصميم حدائق مستدامة في الخبر، مع اقتراح دراسات مستقبلية للتحليل المكاني والمسوحات الإقليمية.

الكلمات المفتاحية: المساحات المفتوحة الحضرية، الحديقة المجتمعية، جودة الحياة، التنمية المستدامة، المشاركة

المجتمعية

CHAPTER 1

INTRODUCTION

This chapter serves as the foundation of the study, providing an overview of the research, by introducing the research problem, aim, and objectives, justifying its significance and outlining its scope. Lastly, it presents the thesis structure.

1.1 Introduction

Cities are rapidly expanding, with approximately 55% of the world's population currently living in cities, and this percentage is expected to exceed 68% by 2050 (United Nations, 2021). In the Middle East many countries have already exceeded the predicted urbanization rate (Alnsour, 2016). The increasing urbanization is placing significant strain on natural environmental natural resources, raising concerns about future resources availability. Urban interventions must prioritize social sustainability, particularly in public spaces (Razia and Abu Bakar Ah, 2023). The quality of urban open spaces is a fundamental parameter of smart habitats and contributes to a positive Quality of Life (QoL), both physically and psychologically (Das and Praharaj, 2022). These spaces play a significant role in urban development and can positively impact an area's sustainability. A study done by Woolley (2003) found that while developed countries recognize and value the significance of urban public spaces, developing and less developed nations struggle to do so due to other significant issues.

According to statistics from 1072 cities, the 2023 UN SDG Report indicates that access to public open spaces remains limited globally, particularly in developing countries (United Nations Department for Economic and Social Affairs, 2023). The report also found that over 75% of the cities involved had fewer than 20% of the total area committed to open spaces and roads. This percentage is substantially less than the UN's target of "45-50% for public spaces and streets" (Ahmimed, 2018).

Urban open spaces are essential in boosting social interactions and community involvement. These spaces allow individuals to come together, promoting a sense of unity and belonging (Azare et al., 2018). Urban open spaces in city centers and local neighborhoods serve as social gathering places for a diverse range of individuals, including residents, workers, shoppers, tourists, and children enjoying playtime (Holland et al., 2007). Furthermore, open spaces are rapidly becoming some of the most essential elements of urban fabric. They are multifunctional urban public spaces that provide economic, social, and environmental benefits (Ibrahim et al., 2018). The Sustainable Development Goals (SDGs) of the United Nation 2030 Agenda focus on improving QoL for all, particularly through the development of SDG 11,7 which states “by 2030, provide universal access to safe, inclusive and accessible, green and public spaces, particularly for women, children, older persons and persons with disabilities“ (UN Secretary-General, 2012). Additionally, urban community parks are recognized as an integral component of urban open spaces (Yang et al., 2023).

Urban open spaces are vital for creating vibrant, healthy, and sustainable cities. They offer numerous benefits, including recreational opportunities, social interaction, environmental enhancement, improved mental and physical health, educational opportunities, cultural

enrichment, and economic advantages (Francis, 2006; Hussain et al., 2010; Loures et al., 2007). Furthermore, the integration of technology and sustainable principles could create intelligent and environmentally friendly public spaces that enhance the QoL for residents and promote a more sustainable future (Savin, 2020). Recent studies indicate that the use of smart technology and sustainable practices in an open space not only leads to a more efficient and environmentally friendly environment but also enhances the overall well-being and satisfaction of those who use these spaces (Bibri and Krogstie, 2017; Itair et al., 2023; Kim et al., 2020). Designing urban open spaces requires careful consideration of the unique environmental conditions. Understanding and addressing the unique environmental conditions is crucial for the successful design of urban open spaces (Nikolopoulou, 2004). Saudi Arabia is the largest country in the Middle East, with 32.2 million people, 83% of them reside in cities (General Authority for Statistics, 2023). The Eastern Region is one of Saudi Arabia's provinces out of other 13 provinces and the third most populous, following Riyadh and Mecca provinces. In 2017, the region's total population was 4,900,325 (General Authority of Statistics, 2017). Geologically, the arid environment of Eastern Saudi Arabia consists primarily of deserts, with temperatures ranging from "15 °C" in January to a high of approximately "42°C" in August and September. Annual rainfall varies significantly, averaging over 100 millimetres in the northern and northeastern areas during winter and less than 10 millimetres in Al Rub al-Khali (Herbarium, 2011).

However, Saudi Arabia has reached a point where the use of public open spaces for leisure activities must be managed systematically considering the rapid expansion of metropolitan areas. This is possible as the landscape profession grows and Western landscape architecture becomes more integrated (Addas, 2015, 2020; Addas and Rishbeth, 2018).

Furthermore, the planning of public open spaces must reflect the significant changes Saudi Arabia has experienced in recent years, as the Kingdom strives to become a global leader in the Middle East. These changes reflect the strategic objectives of Vision 2030, such as increasing livability and upgrading the urban landscape in Saudi cities (Addas, 2020).

1.2. Research Problem, Aim, and Objectives

Despite the importance of urban community parks in promoting sustainable development and community engagement, there is a lack of guidelines and institutional frameworks for designing sustainable urban community parks in Saudi Arabia. This gap in research and policy has hindered the development of effective and sustainable public open spaces. Additionally, community engagement in the planning, design, operation, and management of community parks remains limited. Without active involvement from the communities that will utilize these spaces, there is a risk of developing parks that do not fully meet their needs and preferences.

To address the significant gap and limitations in designing sustainable urban community parks in Saudi Arabia, this study aims to formulate a framework for designing sustainable urban community parks in the hot and arid environment. The aim is going to be achieved by fulfilling the following objectives:

1. To review the current literature on urban open spaces design elements, criteria, and the current status of Saudi Arabia's achievements in designing urban open space to improve people's quality of life, and well-being.

2. To observe and analyze the influence of urban community park on people's behavior, quality of life and well-being, while evaluating sustainable landscape elements and design considerations.
3. To identify the design elements and criteria of sustainable urban community parks and develop a design framework.
4. To explore the challenges associated with implementing the design framework.

1.3. Justification and Importance of the Study

As Saudi Arabia continues to prioritize the Improvement of its citizens' QoL, this study seeks to make a significant contribution to the development of sustainable urban community parks. The integration of smart technologies into urban community parks has the potential to enhance their functionality, efficiency, and overall user experience. However, the absence of clear guidelines and strategies for incorporating these technologies into sustainable design practices for developing open spaces in Saudi Arabia underscores the need for a framework that addresses this gap.

Meaningful community engagement is crucial for the successful development and management of urban community parks. However, there is a lack of strategies and approaches to encourage community involvement in the planning, managing and decision-making processes. The proposed framework would incorporate community engagement strategies to ensure that the spaces align with the needs and aspirations of the local population. The research findings and the developed framework would provide valuable insights and recommendations for both theoretical and practical fields, benefiting urban planners, policymakers, and landscape architects.

By applying this knowledge, these stakeholders can enhance their decision-making processes, design parks that prioritize sustainability, optimize resource utilization, foster community well-being, and contribute to the resilience of urban areas such as Al-Khobar.

1.4. Scope and Limitation of the Study

The scope of this study is centered on developing a framework for designing sustainable urban community parks, with a particular focus on the hot and arid environment of Saudi Arabia, specifically in Al-Khobar. The case study will be conducted in Al-Khobar, a city in the Eastern Province of Saudi Arabia. The study will examine multiple urban neighborhoods in Al-Khobar, selected based on their date of implementation. A mixed-methods approach will be employed, combining both qualitative and quantitative data collection methods, such as case studies, naturalistic observation, surveys, and interviews. These methods will be conducted across several urban community parks in Al-Khobar, gathering insights from various stakeholders, including residents, urban planners, policymakers, and experts.

It is important to note that the data for Hills and Ithra Parks is confidential and proprietary to Aramco, and permission must be obtained prior to use or publish the data publicly.

1.5. Thesis Structure

The thesis is structured into seven chapters as illustrated in **Figure 1**. **Chapter 1** provides an introduction and overview of the study, outlining the research problem, aim, and objectives, as well as justifying the importance of the study and defining its scope. **Chapter 2** examines the concept, definitions, and typologies of urban open spaces. It explores the

significance and role of these spaces in improving urban areas, emphasizing key elements for designing sustainable urban open spaces. Additionally, it investigates the impact of sustainable open spaces and the integration of smart technologies in these environments. Lastly, it reviews the current status of urban open space development in Saudi Arabia and identifies the research gap. **Chapter 3** offers a detailed description of the research design, data collection methods, sample selection process, and data analysis procedures employed in this study.

Chapter 4 presents the results of the data collected through the case studies and naturalistic observation, as well as the quantitative data from surveys, including the data collection methods, data analysis procedures, and study findings. **Chapter 5** presents interviews data validating the proposed framework for designing sustainable urban community parks and explores challenges related to the implementation of the design framework based on in-depth interviews. **Chapter 6** presents the outcomes of the study and the finalized framework.

Chapter 7 provides a summary of the investigation, including the findings of the case study, observation, surveys, and in-depth interviews, and discusses the implications of the findings, including the contributions that the study makes to the field, and the recommendations for future research.

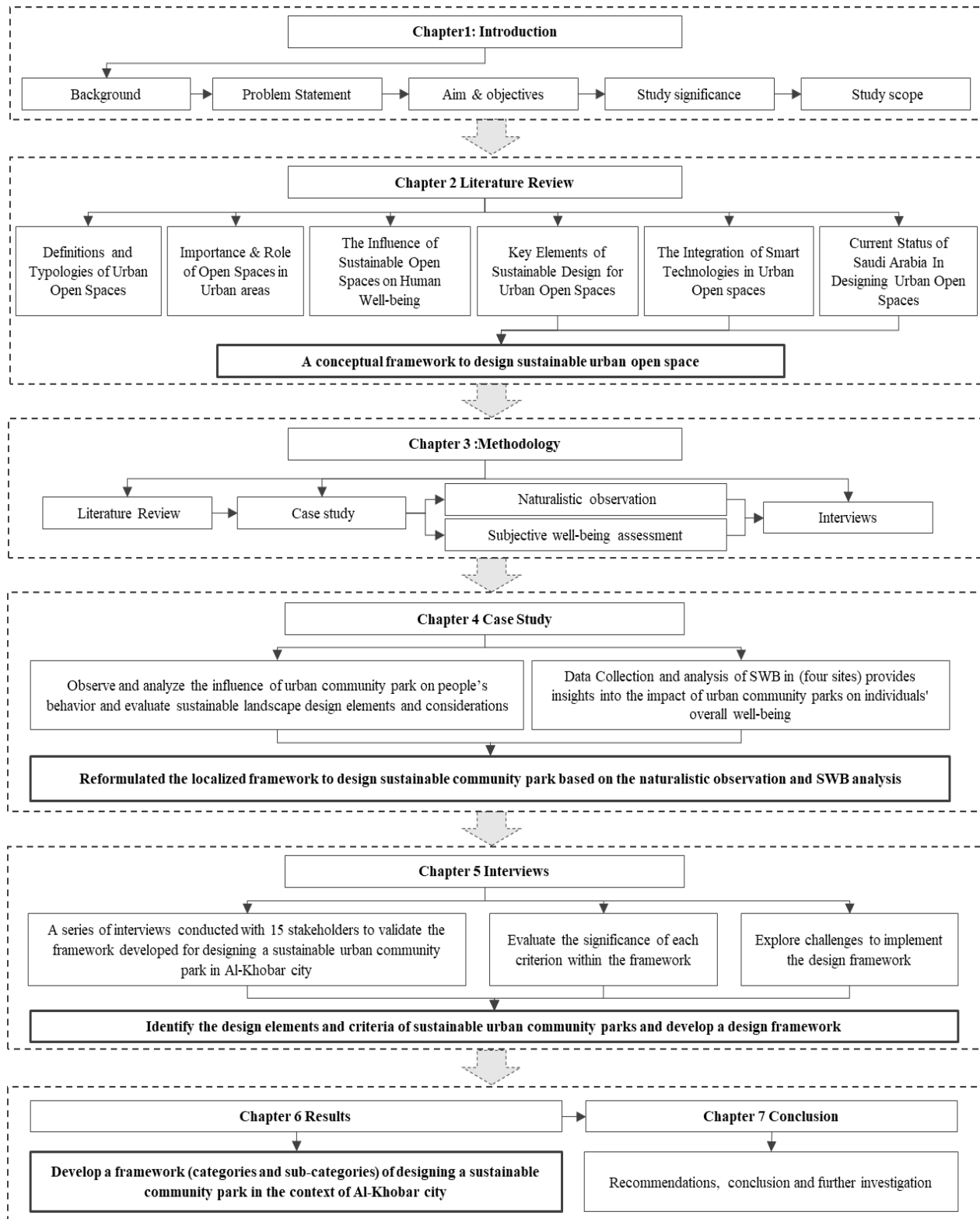


Figure 1. Thesis structure.

1.6. Chapter Summary

Urban community parks are widely recognized as an integral component of urban open spaces, offering numerous benefits, including recreational opportunities, social interaction, environmental enhancement, and improved mental and physical health. The integration of technology and sustainable principles can create intelligent and environmentally friendly public spaces that enhance the QoL for residents and promote a more sustainable future.

However, there is a lack of guidelines and strategies for designing sustainable urban community parks in Saudi Arabia. This gap presents a challenge for professionals working to create sustainable urban open spaces, particularly in hot and arid regions. The study aims to address this issue by developing a comprehensive framework for designing sustainable urban community parks in such environments.

The investigation will include a review of the literature on urban open spaces design elements, criteria, and Saudi Arabia's progress in designing urban open spaces to improve QoL and wellbeing. Additionally, it will observe and analyze the influence of urban community parks on people's behavior, QoL, and well-being, while evaluating sustainable landscape design elements and considerations.

The study will also identify the design elements and criteria of sustainable urban community parks and develop a design framework as well as explore the challenges associated with implementing this framework.

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction

The main aim of this chapter is to provide a comprehensive review of the fundamental concepts, definitions, and typologies of open spaces, unravelling their diverse forms and functions within urban environments. The significance and role of open spaces in urban areas are examined, along with their impact on social, cultural, and environmental aspects. Additionally, an investigation examined the essential elements of sustainable urban open space design. The influence of sustainable open spaces on urban development is also explored, as well as the potential for incorporating smart technologies in urban open spaces. Lastly, the current status of Saudi Arabia in designing urban open spaces that promote QoL is addressed.

2.2. Definitions and Typologies of Public Open Spaces

Urban open space (UOS) is defined as "the sum of the areas of the built-up regions of cities devoted to streets and wide streets, as well as the areas devoted to public parks, squares, recreational green areas, public playgrounds, and open areas of public buildings" (Rakhshandehroo et al., 2017).

Public open space (POS) does not include public facilities (such as schools, stadiums, hospitals, airports, waterworks, or military bases) that are not open to the public, as well as

privately owned places or abandoned lands (United Nations Human Settlements Programme, 2015). **Table 1** highlights some of the definitions of urban open space.

Table 1. Definitions of Urban Open Space.

References	Definition
(United Nations Human Settlement Programme, 2018)	Open spaces, including streets, are and must be viewed as multi-functional areas for social interaction, economic transaction, and cultural expression among a diverse range of individuals. Parks, streets, connecting walkways and pathways, leisure areas, marketplaces, and even edge zone between buildings or roadsides, which are vital spaces for the urban poor, are all examples of public open space.
(Rakhshandehroo and Mohd Yusof, 2014)	Open space for recreation includes private gardens, vacant or abandoned land, outdoor sports complexes, allotments and community farms, nurseries, atriums, and markets, yards, communal areas, and vertical farms.
(Mehta, 2014)	Open space is a place for interaction and meaningful social interactions.
(Kratochvíl, 2013)	It is the space of appearance in the broadest sense, in other words, the place where others see me just as they see other people.
(Al-Shams et al., 2013)	Open space is accessible to everyone, shared by all, and used by anyone.
(Zami, 2010)	Unlike spaces covered by a roof, open spaces are exposed to the sky and benefit from natural lighting, shadow patterns, a sense of openness, rainfall, the colors of the sky, and the beauty of moving clouds.
(Madanipour, 2009)	A space within a community, or any publicly accessible physical location, created through inclusive processes for social, political, and personal interactions.
(Woolley, 2003)	A space shared with others who are neither friends, family, nor colleagues.
(Clawson, 1962)	Open spaces can be used by anyone for a variety of distinct activities or a combination of them.

Public space may include natural areas, such as national parks or government-owned and maintained properties, as well as cultural landscapes or spaces fostering

interaction between people and the natural environment (UN-Habitat, 2018). UNESCO emphasizes the importance of public space in preventing spatial segregation.

As a result, UNESCO's definition of POS is more inclusive and focused on accessibility rather than public ownership or non-profit status, stating, "Public open space refers to an area or place that is open and accessible to all peoples, regardless of gender, religion or ethnicity, race, age, or socioeconomic level." These spaces include public gathering areas such as plazas, squares, and parks. Connecting spaces, such as sidewalks and streets, are also considered public open spaces. However, understanding the concept of open space requires an academic definition of public space (Collins, 2017). These definitions are rooted on political philosophy, urban design, and architecture as **Table 2** presents.

Table 2. Definitions of Public Open Spaces Based on the Field.

Field	Definition
Political Philosophy	Public open space is a place where people can enjoy "the general welfare" or engage in discussions about public issues. This definition is rooted on democratic principles of inclusion and participation. Additionally, researchers examine the relationship between space and politics, describing open space as "a free and open area within which political organizations can organize and expand into larger venues" (Mitchell, 1995).
	Open areas can serve an unlimited number of purposes. encourage tolerance by providing a space for diverse individuals and groups to express themselves (De la Llata, 2021).
	From a political perspective, open space can be understood as a concept involving the tension between boundless spaces that allow for diverse uses but lack coherence, and bounded spaces that prioritize coherence at the expense of diversity (De la Llata, 2021).
	The term "open space" refers to a social and political organizational method that emphasizes its connection to self-organization, freedom, and development (Sen, 2010).

Urban Planning	Open space is defined as a physical location where people "can gather communicate, and join together, while governmental agencies are meant to convey power" (Collins, 2017).
	Urban planning defines open space in urban centers as not only as a beautification element but also as a functional necessity that reflects cultural values (J. Yang et al., 2019).
	Open and green spaces are identified as drivers for increasing resilience and adapting cities to climate change (Scheiber and Zucaro, 2023).
	Urban open spaces (UOS) contribute to improving the QoL and sustainability in cities. They perform best in dense, central, well-equipped, accessible, connected, and easily walkable urban environments (Campos-Sánchez et al., 2019).
	Open space in the context of urban design is defined by its physical interconnectedness and the variety of built form components. Understanding how users perceive and organize urban public open space is crucial for conceptualizing its dimensions and hierarchical relationships (Nikšić and Watson, 2018).
Architecture	Public open space is defined as government buildings intended to indicate strength. These facilities may or may not be open to the public, with limited access based on usage. The term "open space" also believed to have been coined in 1833 by a committee in London working on an "open trail" (Maruani and Amit-Cohen, 2007).
	Public open space in architecture is defined as a dynamic concept that encompasses both physical and social dimensions, with an emphasis on inclusivity, collaboration, and the integration of technology to enhance user experiences and community engagement (Artopoulos et al., 2019).
	Public open space in architecture refers to areas where people gather and interact, including urban centers, landscapes, forests, and national parks (Maciejko and Czajka, 2019).
	The concept of public space is evolving, with a focus on creating inclusive spaces that are open to everyone (Stavrides, 2022).
Landscape	Open spaces should reflect the character of the city and its inhabitants, incorporating physical, semiotic, and functional features that enhance their grandeur and historical significance (Sochacka et al., 2022).
	Open green spaces contribute significantly to cities, urban residents, and ecosystems, making a comprehensive analysis of these spaces essential (Şenik and Uzun, 2022).

	The concept of open space in urban centers encompasses both aesthetic and functional needs and reflects cultural values (J. Yang et al., 2019).
	Public open spaces in cities should incorporate techniques such as multifunctionality, openness, and dynamic balance to create an attractive atmosphere and foster a sense of community (Dormidontova and Belkin, 2020).

Open spaces are purposefully designed to be accessible and inclusive, enabling diverse uses and fostering social interactions (İnce Güney, 2014).

The usability of these spaces is essential for enhancing human capabilities and accommodating a wide range of activities, such as promoting autonomy, active mobility, and facilitating social engagement (Garau and Annunziata, 2022). The attributes of physical components, such as features, conditions, aesthetics, and safety, significantly impact the density and intensity of spatial use in POS (Alwah et al., 2020).

According to Carmona et al., (2003) public open spaces can be understood through four key dimensions, as illustrated in **Figure 2**.

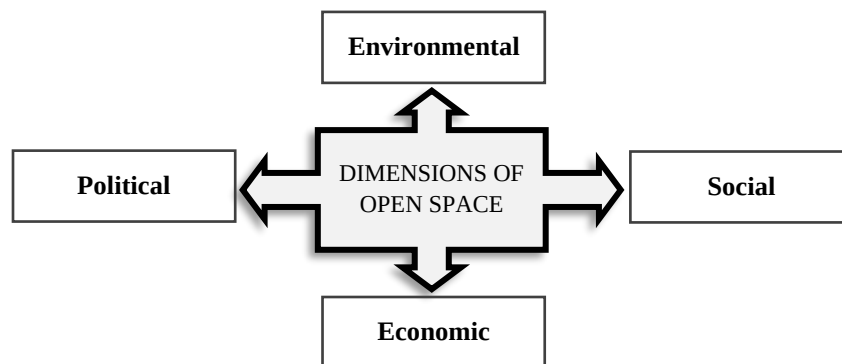


Figure 2. Dimensions of Public Open Spaces. Source: (Carmona et al., 2003).

POS can be categorized based on their characteristics and intended purposes (Woolley, 2003). These classifications provide insight into the diverse functions and attributes of these spaces. As illustrated in **Figure 3**, common types of UOS include city squares, plazas, parks, and streets (Sanei et al., 2017).



Figure 3. Forms of Public Open Spaces. Source: (Scheiber, 2021).

POS can be classified based on their primary focus or orientation. Some are culture- and leisure-oriented, serving as venues for recreational activities and artistic expression. These spaces often host events and festivals, promoting community engagement and entertainment (Zhang et al., 2022). Additionally, community-centered spaces are designed to foster a sense of belonging and social interaction among residents. Acting as gathering points, these spaces strengthen local connections and promote social unity (J. Francis et al., 2012). **Table 3** provides a summary of the various forms of POS.

Table 3. Typologies of Public Open Spaces.

Types	Explanations
Community Parks	Community Park is a designated public space within an urban area, designed and developed for recreational, social, and environmental purposes. It serves as a gathering place for residents of the surrounding neighborhood, providing opportunities for outdoor activities, relaxation, and community engagement (Adedayo et al., 2023).
Playgrounds	Playground spaces are equipped with various play structures, swings, slides, and other recreational equipment. These spaces offer opportunities for physical exercise, imaginative play, and socialization among children (Cohen et al., 2020).

Urban squares/plazas	These are centrally located open spaces serve as gathering places for social activities and events (J. Yang et al., 2019).
Pedestrian streets	These car-free streets are designed for walking and socializing, often lined with shops and cafes (İnce Güney, 2014).
Green spaces	These include parks, gardens, and green corridors that incorporate natural elements and promote physical and mental well-being (Y. Chen et al., 2016).
Civic spaces	These are public spaces that serve as platforms for civic engagement and community events and are considered formal space (Nared and Lamovšek, 2015).
Blue space	Open spaces that attract and provide enjoyment through waterscapes are influenced by the “blue,” which represents our physical, emotional, and genuine experience of the water and sky (Hami and Abdi, 2021; Lengen, 2015).
Large-scale public open spaces	The characteristics of large-scale public open spaces, such as the provision of facilities, division of space, and presence of vegetation, play a significant role in shaping user experiences (Y. Chen et al., 2016).
Waterfronts	Waterfront areas, such as riverbanks, lakeshores, or coastal zones, can be transformed into public open spaces. These areas often include promenades, docks, and recreational facilities, providing opportunities for people to enjoy water-related activities, scenic views (L. Chen and Ma, 2023).

The research will primarily focus on investigating community parks highlighted in **Table 3** above, which are one of the types of open spaces that play a crucial role in enhancing the QoL within neighborhoods.

Limited scholarly works exist in the realm of community parks, with existing studies primarily focused on the tourism sector (Chapman and Light, 2016) and on soil pollution within park environments (Guo et al., 2020). These areas facilitate physical exercise, social bonding, and appreciation of the natural environment, offering a retreat from the fast-paced urban lifestyle (Brown et al., 2014). They also serve as hubs for fostering social connections, drawing individuals from different backgrounds together for leisure activities (Shuib et al., 2015). Therefore, community parks play a vital role as public spaces for social

engagements, offering opportunities for interaction through close proximity and easy access to public amenities, especially in rural settings (Azmi and Karim, 2012).

The acceptable distance for walking to a park is not universally agreed upon, as it varies depending on factors such as individual preferences, physical capabilities, and urban design (McCormack et al., 2010; Rigolon, 2016; J. Zhang et al., 2021).

In urban park planning and design, the "five or ten-minute walk" principle is a commonly applied standard. It recommends that individuals should ideally have access to a park within a 5- to 10-minute walking distance from their residence, typically ranging from 400 to 800 meters. It is important to recognize that these distances serve as broad guidelines, and specific situations may differ. Local climate, terrain, and the presence of pedestrian-friendly pathways are among the factors that can influence the optimal walking distances to parks (Alamri et al., 2023; Sturm and Cohen, 2014; Tatit et al., 2024). In Saudi Arabia, 500 meters is considered a satisfactory walking distance to public parks (Alamri, 2024).

2.3. The Multifaceted Role of Public Open Spaces in Urban Development

The significance of open space cannot be overstated. According to the UN- SDG report "more than half of the built-up areas in cities globally are public open spaces" (United Nations and Department of Economic and Social Affairs, 2018). Land-use planners recommend that 15 to 20 percent of surface areas be devoted to public space, excluding roadways and 30 to 35 percent to streets in urban areas, which account for three percent of the total landmass. A public space functions as a platform, with everyone using that space at the time playing a dual role. They take on the duties of both actor and observer. Public

spaces are places where people can "see and be seen." According to Gehl (1987), "as opposed to being a passive observer of other people's experiences on television, video, or film, the individual himself is present in public areas, engaging in a modest way, but most obviously participating."

Many academicians, philosophers, and urban designers have frequently discussed the topic of encountering the "other" in public space. Hajer and Reijndorp (2001) comment on the public realm's unique status in society, stating that "it is the sphere where we engage the proverbial 'other' and where we must connect to 'other' behavior, beliefs, and interests." Furthermore, it is a place that allows people to try new things, fostering a sense of exploration, adventure, and introspection in some individuals. Public spaces enable the unknown to socialize freely while still maintaining control over their privacy.

As described by Whitt and Zukin (1996), it is "a technique of trusting others while keeping a private identity," where open spaces play a role as a place where society is born. Gehl (1987, p17) further emphasizes that "the presence of other people, activities, events, inspiration, and stimulation represent one of the most significant features of public places overall".

Open spaces are places where culture can flourish and can be viewed as gateway to society's cultural growth (Saudi's vision 2030, 2016). These spaces serve as platforms for cultural and social development, bringing together people from diverse backgrounds with different languages, customs, beliefs, philosophies, and behaviors. The public sphere enables individuals to share and experience these cultural traditions, fostering opportunities for the creation of fresh perspective and expanding the range of cultural and social possibilities, such as in the art, music, and culinary sectors (Whitt and Zukin, 1996). Open

spaces are significant not only for cultural growth but also for individual self-improvement. They aid in developing personal principles and values while helping individuals realize their character and convictions. Participation in broader urban culture within open spaces provides opportunities for personal reflection, reaffirming one's unique identity in society (Rupa, 2015).

Well-designed public spaces are essential for the economic development of cities, benefiting both the residents who use these areas daily and the visitors and commuters who pass through them. These spaces provide the best opportunities for people to experience the true atmosphere and culture of a city. As a place and a sight, a gathering point, and a social stage, open spaces enable the construction and representation of the city's identity. They foster an ideology of openness to strangers, tolerance for diversity, and opportunities for a fully socialized existence, both civic and commercial (Whitt and Zukin, 1996). Consequently, open spaces play a vital role in the social, economic, and cultural growth of cities and their inhabitants.

Many studies suggest that POS is a vital component of the urban environment, contributing positively to the quality of life (Shirvani, 1985). A successful POS should promote psychological comfort and a sense security (Danisworo, 1989). From a physical perspective, clear and easy access with an efficient mobility system are key criteria of high-quality POS (CABE and DETR, 2001; Carr et al., 1992; Danisworo, 1989; Green et al., 2002; Rivlin, 1994). These can be achieved by establishing distinct, interconnected paths, integrating transportation modes with land use, incorporating landmarks for orientation (CABE and DETR, 2001), and designing spaces on human scale (Shirvani, 1985).

Many studies suggest that open space significantly influences QoL factors, including physical and psychological health, social interaction, crime rate, and economic value of property (C. L. Li, 2020). For instance, Cattell et al. (2008) found that public open spaces positively impact individual well-being, sustainable development, and communal life, as illustrated in **Figure 4**. To encourage physical activity and enhance civic life, greenery features must be integrated into high-density neighborhood designs that include public buildings, open space, mixed land use, and pedestrian pathways (Williams et al., 2003). Additionally, research highlights the role of open spaces in promoting physical and psychological health (Chiesura, 2004; Hansmann et al., 2007; Song et al., 2007), and fostering social interaction and cohesion (Kweon et al., 2008).



Figure 4. The Interconnected Benefits of Sustainable Public Open Spaces. Source: (Scheiber, 2021).

Open spaces may not be a merely means of accessing culture but also platforms for constructing and contributing to both individual and social culture. The right to participate in cultural life comprises three fundamental and interconnected components: (a) participation in cultural life, (b) access to cultural life, and (c) contribution to cultural life (United Nations General Assembly, 2012). When public spaces, such as parks, libraries, or museums, are designated as sites for cultural participation, they can actively enhance engagement with cultural rights. Moreover, well-designed public spaces can facilitate access to cultural life by addressing issues like safety, thereby encouraging movement and participation among women and other vulnerable groups. Finally, public space can support cultural contributions by hosting activities such as a march or protest, or other cultural gatherings (Kanes and Fellow, 2019).

Accessibility ensures the unrestricted movement of people and services, playing a crucial role in fostering communal or social representations that shape the images of a city (Hinojosa Hinojosa and Estuardo Aparicio Moreno, 2016). By guaranteeing access to public spaces for all individuals, accessibility promotes inclusivity and diversity among users. This inclusiveness, in turn, allows for more comprehensive social representation. When public places are designed with accessibility in mind, they encourage social interaction and representation. Conversely, environments that fail to invite people to gather are more likely to perpetuate social exclusion (United Nations Conference on Housing and Sustainable Urban Development, 2017).

Cross-cultural relationships are more challenging to establish when open spaces are segregated, and people's activities are restricted. The importance of engaging in public places at the neighborhood level becomes particularly evident in situations where

abandoned areas are shaped by economic forces, following their consuming logic rather than social goals or public infrastructure (Wood, 2015).

The closure of public open spaces can have profound sociological consequences, triggering a downward spiral. As the vibrancy of public spaces fades and the natural policing of streets, driven by people's presence, is replaced by 'security,' the city becomes less free and more alienating. These accessible retreats must also be recognized as essential spaces for promoting diversity and social interaction (Rogers, 1997; 2008). POS is an area accessible to everyone and described as "the vital ingredient of successful cities" (Hajer and Reijndorp, 2001).

Such spaces play a crucial role in fostering a sense of belonging, social cohesion, and empowerment. They provide opportunities for various activities, including physical exercise, leisure, arts and culture, shopping, and meeting new people (UN-Habitat, 2015). POS is an essential component of the urban environment, influenced by the buildings and structures in its vicinity. Recognized as “a fundamental component in the creation of inclusive, healthy, functioning, and productive cities,” POS serves as an effective tool for sustainable development by offering environmental, social, economic, and health benefits.

Figure 5 illustrates the correlation between the development of UOS and five Sustainable Development Goals (SDGs): SDG 3 (Good Health and Well-being), SDG 5 (Gender Equality), SDG 8 (Decent Work and Economic Growth), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action). These specific SDGs are intricately linked to the advancement of UOS, with the authors suggesting that addressing these goals can enhance the overall development and sustainability of such spaces (Vukmirovic et al., 2019).

Moreover, well-designed open space should meet specific criteria derived from normative urban design principles (Vukmirovic, 2013). Among these, comfort is recognized as one of the most significant requirements. Given the diverse environmental impacts, this multifaceted criterion includes components such as "thermal comfort, visual comfort, auditory comfort, tactile comfort, fragrance, air pollution and allergens, mobility, and a sense of security" (Ovstedal and Ryeng, 2002).



Figure 5. Contribution of Urban Open Spaces to Other SDGs. Source: (Vukmirovic et al., 2019).

2.4. The Role of Sustainable Public Open Spaces in Enhancing Well-Being and Social Interaction

Sustainable open spaces can serve as "in-between spaces," foster meaningful collaboration and communication among diverse stakeholders, including individuals from varied backgrounds (Abraham, 2023). The United Nations (SDG) underscores the significance of sustainable open space in its eleventh target, Goal 7, which states: "by 2030, providing universal access to safe, inclusive, and accessible green and public spaces, particularly for women and children, older people, and people with disabilities" (UN Department of Economic and Social Affairs, 2015). Additionally, other global frameworks, such as the Future Urban Agenda for 2030, highlight the critical role of Urban Green Spaces (UGS) in enhancing urban organization, promoting well-being, and preserving biodiversity (Pinto et al., 2022).

Urban cities view green spaces as vital assets in mitigating many adverse health impacts caused by rapid urbanization. These spaces offer economic, environmental, and social benefits by providing unique settings for stress relief, fostering social connections, promoting physical activity, encouragement and nurturing a sense of belonging to nature, including the local wildlife (Selanon and Chuangchai, 2023). Significant research has been devoted to exploring the health benefits of soft spaces (Lee et al., 2015). While these spaces are beneficial for well-being, much of the existing research relies on measuring "greenness" to assess exposure to green spaces. This approach often overlooks the considerable variation in the qualities that make these spaces appealing to visitors and support their well-being and health. For example, soft green spaces can evolve based on objective, quantifiable attributes, such as the presence of appealing features, like tree canopies,

pathways and seating areas, as well as subjective, intangible qualities, such as spiritual connections or a personal sense of attachment to a particular green space (K. Chen et al., 2021).

Moreover, busy streets and inaccessibility are examples of poor- quality features that can deter visitors and negate the potential well-being benefits of green spaces. Overlooking the attributes that either discourage or attract individuals to spend time in such spaces has hindered progress in leveraging these areas as catalysts for promoting community well-being and reducing inequities (Larson et al., 2016). Analyzing these attributes, both positive and negative can bridge the gap in understanding the relationship between soft spaces and well-being (Nguyen et al., 2021). Open spaces, such as parks and gardens, are as fundamental for improving QoL of urban residents by accommodating diverse social and physical activities while fostering societal cohesion for sustainable development. However, the rapid urbanization in developing nations often leads to an insufficiency of open green spaces within cities (Do et al., 2019). Studies have shown that interactions with nature positively impact physical and mental health, such as reducing stress. Park users' experiences and well-being depend on managers' decisions and the location of parks (Houlden et al., 2018).

Southon et al. (2018) investigated the impact of the duration of visits to open spaces on users, finding a positive association between time spent in green spaces and improved mental wellness. Similarly, Liu et al. (2021) examined facial expressions of users in urban green spaces and their correlation with landscape metrics, concluding that the expansion of green spaces significantly increased positive emotions and happiness levels. Afrad and Kawazoe (2020) discovered a negative relationship between levels of depression and life

satisfaction in neighborhoods with accessible green spaces. Furthermore, a successful public open space should foster psychological comfort and a sense of safety (Danisworo, 1989).

Natural components are essential elements of open spaces as they enhance comfort, provide pleasant experience, facilitate relaxation, and mitigate adverse weather conditions by incorporating trees along pedestrian pathways and rest areas (Carr et al., 1992; Gehl, 2002; Kaplan and Kaplan, 1982). According to Williams et al. (2003), greenery features not only promote physical activity but also enrich civic life. These features should be integrated into high-density community designs, which include public buildings, open spaces, mixed land use, and pedestrian-friendly routes.

Sustainable open spaces also play a pivotal role in fostering community participation and stewardship. By actively involving residents in the management and maintenance of these spaces, a continuous dialogue between people and the environment can be established. This interaction not only strengthens human-nature relationships but also contributes significantly to sustainability (Suomalainen et al., 2022; Willis and Gupta, 2023).

Additionally, sustainable open spaces serve as platforms for fostering social harmony, multiculturalism, openness, and collaboration. They provide opportunities for various age groups to harmoniously utilize public spaces and contribute significantly to increased social cohesion and well-being (Ajayi and Amole, 2022; Barau et al., 2023). Open spaces, such as "parks, gardens, and squares", are essential components for enhancing the QoL of urban residents. They support diverse social and physical activities while fostering societal coherence for sustainable development (Do et al., 2019).

Sallis (2009) emphasizes that visitors to open spaces are more likely to engage in physical activities when the location is accessible, safe, and enjoyable. Furthermore, open spaces play a vital wellness role by functioning as the "lungs" of urban areas, allowing cities to breathe, and promoting healthier communities. Expanding such spaces has been linked to improved community well-being (Smailes et al., 1960). **Table 4** summarizes the impacts of sustainable open spaces on human mental and physical well-being and social interaction.

Table 4. Summary of the Influence of Sustainable Open Spaces on Human Well-Being.

Influence	Explanation
Psychological Wellbeing	The positive impact of green spaces on mental well-being is significant, with features such as water environments and meadows having the most beneficial effects (Janeczko et al., 2023).
	The availability of POS and their greenness help protect against increasing psychological distress and socioeconomic inequalities in well-being (Høj et al., 2021).
	Nature-based solutions and evidence-based design have been shown to be beneficial for individuals diagnosed with mental disorders (Andreucci et al., 2019).
	Ensuring the adequate distribution and accessibility of open spaces for all can help mitigate mental health issues associated with limited access to greenspace (Cai et al., 2022).
	Exposure to greenery can promote physiological relaxation, psychological restoration, and the reduction of fatigue and tension. Incorporating water features into green areas and urban environments can maximize these physiological and psychological benefits (Yin et al., 2023).
	Urban green infrastructure promotes stress recovery and enhances resilience to stress (Li and Lange, 2023).
	Green spaces have been shown to enhance self-rated health, improve mental health, and reduce symptoms of physical discomfort (Liao and Du, 2022).
Physical Wellbeing	Open spaces have a restorative effect on physiological health, including helping to control obesity and improve overall well-being (Alabbasi and Said, 2019).

	Parks and green spaces promote physical exercise and are positively correlated with the livability of cities (Islam et al., 2023).
	The relationship between green spaces and public health is context-dependent, with wealthier cities experiencing greater benefits from green spaces (Amano et al., 2018; Reyes-Riveros et al., 2021).
	Optimizing the spatial quality of urban parks has been shown to promote physical activities, and the quality of parks is strongly linked to the intensity of physical activities (Liu et al., 2023; Reyes-Riveros et al., 2021).
	The variety of physical activity facilities in parks was positively associated with increased activity during a park visit (Stewart et al., 2018).
Social Interaction	Physical and built factors in POS play a key role in enhancing human interaction and fostering conviviality (Thombre and Kapshe, 2021).
	The physical components of the environment significantly influence social interactions and sociability of physical spaces (Hashemi et al., 2022).
	Design elements that promote inclusiveness, desirable activities, comfort, safety, and pleasure contribute to the quality of social interactions in multi-functional public spaces (Ferwati et al., 2021).
	Flexible, informal, and adaptable open spaces are crucial for engaging socially disadvantaged population groups and ensuring participation (Termansen et al., 2023).
	Open spaces can serve as platforms for promoting social coexistence, multiculturalism, tolerance, and exchange (Barau et al., 2023).
	Well-designed public spaces can strengthen social cohesion in multicultural, low-income neighborhoods undergoing gentrification (Simões Aelbrecht et al., 2022).

Some researchers assess human well-being or level of stratification by conducting the Subjective Well-Being (SWB) assessment, which refers to a person's “positive and negative” evaluations of their life (K. V. Das et al., 2020). This involves cognitive evaluation of "life satisfaction" and affective evaluation "positive and negative feelings.” Therefore, SWB can be viewed as an umbrella term encompassing people's diverse appraisals of their lives and experiences, typically referring to an assessment of the body,

mind, and conditions under which individuals live (Diener, 2006). While "well-being and ill-being" are subjective concepts, SWB can be objectively assessed through nonverbal and verbal responses, as well as human behaviours (Sadeghi et al., 2022). It can be argued that the term happiness or well-being are often used interchangeably with SWB (Watson, 2018). Within this context, the two dimensions of SWB must be distinguished. The first is the cognitive dimension, which is typically understood as people's satisfaction with life. The second is the affective dimension, which refers to the "sense of comfort or discomfort" among individuals, or a balance between "positive and negative" feelings (Diener, 2006). Therefore, SWB is characterized by the concepts of emotional well-being and good performance. It encompasses aspects such as happiness, life satisfaction, a balance of positive and negative emotions, mental health, and social well-being. These aspects are closely linked to individuals' daily activities, as both positive and negative emotions arise from the things people engage with in their lives, thus having a significant impact (Russell, 2008). The main aspects and components of SWB are shown in **Figure 6**.

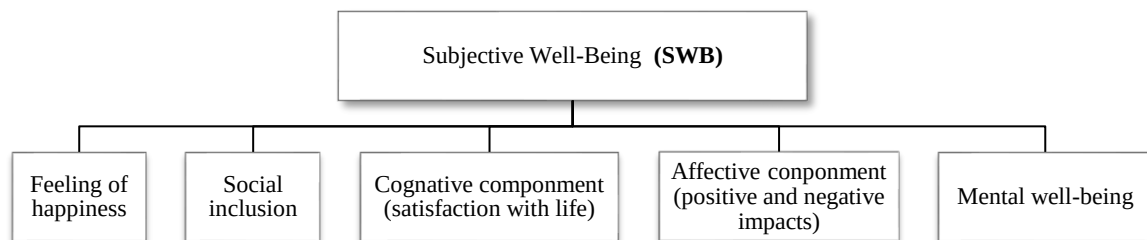


Figure 6. Main Elements of SWB. Source: (Sadeghi et al., 2022).

2.5. Principles and Design Elements for Sustainable Public Open Spaces

Project for Public Spaces (2009) devised a model, depicted in **Figure 7**, to illustrate the attributes of public places. This model revolves around the concept of a place and identifies four fundamental aspects: “Sociability, Uses and Activities, Access and Linkages, and Comfort and Images.” These attributes are encompassed by a circle labeled 'Intangibles', which, in turn, is embedded within a larger circle representing the overarching framework of 'key attributes'. Developing such a model provides an overview of the diverse elements that contribute to the creation of a place, offering valuable insights into various domains.

Additionally, it can stimulate discussions concerning the quality of public places. However, the origin and database used to develop this model remain unclear. Furthermore, certain 'Intangibles', such as 'Sustainable' or 'Green', are vaguely defined or lack precise definitions. Moreover, the model fails to acknowledge that these intangibles can be interpreted differently, potentially leading to contrasting perspectives. For instance, the meaning of 'spiritual' may vary depending on an individual's spiritual beliefs. Consequently, it remains unclear whether the essence of a remarkable public place relies on the unique experiences, values, and perceptions of the individuals shaping its meaning (Reich, 2020).

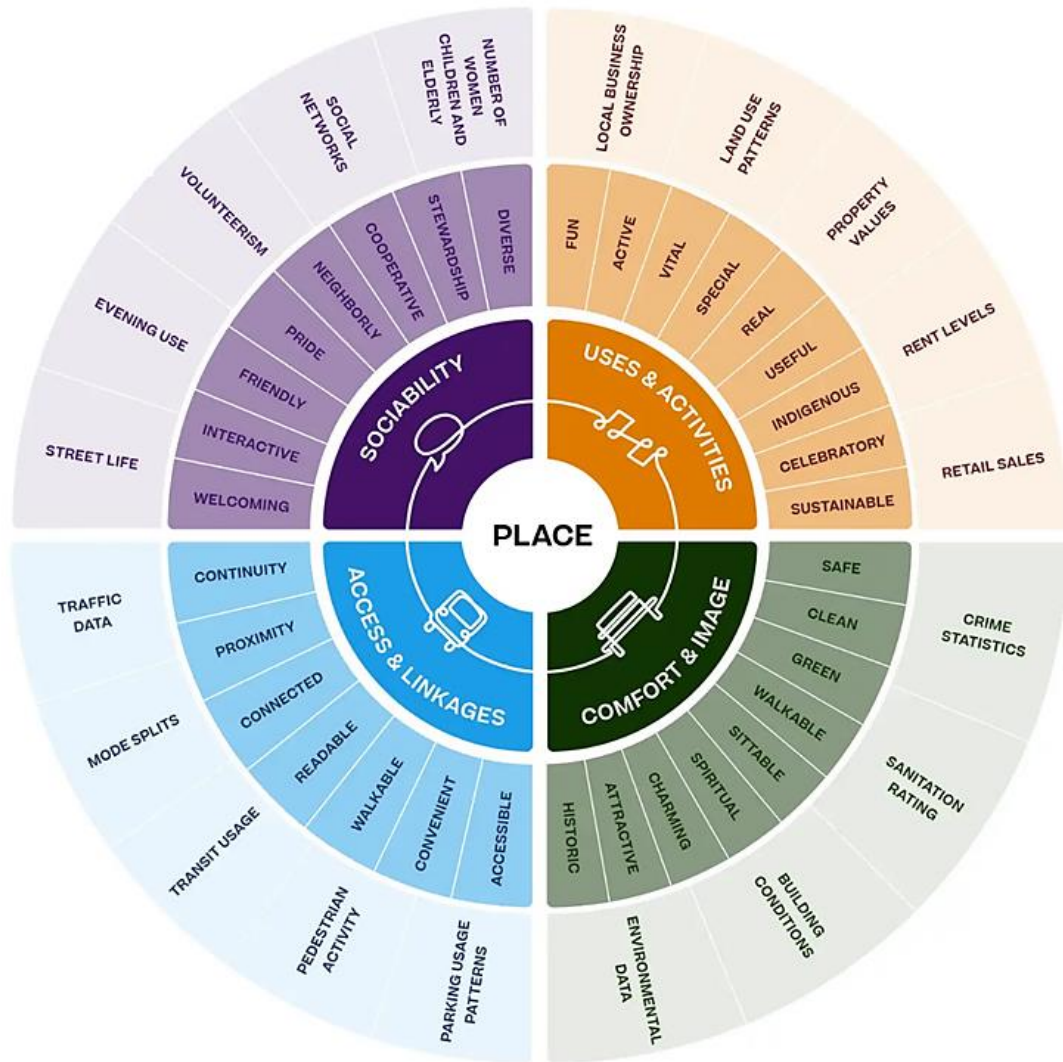


Figure 7. Attributes of What Makes a Great Place. Source: (Project for Public Spaces, 2009).

In recent years, the concept of sustainability has become increasingly important in urban planning and design. Shebek et al., (2021) highlight that one area receiving particular attention is the development of sustainable public open spaces. As cities and neighborhoods continue to expand, the planning and management of POS have become crucial to enriching human life and striving for social, cultural, and environmental balance (Yessoufou et al., 2020). These POS are crucial in providing socio-economic and ecological benefits to urban dwellers, thereby contributing to healthy urban living and the

overall well-being of the city (Hameed, 2021). In the pursuit of creating sustainable POS, certain key design principles are essential (Polat and Alabbas, 2018). These principles ensure that the open space design considers the needs and preferences of a diverse range of users, guarantees inclusive access regardless of abilities or backgrounds, and fosters a fair distribution of resources and benefits within the community (Podvalny et al., 2021). To ensure accessibility and usability, it is recommended that community parks be located centrally within the community (Adedayo et al., 2023).

Urban planners are encouraged to optimize park designs to meet the evolving needs of residents, particularly in the context of healthy city initiatives (Xuan et al., 2024). The study suggests the following strategies for optimizing the spatial layout of community parks:

1. **Space planning:** “it is essential to consider the diverse needs of various age groups and individuals, fully utilize spatial resources, and strategically allocate functional areas, such as spaces for children's recreation, fitness activities, leisure green areas, and zones for cultural activities to cater to the interests of the community. Moreover, optimizing the spatial layout should prioritize the parks' openness and sociability. Incorporating open squares and leisure seating areas will foster spaces for socialization, relaxation, and enhanced interaction among community residents.”
2. **Landscape design:** “it is crucial to blend nature and culture harmoniously to create a welcoming and enjoyable atmosphere. Incorporating diverse plant species to create a lush green environment, along with integrating terrain and water system designs, fosters a natural, ecological ambiance, enhances people's recreational experiences.”

3. **Road layout:** “well-planned trails and rest areas within the park can promote healthy walking habits and ensure safe, seamless pedestrian traffic flow. Adding sports equipment and fitness facilities along these paths can further encourage residents to engage in outdoor sports and recreational activities.”

A study by Lin et al. (2024) highlights specific park features that promote physical activity, such as natural elements, diverse activity areas, safety measures, and aesthetic qualities, as illustrated in **Figure 8**. This identification helps urban planners understand which aspects of park design are most beneficial for fostering physical activity.



Figure 8. Park Features That Promote Physical Activity. Source: (Lin et al., 2024).

According to Kong and Chen (2022) urban community parks must reflect community culture and regional characteristics of the area. This focus on local identity not only helps foster a sense of belonging among residents but also encourages community engagement.

Community parks should include sufficient spaces, basic amenities, privacy, security features, and facilities suitable for various age groups to enhance social interaction and safety (Adedayo et al., 2023). Key factors that enhance satisfaction include the availability of recreational facilities, cleanliness, and the natural environment. Studies show that amenities and usability positively correlated with satisfaction, while incivilities tend to detract from it (Roberts et al., 2019).

Specific landscape features, such as flower clusters and waterscapes, contribute to users' mental and physical well-being (L. Zhang et al., 2021). In addition, park management including maintenance and accessibility, plays a crucial role in shaping user experiences (Yu et al., 2018).

These factors collectively influence the level of satisfaction users derive from community parks. While these factors generally enhance satisfaction, individual preferences and contextual elements, such as cultural background and socioeconomic status, can significantly shape user experiences in community parks (Roberts et al., 2019). Community parks should foster leisure, entertainment functions, physical and mental health, and address residents' needs through improved service levels and optimized features (Xuan et al., 2024). Key design elements for both community and neighborhood parks include accessibility, multifunctional spaces, plant configuration, seating, toilets, safety, well-connected pathways, and ecological value. These elements are crucial for enhancing user experience, promoting social interaction, and supporting health restoration (Dempsey, 2011a; Wan et al., 2024).

A design framework of small parks has been developed by Currie (2017), with key factors including “Accessibility, Specificity, Authenticity, Adaptability and Functionality.” Another study done by Malek et al. (2011) assessed key design elements for neighborhood parks, such as natural settings, safety, aesthetic appeal, convenience, psychological comfort, symbolic ownership, policies on use, cost, and interaction with the natural environment.

According to Dempsey (2011b), effective neighbourhood park design includes clean, well-maintained green spaces, accessible seating, playground facilities, litter bins, and regular maintenance to enhance user experience and safety. Inclusive design elements should prioritize social gathering spaces and safety, while considering cultural significance and user reliance on existing park features to enhance environmental justice (Carnahan et al., 2020). Additionally, parks should include nature trails, bike paths, playgrounds, athletic fields, and accessible green spaces to promote physical activity and mental health benefits for adolescents (Feda et al., 2015).

Design elements that enhance neighborhood parks include flower clusters, waterscapes, fitness trails, benches with backrests, pavilions, and green corridors, which promote relaxation and alleviate stress (L. Zhang et al., 2021). When parks are designed to cater to the varied needs of individuals from all age groups and backgrounds, both user satisfaction and park usage significantly rise (Bambó Naya et al., 2023; Malek and Nashar, 2018).

Figure 9 below presents neighbourhood/ community park design features.

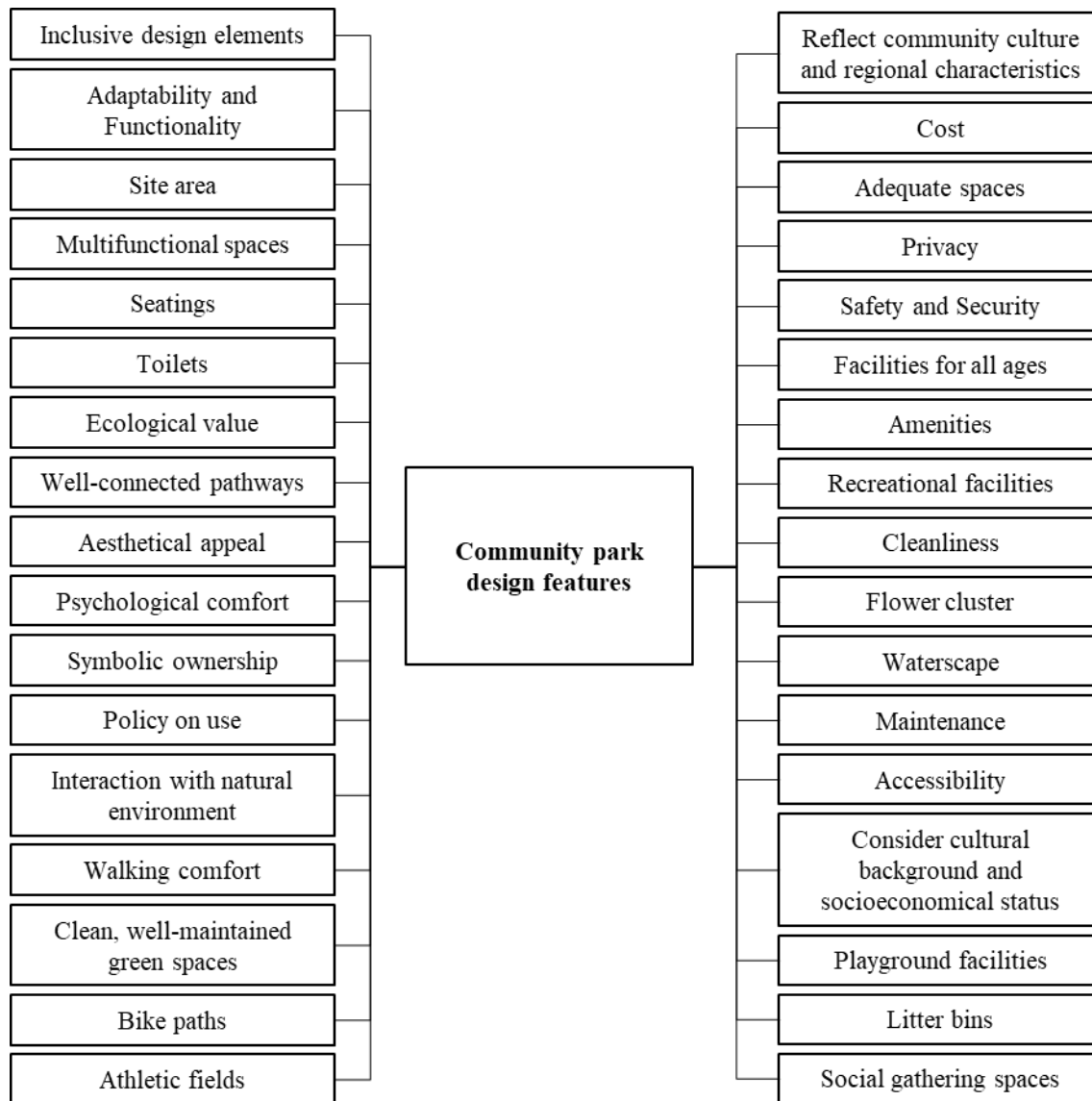


Figure 9. Community Park Design Features.

POS play a crucial role in enhancing the QoL in cities, serving as essential spaces for recreation, social interaction, and ecological balance. As urban areas grow, the need for sustainable design principles becomes even more critical (Beck, 2009). **Table 5** presents key design principles for creating sustainable urban open spaces, categorized into three main considerations: environmental, socio-cultural, and economic.

Table 5. Design Principles for Creating Sustainable Public Open Spaces.

Key design principles	Auxiliary design principles	Descriptions
Environmental Considerations	Microclimatic amelioration	Transforming contaminated post-industrial landscapes into healthy, sustainable public parks can help reduce urban heat intensification and improve human health and well-being (Dupper, 2021), while sustainable and resilient design approach is essential to cope with the effects of climate change (Mussinelli et al., 2020).
	Ecosystem services	It is important to ensure that public spaces reflect the social and environmental complexity of a community by implementing regulations that guarantee ecosystem services to offset any losses for the community (Valente, 2020).
	Flexible open spaces	Providing urban areas with appropriate, flexible open spaces is crucial, particularly in light of the COVID-19 pandemic, to ensure access to areas for collective social interaction (Franchino and Frettoloso, 2020). In Saudi Arabia, most social outdoor gatherings typically take place in the late evening to avoid the intense heat. Following the COVID-19 pandemic, parks have become more important as secure outdoor areas for social interactions and gatherings (Al-Khawaja and Asfour, 2024).
Socio-Cultural Considerations	Social success	Creating comfortable spaces where people of diverse backgrounds, genders, and ethnicities can benefit from numerous opportunities for social interaction is essential (Askari and Soltani, 2019).
	Inclusivity	POS should be designed to stimulate all age groups, encouraging their participation in activities, events, and gatherings, while promoting social sustainability (Jagtap and Singh, 2019).
	Community involvement	Engaging and empowering the community through collaboration between the public sector, private sector, and local residents is essential for the sustainable management of POS (Sujatini, 2017).

Economic Considerations	Economic growth	Public open spaces can drive economic growth and enhance the vitality of cities by improving QoL, aesthetic appeal, and walkability (Jayakody et al., 2018).
	Cost-effectiveness	Designing public urban parks with low initial and maintenance costs is essential for ensuring their long-term sustainability (Dupper, 2021).

In the light of **Table 5**, it can be posited that the principles for creating sustainable urban public open space are interconnected, and **Figure 10** illustrates the framework of design principles for creating such spaces.



Figure 10. Principles for Creating Sustainable Public Open Spaces.

When designing sustainable urban public open spaces, certain design elements contribute to their success. These design elements help create spaces that are appealing, functional, and well-utilized by the community (Carmona, 2019). The design should be guided by the fundamental components of landscape character, which can be perceived as the tangible expression of these factors such as visual appeal, consideration of the surrounding natural environment, integration with the surroundings, fostering a sense of tranquillity, and encouraging spontaneous engagements, all while maintaining harmony with the environment (Lau et al., 2014). According to Dober (2000), design ideas should emphasize the outdoor space's location, slope, site furniture and seating, shading, and vegetation.

Table 6 summarises the key landscape elements for designing a sustainable urban public open space in hot, arid regions.

Table 6. Landscape Elements for Creating Sustainable Public Open Spaces.

No	Elements	Description
1	Green Lawn	Poorly maintained green spaces can increase stress levels by fostering a sense of disorder and neglect (Ward Thompson et al., 2012).
2	Trees, Colourful and Dense Plantation	The presence of trees in an area can instantly become the main attraction, with the shade being the most appreciated aspect (Lau et al., 2014; Panduro and Veie, 2013). The stages of plant growth influence the colour combination, leafing, flowering, bunches, and the timing of leaf yellowing. The use of plants that turn red or yellow in the autumn should be balanced with evergreens (Atik and Kösa, 2013). Additionally, vegetation in urban environments can have a positive impact on mental health and well-being by providing a calming effect that reduces stress and anxiety (Ulrich, 1986).
3	Waterscape	Water features are highly popular in urban environment, as their integration with human interactions makes significant contributions to the landscape, enhancing its beauty (López-Martínez, 2017; Salama, 2022).
4	Circulation path	Circulation space serves more purposes than just transportation. Well-planned circulation can help control stimulation by reducing exposure to noise and congestion (Lau et al., 2014).
5	Urban furniture	A successful open space should be equipped with furniture that influences users' attitudes and provides them with a unique experience (Zami, 2010).
6	Sculptures and landform	Placing sculptures in an open space attracts users and encourages social interaction (Zami, 2010).
7	Safety and Security	Creating a safe and secure environment is essential for the success of an open space. Adequate lighting, clear sightlines, and proper maintenance all contribute to promoting a sense of safety (Shehayeb, 2008).
8	Comfort and Amenities	Providing amenities that enhance the comfort and enjoyment of open space is crucial. These include seating areas, shaded spots, drinking fountains, public restrooms, and bicycle parking, all of which make the space more inviting and convenient for users (Ruskin, 2018).
9	Flexibility and Adaptability	Successful open spaces are adaptable to a variety of activities and events. Design elements such as movable furniture, multipurpose spaces, and modular structures provide flexibility in accommodating diverse needs (Zivkovic et al., 2019).

10	Smart Technology Integration	Incorporating smart technologies, such as sensors and IoT devices, can help monitor and optimize resource usage, enhance user experience, and enable efficient maintenance and management (Soori et al., 2023).
11	Health and wellbeing	Providing opportunities for both active and passive recreational activities, such as sports facilities, play areas, walking paths, and contemplative spaces, helps cater to diverse user preferences (US Environmental Protection Agency, 2021).
12	Wayfinding system	A clear and intuitive wayfinding system helps visitors navigate open spaces, reducing confusion and frustration. By providing clear directions, signage, and information, it enhances the overall user experience, ensuring people can easily find their desired destinations within the space (Guida, 2015).

In light of **Table 6**, it can be posited that the landscape design elements that collectively contribute to creating sustainable urban public open space are interconnected. **Figure 11** illustrates the framework of these design elements for creating such spaces.

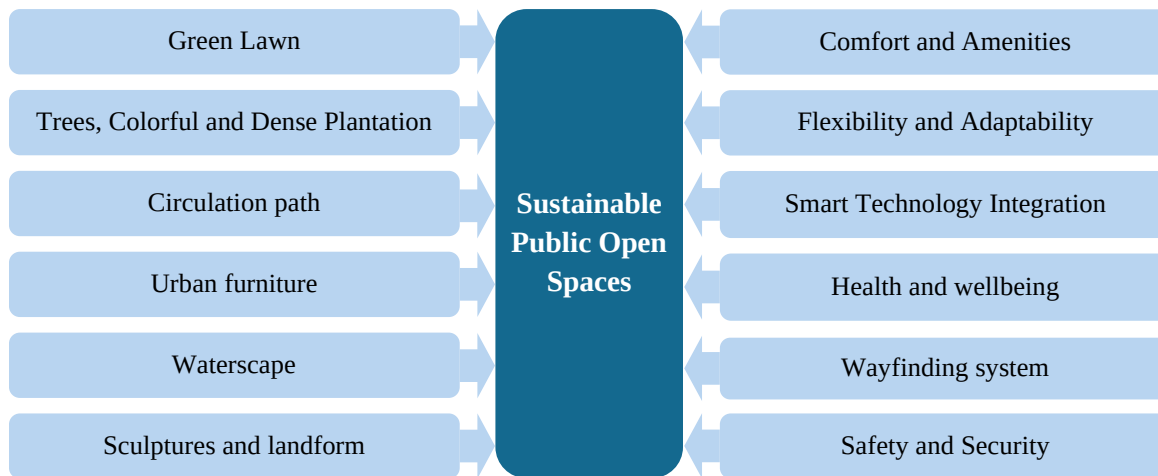


Figure 11. Landscape Elements for Creating Sustainable Public Open Spaces.

POS play a crucial role in the livability and sustainability of cities, particularly in hot and arid environments (Farjami and Taefnia, 2022). As urban populations continue to grow, the need for well-designed and sustainable open spaces becomes increasingly important. Urban planners must prioritize the creation of accessible green areas that promote community engagement and provide environmental benefits such as improved air quality, biodiversity preservation, and temperature regulation (Maes et al., 2019).

Table 7 summarises the key factors/conditions for designing a sustainable urban public open space in hot, arid regions.

Table 7. Design Conditions for Sustainable Public Open Spaces.

No	Design conditions	Description
1	Incorporating Shading	Providing adequate shade and shelter is crucial for making open spaces comfortable for users. Incorporating natural shade elements, such as trees or pergolas, helps reduce heat exposure and creates inviting spaces (Turner et al., 2023).
2	Heat mitigation strategies	Integrating design strategies to mitigate the urban heat island effect is essential. Urban green areas serve as an effective approach to address this issue (Aram et al., 2019). Design green spaces and incorporating water features, such as fountains, ponds, or misting systems, can help cool down urban open spaces (Jacobs et al., 2020; Langie et al., 2022).
3	Efficient use of resources	Efficient use of energy: Design the open space to maximize energy efficiency, considering the use renewable energy sources (Ozgun et al., 2015). Smart Waste Management: Implement efficient waste management systems, including recycling facilities, smart bins, and waste reduction initiatives, to promote cleanliness and environmental sustainability (Esmaeilian et al., 2018). Water management: Employ smart irrigation techniques, such as drip irrigation or low-flow sprinklers, to minimize water usage. Incorporate moisture sensors and weather-based controllers to adjust watering schedules based on real-time weather conditions (Bhavsar et al., 2023).
4	Biodiversity	Enhance biodiversity by incorporating native plant species, creating wildlife habitats, and preserving existing natural features (Threlfall et al., 2017).
5	Appropriate Landscaping	The choice of heat-tolerant and drought-resistant plant species that can thrive in the local climate conditions. Utilize native plants that require minimal water and maintenance while enhancing the aesthetic value of the space (High Commission for the development of Arriyadh, 2014).
6	Adding Function	The open space infrastructure in urban centers can be categorized into three groups based on its functional features: open space for mobility, open space for commerce, and open space for recreation. Together, these elements create a

		dynamic environment, offering citizens areas for leisure activities and public interaction (Han et al., 2022).
7	Design for Interactions	The connection between the environment and society influences all social behavior that reflected in public space (Hashemi et al., 2022). Public spaces support human activities in daily life, fostering a variety of interactions between people, and their surroundings (Alnaim and Noaime, 2023).
8	Easy Accessibility and Universal Design	For a public place to succeed, it should be easily accessible to all members of the community, allowing people of all ages, abilities, and mobility levels to enjoy and navigate the space comfortably (Persson et al., 2015). Incorporating universal design principles help create spaces that are accessible, usable, and enjoyable for people of all ages, abilities, and backgrounds (Esfandfard et al., 2018).
9	Community Engagement and Sense of belonging	Involving community members through workshops, surveys, and public meetings in the design and planning process fosters a sense of ownership and ensures the space meets their needs and desires (Francis et al., 2012).
10	Aesthetics	Aesthetics is a key element in creating successful urban space. Landscape and urban designers aim to craft visually pleasing environments that enhance the overall experience of residents and visitors. Incorporating elements such as well-designed walkways, attractive landscaping, and thoughtful use of colors and materials can contribute to a sense of harmony and beauty in urban spaces. Additionally, attention to aesthetics can positively impact on the functionality and usability of the area, as people are more likely to engage with and enjoy spaces that are visually appealing (Balasubramanian et al., 2022).
11	Sustainable Construction Materials and Surface	Using environmentally friendly and locally sourced materials in the construction and maintenance of urban open spaces helps reduce the carbon footprint and promote sustainability (Qiuli et al., 2017). Choose materials and surfaces that minimize heat absorption and retain less heat. Light-coloured paving materials, such as light-coloured concrete or reflective coatings, can help reduce the heat island effect (Sankar Cheela et al., 2021).

In light of **Table 7**, it can be posited that the conditions that collectively contribute to creating sustainable urban public open space are interconnected. **Figure 12** represents the framework of these conditions for creating sustainable urban public open spaces.

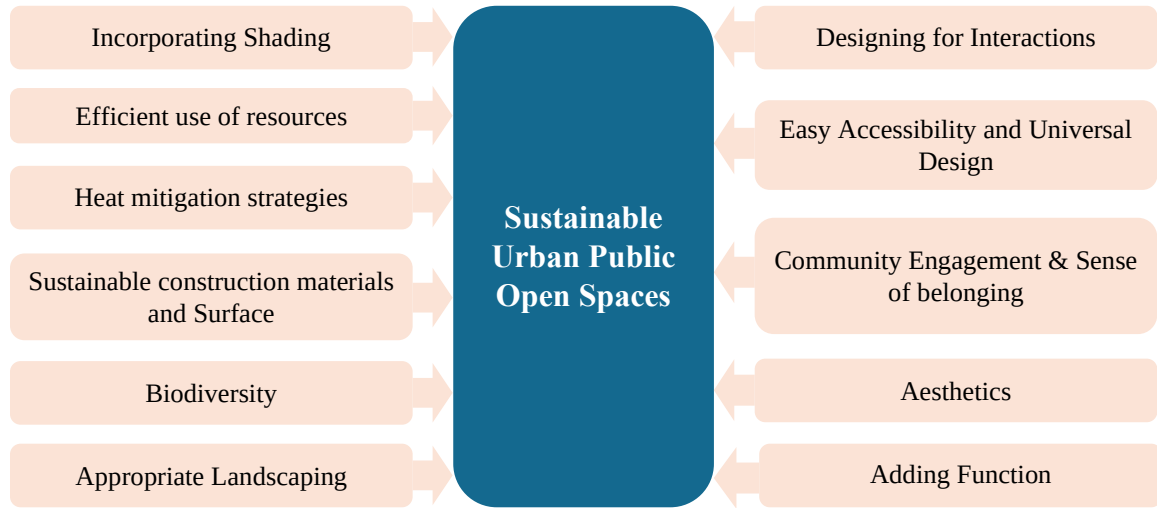


Figure 12. Design Conditions for Creating Sustainable Public Open Spaces.

2.6. The Integration of Smart Technologies in Public Open Spaces

The aim of digitally networking public spaces is not solely to enhance accessibility, utilization, and aesthetics but also to gain insights into the behaviour of urban residents through the collection of dynamic data, such as pedestrian patterns, mobility trends, and environmental information. This ongoing assessment serves as a foundation for the continuous improvement of smart public space networking, aiming to align with the preferences of city dwellers and enhance the sustainability of public spaces (Radwan et al., 2018). Additionally, the study by Pancholi et al. (2015) compared traditional urban public spaces from smart urban public spaces:

Factors	Urban public space	Smart urban public space
Accessibility/connected	Physically only	Physically and digitally
Visually attractive	Yes	Yes, and VR can add to it
Eco-friendly	According to city governance	Usually eco friendly
Sociable	Yes	Yes
Inclusive	Yes	Yes
Management	Governmental, rigid	Collaborative, adaptive
Event coordination	Regulated, time consuming	Impulsively
Users experience feedback	Manual surveys, infrequent	Digital surveys, in the moment
Interaction with the space	Limited	Vast, evolving

According to the U.S. Environmental Protection Agency (EPA), Smart Growth defined as “strategies for the development and maintenance of the society, the protection of the natural environment, economic strengthening and social preservation by planning and designing residential buildings along with service buildings (i.e., commercial, educational, religious, health, gardens) that are accessible by walking, cycling, public transportation, and involving people in the decision-making process. These communities create vibrant places for living, working, playing and high QoL” (Environmental Protection Agency, 2006, 2016). Countries must consider the necessity of open spaces for preservation, such as recreation facilities and park areas, which play a critical role in supporting Smart Growth (Kelsey, 2001). Smart open spaces are driven by the idea of a smart city, which aims to enhance the QoL in urban areas by engaging residents in city governance and improving the effectiveness of city infrastructure and functions (Albrecht et al., 2013; Gracias et al., 2023; Szczepańska et al., 2023).

Figure 13 illustrates the framework developed by Shahrour and Xie for their revolutionary smart open-space concept. This framework consists of six layers, each is critical to determining the idea's utility and efficiency: “governance, physical infrastructure, collecting data systems, communication protocols, servers the built environment, and smart

services" are all covered under these layers (Shahrour and Xie, 2021). This framework has also been adopted in several studies. For instance, an investigation by Itair et al. (2023), aimed to enhance the inclusivity of urban public spaces using smart technologies.

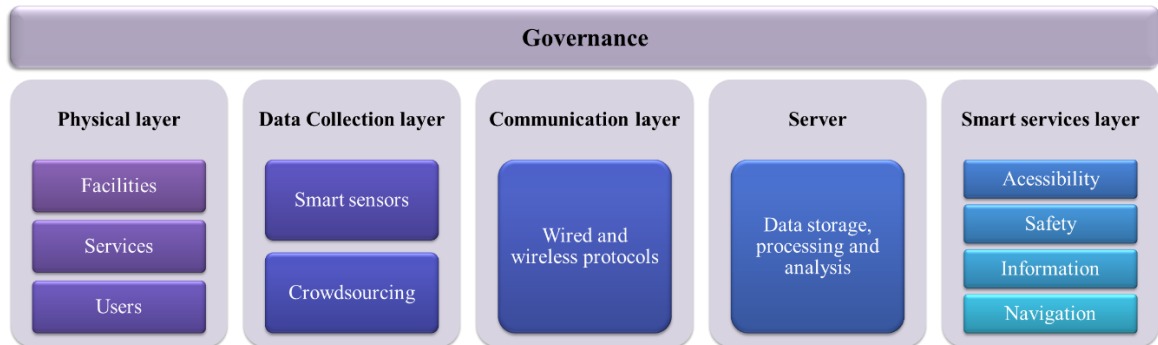


Figure 13. Layers of the Smart Public Space Framework. Source: (Shahrour and Xie, 2021).

In recent years, cities have increasingly focused on achieving smart city objectives rather than solely prioritizing sustainability goals (Marsal-Llacuna et al., 2015). However, these concepts are interconnected, and smart cities often align with the goals sustainable cities. Despite this overlap, the relationship between smart and sustainable city concepts is not always clearly defined in the wide array of smart city definitions (Albino et al., 2015). This underscores the need for a deeper understanding of how these concepts complement each other (D'Auria et al., 2018). To achieve sustainability, cities must adopt smart solutions supported by smart technology, which require the implementation of "smart city initiatives" within communities (Albino et al., 2015). Smart cities leverage technologies such as the Internet of Things (IoT), artificial intelligence (AI), sensors, and data analytics to collect and analyse real-time data. This data-driven approach enables efficient urban management and decision-making (Ullah et al., 2023).

In theory, smart urban public spaces incorporate smart city initiatives to enhance their operation and maintenance by utilizing Information and ICTs and real-time data analysis

(Filipponi et al., 2010). This approach enables a deeper understanding of user demographics, assesses user needs, ensure efficient physical infrastructure, fosters social integration, and promotes equitable access to amenities. These efforts aim to improve the QoL while delivering economic and environmental benefits. Furthermore, the integration of technology has significantly reshaped the nature, purpose, and visibility of urban public space, redefining their role in the urban landscape (Capdevila and Zarlenga, 2015).

Smart parks integrate modern technologies to enhance energy efficiency, bolster urban resilience, and provide recreational benefits, setting them from traditional parks through implementation of smart, green, and integrated infrastructure systems (Abdelaziz et al., 2024). Leveraging social media data and deep learning, these parks can monitor management effectiveness and visitor satisfaction in real-time, enabling adaptive and responsive operations (S. Liu et al., 2024). According to Turna and Bhandari (2023), smart parks enhance urban green spaces by improving maintenance, accessibility, and user experience, thereby contributing to sustainable urban development, and improving residents' QoL. Similarly, J. Zhang et al. (2023) highlight how smart parks utilize advanced technologies, such as 5G and IoT, for efficient data sharing and management, fostering interactivity and addressing design and expansion challenges through integrated platforms.

Being in a smart, sustainable urban space ensures access to well-maintained open spaces, smart landscaping, and a healthy, environmentally friendly atmosphere (Construction agency, 2006). Such spaces reflect the city's focus on "smart people and smart living," where local inhabitants play a pivotal role in implementing initiatives and proposals for urban growth. Community involvement is critical to the success of creative approaches,

and while addressing the needs of various social categories may be challenging, it is essential for equitable development (Seresinhe et al., 2015).

Smart urban environments provide viable options for long-term sustainability with a people-centric approach, enhancing the QoL, supporting businesses, and strengthening communities. Additionally, organizations increasingly recognize the potential of smart spaces to accelerate their sustainability objectives (Gilman and Riekk, 2012).

Open spaces in cities can be transformed into vibrant, innovative hubs for interaction through active community engagement, serving diverse purposes. Smart, sustainable urban areas are essential for various reasons (Radwan et al., 2018):

- Enhancing human wellness
- Fostering economic growth
- Revitalizing underutilized areas
- Improving public utilities
- Reducing crime rates
- Minimizing environmental impacts

Inhabitants, as the primary users of open spaces, should play an active role in their governance. These spaces can also provide visitors with access to informative data on their surroundings, layout, amenities, services, and sociological atmosphere. Modern technologies should continuously monitor such environments to improve visitor services, focusing on aspects like “accessibility, safety, navigation, access to tap water, public restrooms, seating, shaded areas, and green, humid spaces.” Particular attention should be given to supporting individuals with disabilities to ensure inclusivity. These spaces must

adopt environmentally friendly practices using innovative technologies, such as: technologies for water-efficient water supply, energy from renewable sources, smart public lighting, and biodiversity monitoring and conservation (Itair et al., 2023).

Figures 14, 15 and 16 below present case studies showcasing the development of urban open spaces using smart development approach.



Figure 14. Smart and Sustainable Design Elements Employed in San Francisco's Open Spaces.
Source: (SFCOIT, 2022).



Figure 15. The Riverfront Park Design Combines Various Smart and Sustainable Design Elements.

Source: (El Barmelgy and El Khateb, 2020; US Environmental Protection Agency, 2015).



Figure 16. Smart and Environmentally Friendly Design Techniques Employed in the Old Fourth Ward Park Development.

Source: (El Barmelgy and El Khateb, 2020; US Environmental Protection Agency, 2015).

2.7. The Role of Public Open Spaces in Saudi Arabia's Urban

Development and Vision 2030

Parks in Saudi Arabia hold significance beyond their recreational purpose; they serve as cultural sites that reflect the nation's social fabric and traditions. These parks are thoughtfully designed to accommodate family gatherings, ensure gender separation, and guarantee privacy, aligning with societal norms and values that profoundly influence public life (Imam et al., 2023). Recently, urban planning in Saudi Arabia has been largely undervalued, with its necessity and legitimacy often questioned. This oversight has led to growing concerns among architects and urban planners about its repercussions. They contend that the lack of clear parameters for spatial health and social minimums has resulted in significant urban challenges, such as the development of residential complexes devoid of essential amenities, including public transportation, schools, kindergartens, green spaces, and sports facilities (Addas, 2023; Al-Hathloul and Anis-Ur-Rahmaan, 1985; Al-Soliman, 1993). A study by Addas (2020), identifies six factors for designing POS, as illustrated in **Figure 17**. These factors include “Accessibility, Activities and programming, Aesthetic quality, and Amenity” with associated sub-factors such as “Continuity, Parking, Special needs, barrier-free, Age and gender, Activities, events, site image, site furniture, public art, vendors, soft/hardscape, lighting, pedestrian, night use, and not isolated.” The study highlights a significant knowledge gap in effective techniques and methodologies for the design, planning, maintenance, and operation of POS in urban environments in Saudi Arabia. This shortfall impedes the development of accessible, well-connected, and user-friendly communal spaces in cities.

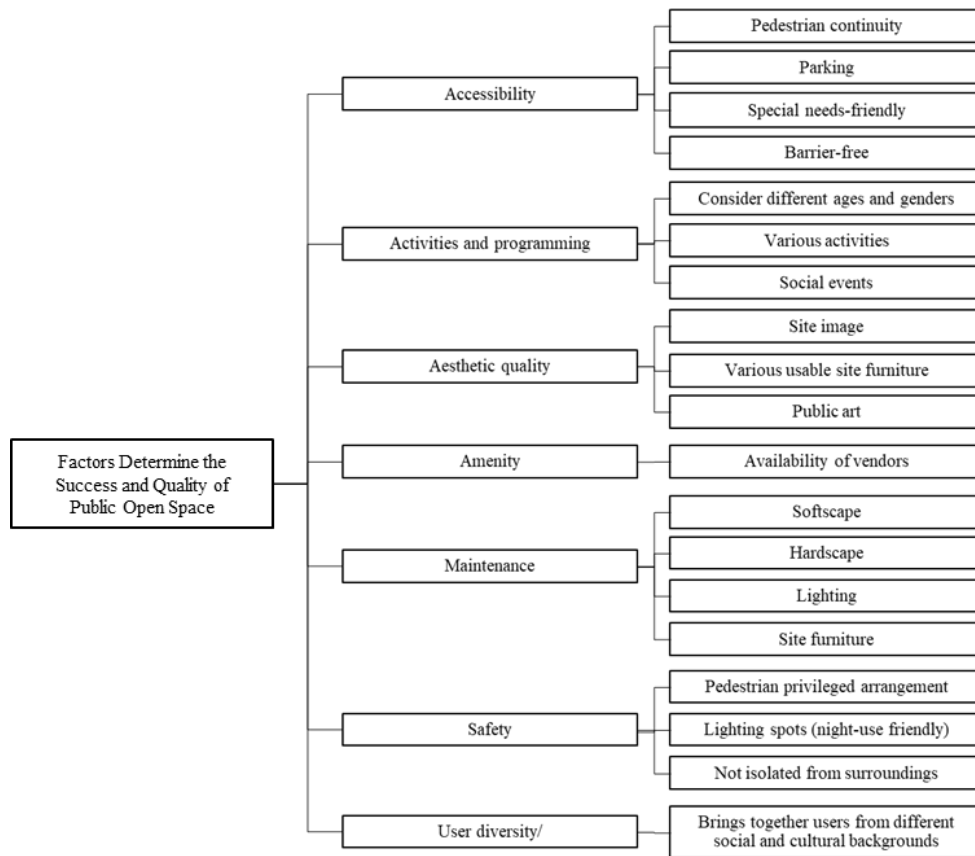


Figure 17. Factors Defining the Success and Quality of Public Open Spaces. Source: (Addas, 2020).

The lack of a systematic approach in designing and managing POS in the country can be attributed to a fundamental misunderstanding of urban planning and landscape architecture. This results in non-specialists being responsible for the design and management of these crucial spaces. Furthermore, the absence of early integration of open space planning within the city's development master plan, combined with the historical fragmentation of responsibilities due to the lack of a robust institutional framework, exacerbate the issue (Addas, 2019; Mandeli, 2010).

Quantitative research conducted by Addas and Alserayhi (2020) indicates that a significant portion, 24%, of proposed open spaces in Jeddah city has remained unrealized due to financial challenges related to design, operation, and upkeep. Engaging in partnerships

with the private sector could alleviate the financial burden on both the ministry and the municipalities, ensuring the successful implementation of these vital spaces.

Maniruzzaman et al. (2021) investigate residents' satisfaction with various features of urban parks in Dammam. As illustrated in **Figure 18**, the study evaluates attributes such as park amenities, aesthetics, convenience, and safety. The findings reveal differing levels of satisfaction among residents based on these attributes, with maintenance and safety being particularly crucial for enhancing user experience. The analysis underscores the importance of incorporating resident feedback into park design and management to improve satisfaction and promote greater use of urban parks.

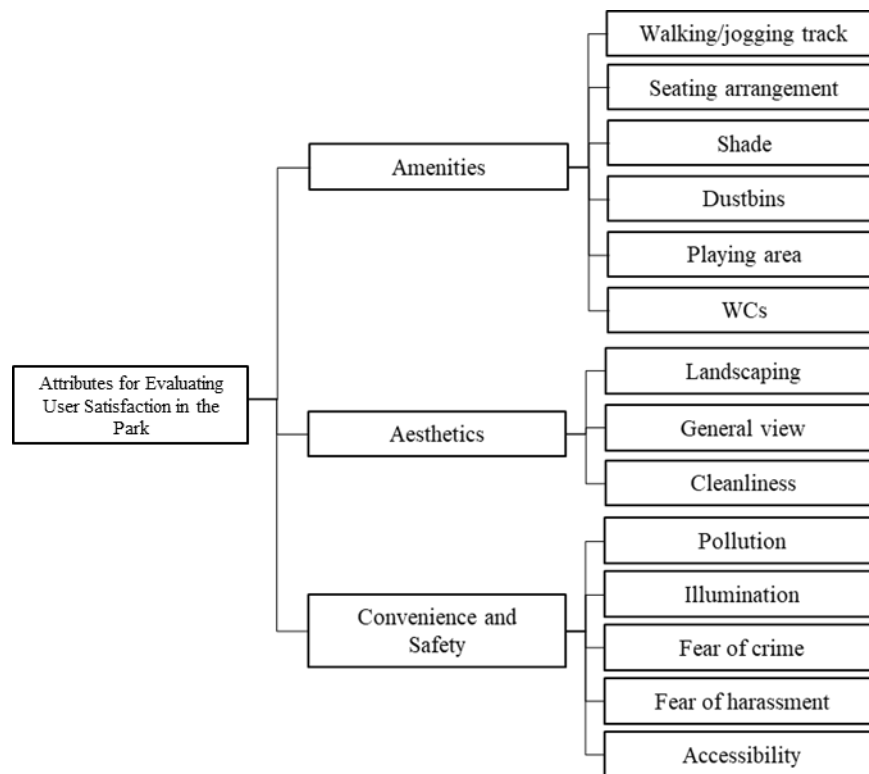


Figure 18. Attributes for Evaluating User Satisfaction in the Park. Source: (Maniruzzaman et al., 2021).

Mashary Alnaim and Noaime (2023) examine how parks in Hail are influenced by cultural shifts and user perceptions. The assessment attributes of the parks include “amenity,

accessible and linkage, safety, attractiveness and appeal, activity and uses and comfort of outdoor space,” highlighting how they cater to the evolving needs of the community. The study reveals that as cultural norms change, user expectations for public spaces also shift, leading to increased demand for areas that promote social interaction and inclusivity. The findings suggest that effective public space design must consider these cultural dynamics to enhance user satisfaction and engagement.

Alamasi et al. (2024) evaluated user satisfaction in Wadi Hanifa Park based on seven domains, as illustrated in **Figure 19**. The study recommended that integrating smart technologies could improve both operational efficiency and user experience in urban parks. This integration may include digital signage, smart outdoor fitness equipment, and advanced maintenance technologies. Based on the analysis of Wadi Hanifa Park, policymakers are urged to develop similar parks throughout Saudi Arabia to address the challenges posed by extreme weather while maximizing the benefits of natural amenities in urban settings.

Additionally, the study emphasized the importance of implementing native plant species and green infrastructure strategies. It also highlighted the need to create national design guidelines for public park development to assist urban designers and policymakers in establishing public spaces that adhere to best practices in urban sustainability. Furthermore, the study suggests developing a national evaluation framework for these parks, considering the specific environmental and social contexts of Saudi Arabia. This framework would facilitate consistent assessments of park quality, ultimately improving user experience and satisfaction. The study recommends conducting further field studies to determine design priorities for upgrading existing parks in various regions of Saudi Arabia.

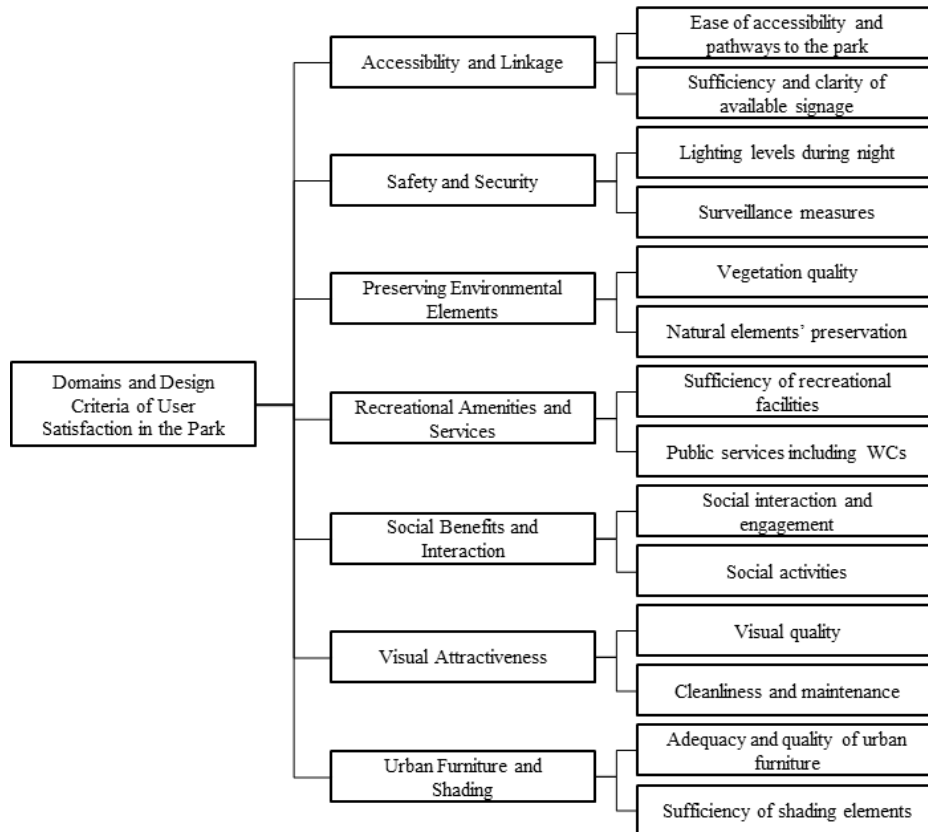


Figure 19. Domains and Design Criteria of User Satisfaction in the Park. Source: (Alamasi et al., 2024).

Ministry of Municipal and Rural Affairs and Housing (MOMRA) is responsible for providing point-of-sale systems in Saudi cities. It regulates, recommends, and oversees the local authorities (Amanah) in every major city. Under MOMRA's requirements, POS must be integrated into the planning phase for the housing development, which might include "roads, walkways, plazas, playgrounds, gardens, and parking areas." POS should occupy no more than "33%" of the overall space. "Playgrounds for every 20 residential blocks" must be at least "400 square meters" in size. Furthermore, at the neighbourhood level, POS with of at least "5000 square meters" is required to provide "5 square meters per capita for inhabitants." It is critical to note that these regulations lack sufficient details regarding quality and design. Furthermore, MOMRA does not have an established plan for creating and maintaining city-level parks (Addas and Maghrabi, 2020).

Saudi Vision, established in 2016, aims to improve citizens' QoL and meet their needs while preserving the environment and natural resources (Unified National Platform, 2023). It establishes defined goals for transforming Saudi Arabia over the next 12 years. The Kingdom of Saudi Arabia has a clear vision for the future, and Saudi cities playing a key in achieving the government's objective of creating a smart Saudi Arabia by 2030 (Saudi's vision 2030, 2016). Furthermore, the Saudi government has recently developed and implemented a long-term development plan focused on building a knowledge-based society and targeting a substantial percentage of the economy through knowledge-driven technological innovation (Aldusari, 2015).

Vision 2030, also known as the National Transformation Program (NTP), includes the Quality-of-Life Program, which was initiated in 2018. This program aims to promote healthy living and foster vibrant urban environments throughout the Kingdom. Within the urban design domain, the initiative emphasizes the importance of enhancing the management of POS and sets a target to increase public space per capita from “3.48 m² to 4.65 m²” by 2023 (Saudi Vision 2030, 2024). This expansion of open space coverage presents a significant challenge for MOMRA due to existing planning and management practices related to public open spaces (Addas and Alserayhi, 2020; Mandeli, 2010).

Despite the historical challenges in increasing public open spaces per capita since the inception of the NTP and Vision 2030, MOMRA and municipalities in major Saudi cities are actively working towards this objective. Furthermore, community involvement in policymaking is minimal, although the NTP aims to enhance citizen engagement in the civic sphere. MOMRA's initiatives involve reassessing the regulations and policies governing the provision. Similarly, projects such as the Green Riyadh initiative aim to

increase public open spaces per capita in Riyadh and improve overall QoL (Addas, 2020; Addas, 2019).

The second theme of the National Transformation Program (Improve Living Standards and Safety) aims to elevate Saudi cities into smart cities with high-quality services and infrastructure, including public spaces, green areas, and sidewalks. This theme also strives to achieve a healthy and safe environment by enhancing traffic safety and reducing pollution.” Additionally, the program seeks to apply the concepts of smart cities, which aim to transform Saudi cities to smart cities, enhancing management efficiency and improving QoL (National Transformation Program, 2018). Furthermore, the Innovation Laboratory of MOMRA proposed that a smart city relies on six elements, each with its own initiatives and objectives. This study contributes to the smart living dimension, which has eight objectives, with “smart parks” is one of them (Saudi MOMRA, 2017).

Saudi Arabia has a clear goal and the necessary means to invest in technology and scientific fields while directing its resources towards investing in individuals rather than infrastructures (Doheim et al., 2019). **Figure 20** below depicts the components of vision 2030 associated with smart cities.

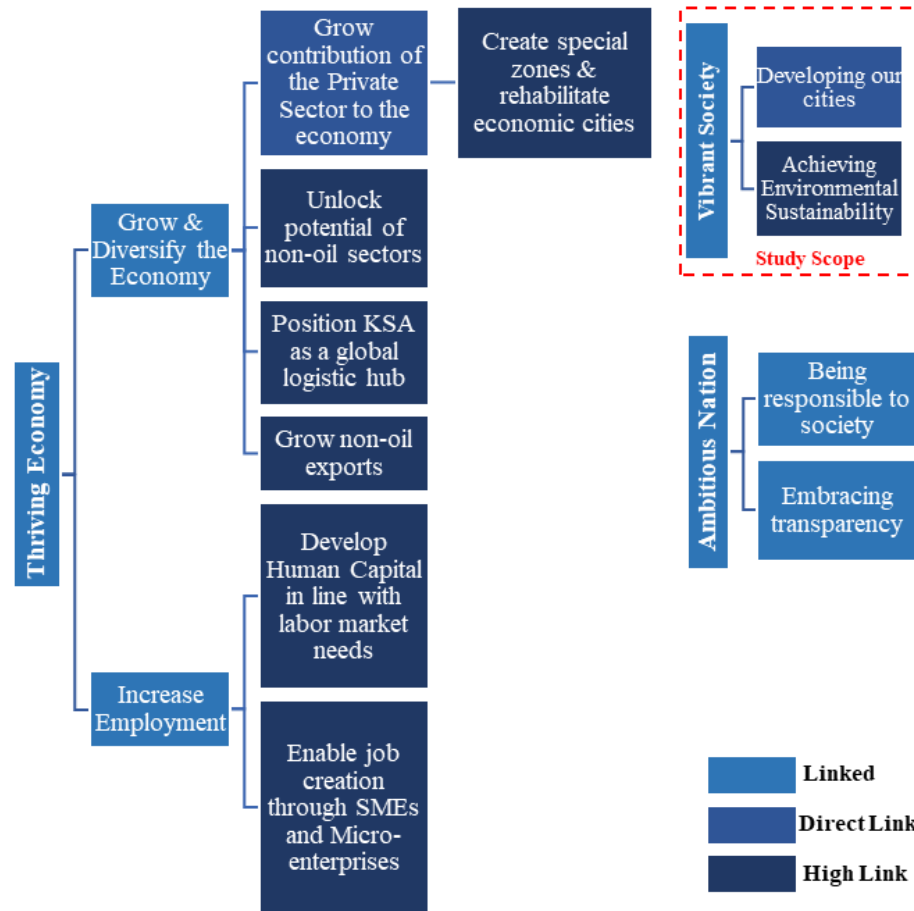


Figure 20. Linkage Between Vision 2030 Components and Smart Cities.
Source: (Saudi MOMRA, 2017; Saudi's vision 2030, 2016; VRP, 2024).

In accordance with the Saudi Vision 2030 and National Transformation Program 2020 goals, MOMRA announced it is "application of smart city concepts" initiative. This initiative seeks to enhance the competitiveness of Saudi cities, promote urban sustainable growth, improve residents' satisfaction, optimize urban governance, reduce adverse environmental impacts, attract regional and global investment, and provide more employment opportunities (Al-Hindi, 2017).

Saudi Arabia defines a Smart City based on the dimensions and approaches of global standards, such as those outlined by "European Parliament" (European Parliament, Smart Cities Council, City Protocol Society, "Smart Cities Readiness Guide", NXN analysis).

These standards align with Smart City activities defined by MOMRA and national priorities (Saudi MOMRA, 2017). A smart city is characterized by seven dimensions: "(1) regional and global competitiveness; (2) QoL (3) citizen participation in city governance; (4) human and social capital; (5) natural resources; (6) transportation and mobility; and the (7) Smart Enablers layer, which includes ICT" (European Parliament, 2014; European Parliamentary Research Service, 2023; Saudi MOMRA, 2017). Furthermore, within each dimension, the Innovational Laboratory proposed specific activities, as shown in **Figure 21** below. However, within each proposed activity, there are outlined as proposed in **Figure 22**. In the realm of Smart Living dimension, a framework of Smart Parks initiative, which is the focal point of our study, is proposed and presented in **Figure 23**, along with a database of initiative benchmarking, developed and presented in **Figure 24**.

Saudi Vision's first track, "Vibrant Society," aims to promote happiness and well-being among its residents, ensuring an optimal standard of living for all. Developing a balanced and healthy lifestyle is crucial for achieving the highest QoL (United Nation, 2018). The new living environment will offer greater opportunities for regular physical activity, which were previously limited. Another key objective of enhancing the standard of life is to create an appealing environment for residents, which can be achieved by providing high-quality utilities such as energy, water, public transportation, and roadways, as well as open spaces and landscaping for leisure purposes (Saudi Vision 2030, 2024).

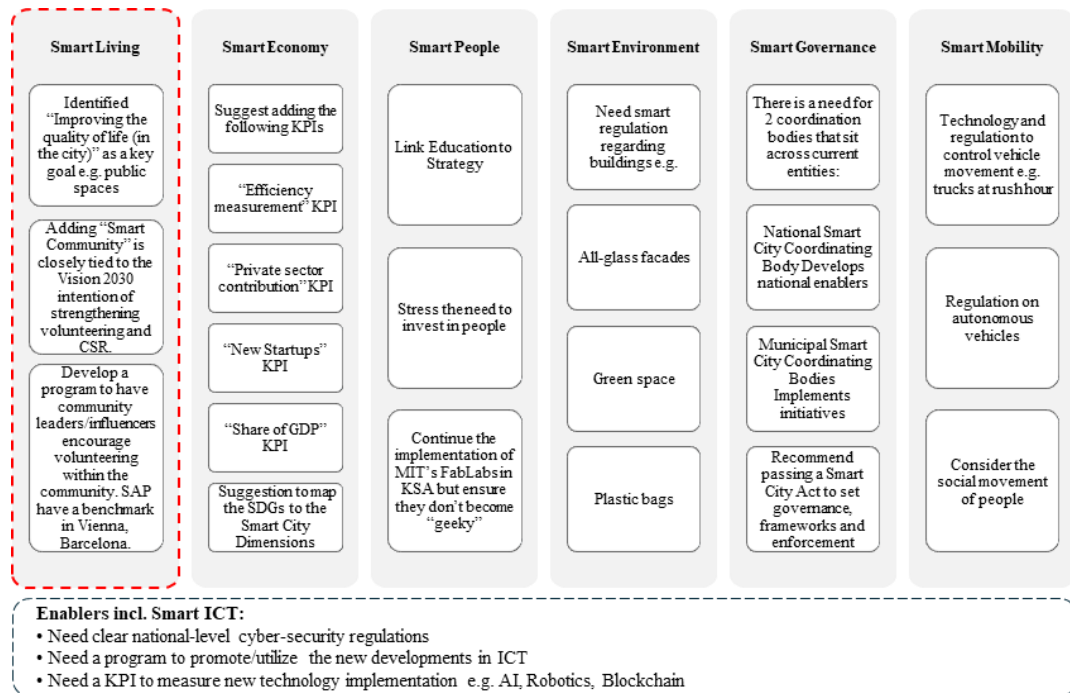


Figure 21. Dimensions and Activities of Smart City Initiatives in Saudi Arabia.
Source: (MOMRA, 2017; MOMRA, 2023).

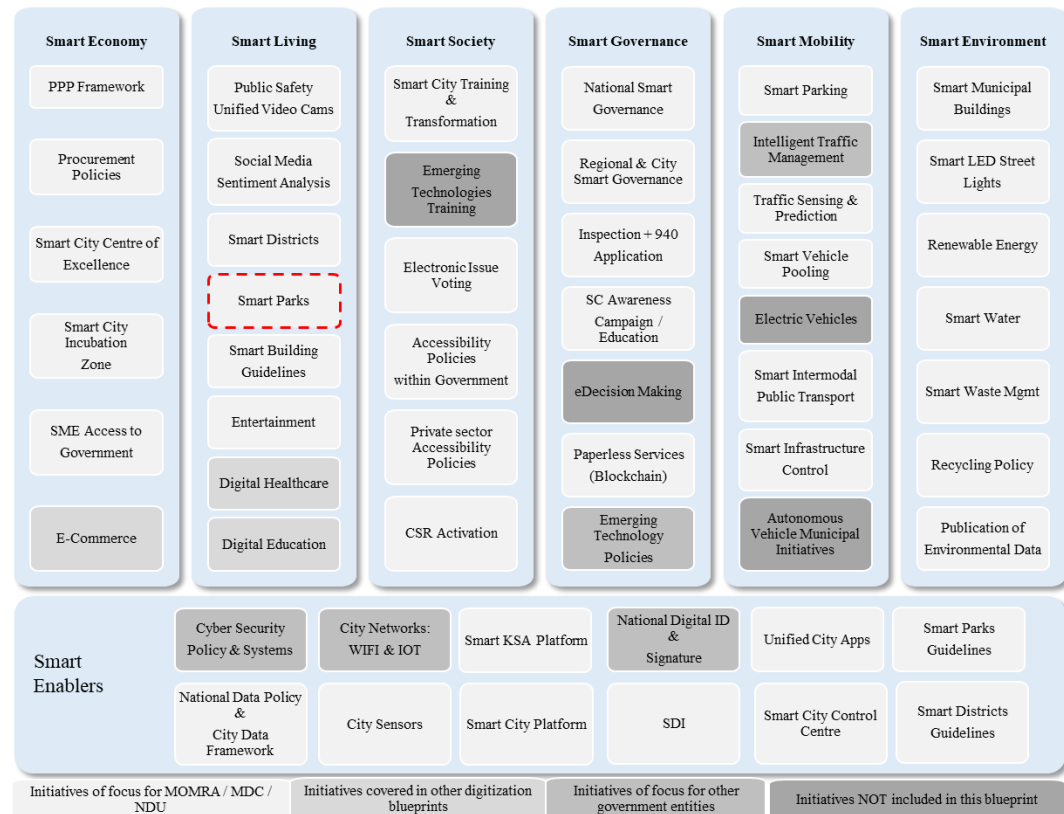


Figure 22. Innovative Laboratory Proposed Particular Initiatives. Source: (European Parliamentary Research Service, 2023; Saudi MOMRA, 2017; SMART CITIES COUNCIL, 2014).

Smart Park	Municipal Initiative
Objective	Open Spaces with technology, safety and entertainment services
Goal	Public Spaces providing education and entertainment
Description	- Urban redevelopment is an economic engine and a reform mechanism for city-initiated development projects. They contribute to the city's social and economic fabric through sustainable development, efficient public services, and advanced ICT infrastructure. - Part of the initiative development would include an examination of the current implementations, and the lessons learnt, and then designing the services and associated technologies that a Smart Park should support along with a set of guidelines for implementing Smart Parks allowing the different cities an easier and more assured path towards implementing Smart Parks.
Dimension	- Smart Living (the Parks) - Enablers (the Guidelines)
Challenges	- Enablers - ICT Infrastructure
Impact	- Savings - Job opportunities
Related KPIs	Population satisfaction index

Figure 23. Framework of Smart Park. Source: (Saudi MOMRA, 2017).

Public Spaces External infrastructure that continues the fluid Smart City experience in public or exterior places	
Areas of Focus	Initiatives
Smart Municipal Furniture enhances sensing and provides inputs to Smart Services	Public interactive information signage
	Smart Kiosks, benches
	Smart Street signs
	Mobile Community and Tourist information
Digital Signage enables two way communication between government and residents	Interactive mobile applications for residents, tourists and MICE
	Ubiquitous Wifi
	RFID Ticketing
Smart Parks and Recreation Facilities provide relaxation and education opportunities enhanced by ICT	Smart Park Dynamic Applications for Public Discovery, Ticketing, Mapping
	Child ID and tagging
	Augmented reality applications to increase resident/visitor information

Figure 24. Benchmarking Database Initiatives.
Source: (Saudi MOMRA, 2017; SMART CITIES COUNCIL, 2014).

The concept of smart city has its roots in the Saudi literature, particularly in e-government studies. Since 2008, numerous publications on e-government have been considered the first attempt to introduce digital tools and smart approaches in Saudi cities (Aldegheishem, 2023). In 2014, the concept of smart cities began to emerge in Saudi literature, with a focus primarily on smart development (Komninos, 2014). These studies emphasized the lack of urban smartness in improving economic factors such as tourism (Amoudy, 2014), industry (Arain and Azhar, 2014), corporate initiatives, and economic efforts to minimize energy use (Alaidroos and Krarti, 2015; Shiraishi and Yabe, 2014).

According to Royal Commission for Riyadh (2024a), green Riyadh initiative represents one of the most significant urban greening projects worldwide. In 2019, King Salman Bin Abdulaziz announced one of Riyadh's four mega-projects. The initiative is expected to be a major step toward achieving a key goal of the Saudi Vision 2030: promoting Riyadh's status among the globe's top "100 most livable cities" The project will contribute to increase both the amount of green space available to individuals and the overall green coverage in the city by planting trees across urban landmarks and services, and throughout the provinces. All greening efforts will be irrigated using reclaimed water from a drainage system. The greening program is expected to improve air quality and reduced temperatures across the district. As a result, this initiative will encourage Riyadh residents to adopt healthier habits, in line with the goals of Vision 2030. **Figure 25** below presents the project's key elements, and **Figure 26** shows the developed plan of open spaces in Riyadh's parks and gardens, which aims to develop 3330 neighbourhoods park and 43 public parks.

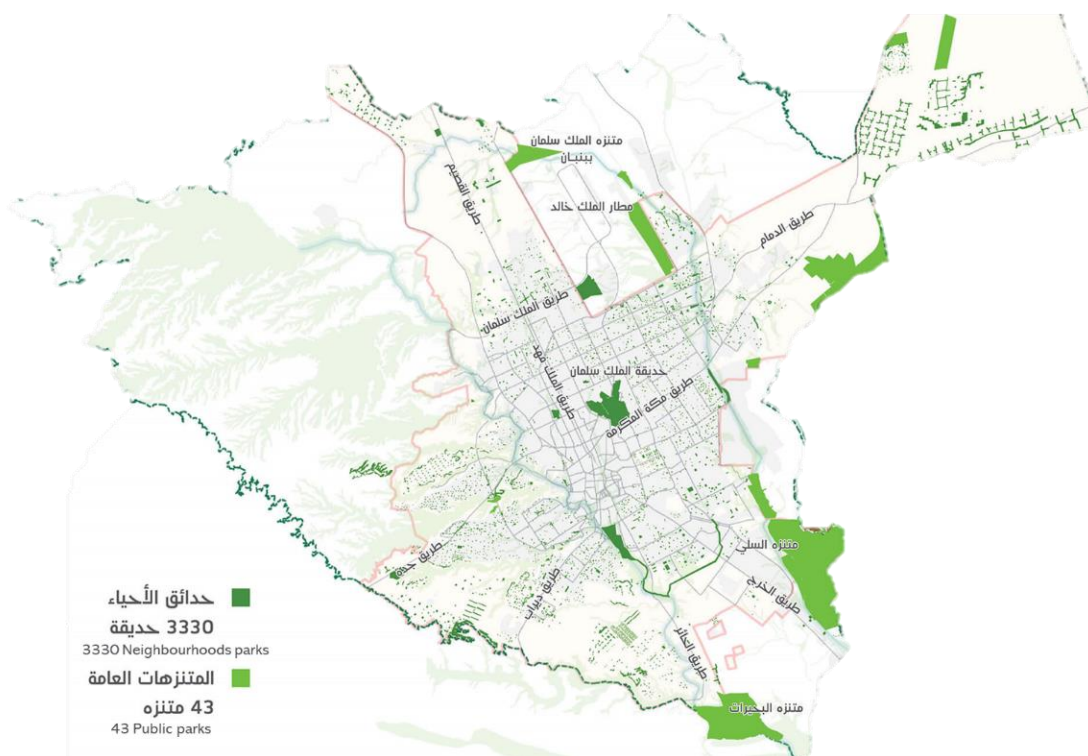
Planting 7.5 million trees across the capital as follow:

- 3.330 neighbourhood gardens
- 43 parks
- 9.000 mosque
- 6.000 schools
- 2.000 car parking sites
- 1.670 public facilities
- 390 healthcare facilities
- 64 universities and collages
- 16.400 kms of streets and roads
- 1.100 kms green belts along utilities lines
- 272 kms valleys
- 175.000 square kms of empty lands

- About 72 native shade plant species compatible with Riyadh's environment will be used for the project.

- A new water treatment network for irrigation with daily capacity of 1.000.000 m³
- A network of plant nurseries to provide the required seedlings and trees.
- Improved urban regulations to enhance afforestation in both public and private projects.
- Awareness initiatives to encourage voluntary engagement .

Source: (Royal Commission for Riyadh, 2024a).



Source: (Royal Commission for Riyadh, 2024a).

Figure 27 illustrates King Salman National Park, one of Riyadh's four major projects launched in 2019 by King Salman bin Abdulaziz. The Park aims to offer a variety of activities, ranging from social and cultural to creative and leisure alternatives. It also features an Islamic-style landscape, vertical gardens, a maze garden, and a bird and butterfly sanctuary, catering to both Riyadh's residents and tourists. This initiative contributes to enhancing city's QoL in alignment with Saudi Vision 2030's objectives of fostering a "vibrant and healthy society" and elevating Riyadh's international reputation (Royal Commission for Riyadh, 2024b; Saudi Vision 2030, 2023b).



Figure 27. Master Plan of King Salman Park in Riyadh. Source: (Omrania, 2024).

The project objectives are presented in **Figure 28** below. The development plan for King Salman Park envisions future multi-use developments surrounding the central public open spaces, creating a vibrant and sustainable urban neighbourhood aligns with the objectives of Saudi Vision 2030. This initiative is one of numerous ambitious, multibillion-dollar

projects launched by the Saudi authorities to transform Riyadh into a more liveable and globally appealing urban center (Omrana, 2024).

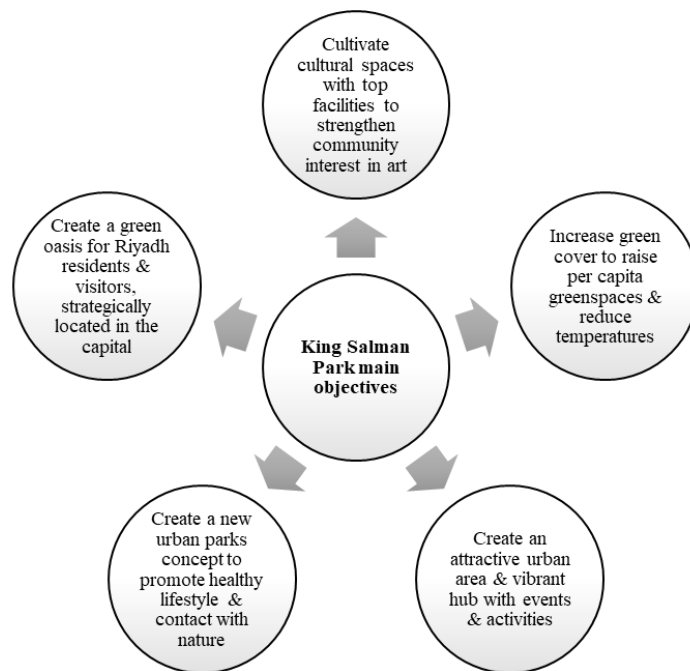


Figure 28. Main Objectives of King Salman Park. Source: (Saudi Vision 2030, 2023b).

Local initiatives have been undertaken to preserve native plants as a part of the country's vision 2030 goals. According to National Transformation Program (2021), the objective of "2.4.3 Protect and rehabilitate natural landscapes" falls under the theme of "Ensure Sustainability of Vital Resources." Vision 2030 aims to transform urban areas and improve QoL by implementing sustainable urban landscaping, providing abundant greenery, and creating opportunities for interaction with the natural environment. By adopting an environmentally conscious and innovative strategy to address current climate and energy challenges, Vision 2030 positions Saudi Arabia as an international model for sustainable development (Saudi Vision 2030, 2023a). The Saudi Green Initiative (SGI), launched in 2021, is a vibrant local project aimed at mitigating climate change, enhancing QoL, and preserving natural resources for future generations. **Figure 29** below illustrates its main

objectives (Saudi Vision 2030, 2023c). Additionally, the Ministry of Environment Water and Agriculture (MEWA) has developed an index of essential native plants suitable for planting in "gardens, streets, courtyards, open spaces, and city entrances" (MEWA, 2022).

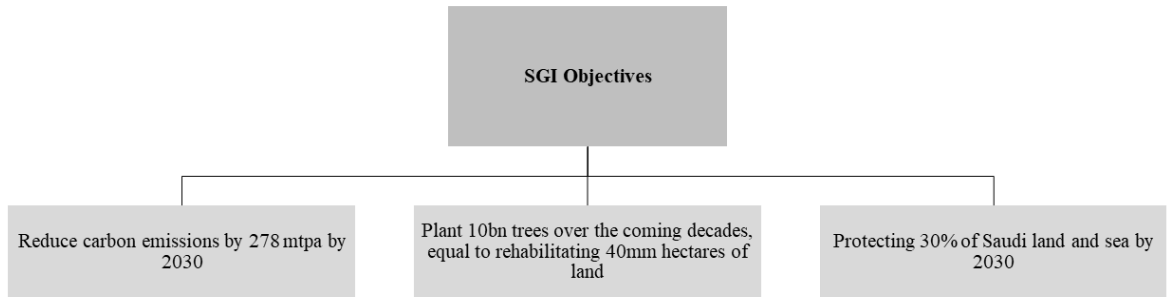


Figure 29. Objectives of the Saudi Green Initiative. Source: (Saudi Vision 2030, 2023c).

2.8. Chapter Summary: Development of the Conceptual Framework for Designing Sustainable Public Open Spaces

The proposed framework integrates sustainable principles, landscape design elements, design conditions, and smart technologies to establish a comprehensive approach to urban development. This framework is rooted in the Saudi Arabian Smart Living dimension, as illustrated in **Figures 21** and **22**, which provide the foundational basis. At its core, the framework incorporates a QoL layer that prioritizes sustainable design principles to improve environmental, economic, and socio-cultural conditions.

The QoL layer of the framework prioritizes environmental factors by incorporating sustainable design principles that address key considerations such as microclimatic amelioration, ensuring more comfortable local climates, and the provision of ecosystem services to support biodiversity and natural processes. Beyond environmental priorities, the framework integrates essential economic factors, such as growth potential and cost-

effectiveness, helping to ensure that urban development is both economically viable and scalable. Socio-cultural considerations emphasize social success, inclusivity, and the promotion of active community involvement, ensuring that development aligns with the needs of people. These principles are derived from the detailed sustainable design framework outlined in **Figure 10**. Furthermore, the sustainable principles layer within the framework includes the extraction of 13 landscape design elements and 13 design conditions. These elements and conditions are based on the frameworks depicted in **Figure 11 and 12**.

The second layer of the framework emphasizes smart enablers, specifically the “Smart Park Guidelines,” which outline targeted areas of focus and initiatives for urban parks and public spaces. These guidelines are derived from the Saudi local Smart Living dimension framework, serving as an initial foundation for the Smart Parks initiative, as illustrated in **Figure 22**. Additionally, the smart enabler layer integrates a benchmarking initiative, detailed in **Figure 24**, which offers a reference for comparative analysis and performance tracking.

By synthesizing elements from various frameworks, depicted in **Figure 10, 11, 12, 17, 18, 19, 21, 22, 23 and 24**, a comprehensive localized framework is proposed. This integrated framework, illustrated in **Figure 30**, combines sustainable design principles, landscape design elements and conditions, and smart technologies to establish a unified approach that maximizes the potential for sustainable urban open space development in Saudi Arabia.

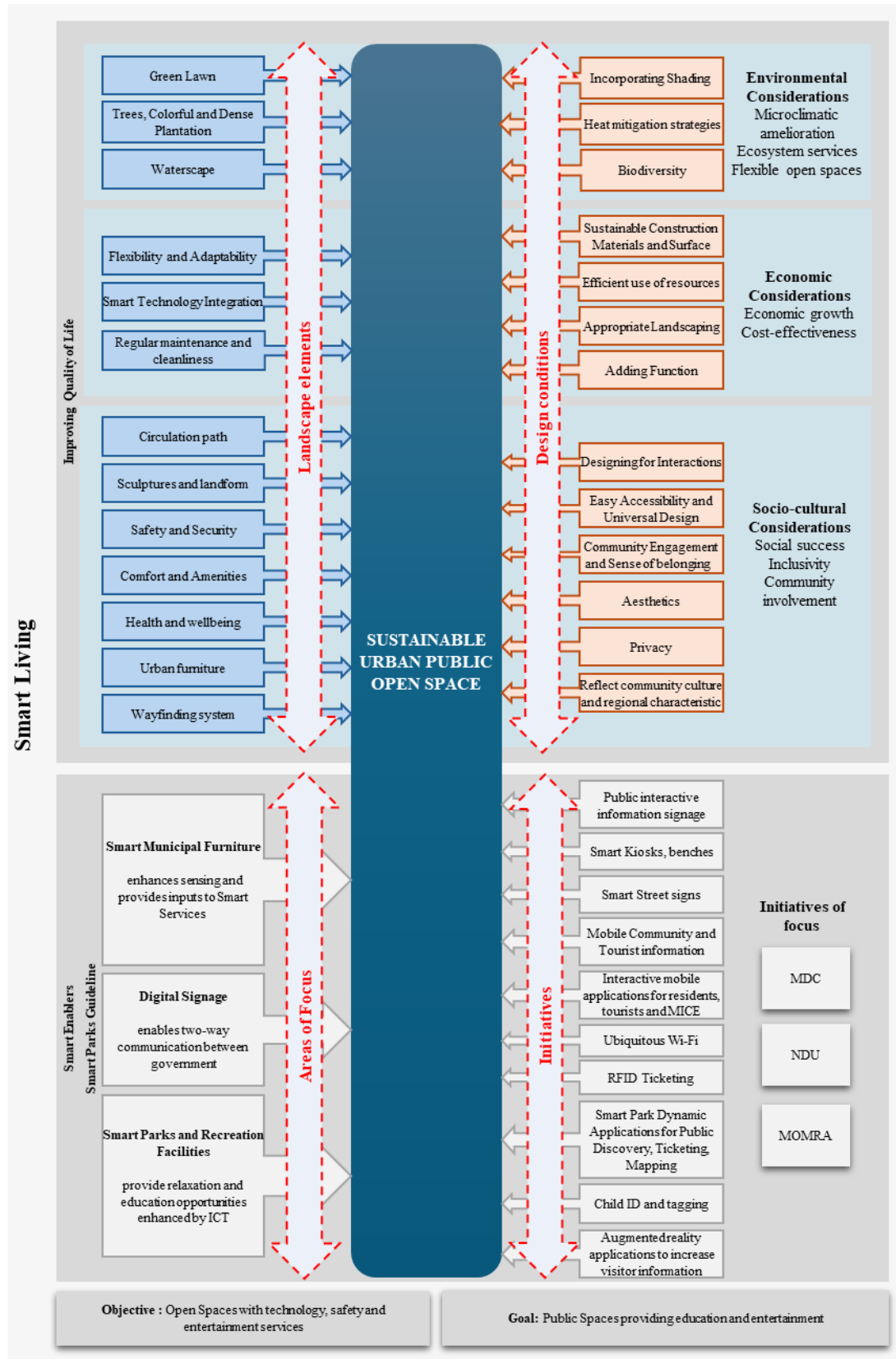


Figure 30. A Conceptual Framework for Designing Sustainable Urban Public Open Spaces.

CHAPTER 3

METHODOLOGY

3.1. Introduction

This chapter outlines the approach and techniques used to investigate the efforts toward developing a framework for designing sustainable urban community park in hot and arid environments, while aligning with the Saudi climate and culture. Moreover, it provides a detailed description of the research design, data collection methods, sample selection process, and data analysis procedures employed in this study.

3.2. Methodological framework

As illustrated in **Figure 31** below, a mixed-methods approach was adopted to achieve the objectives of this research, combining both qualitative and quantitative research methods. The qualitative methods included secondary data, case studies, and naturalistic observation. as well as conducting in-depth interviews with experts. The quantitative research methods involved surveys.

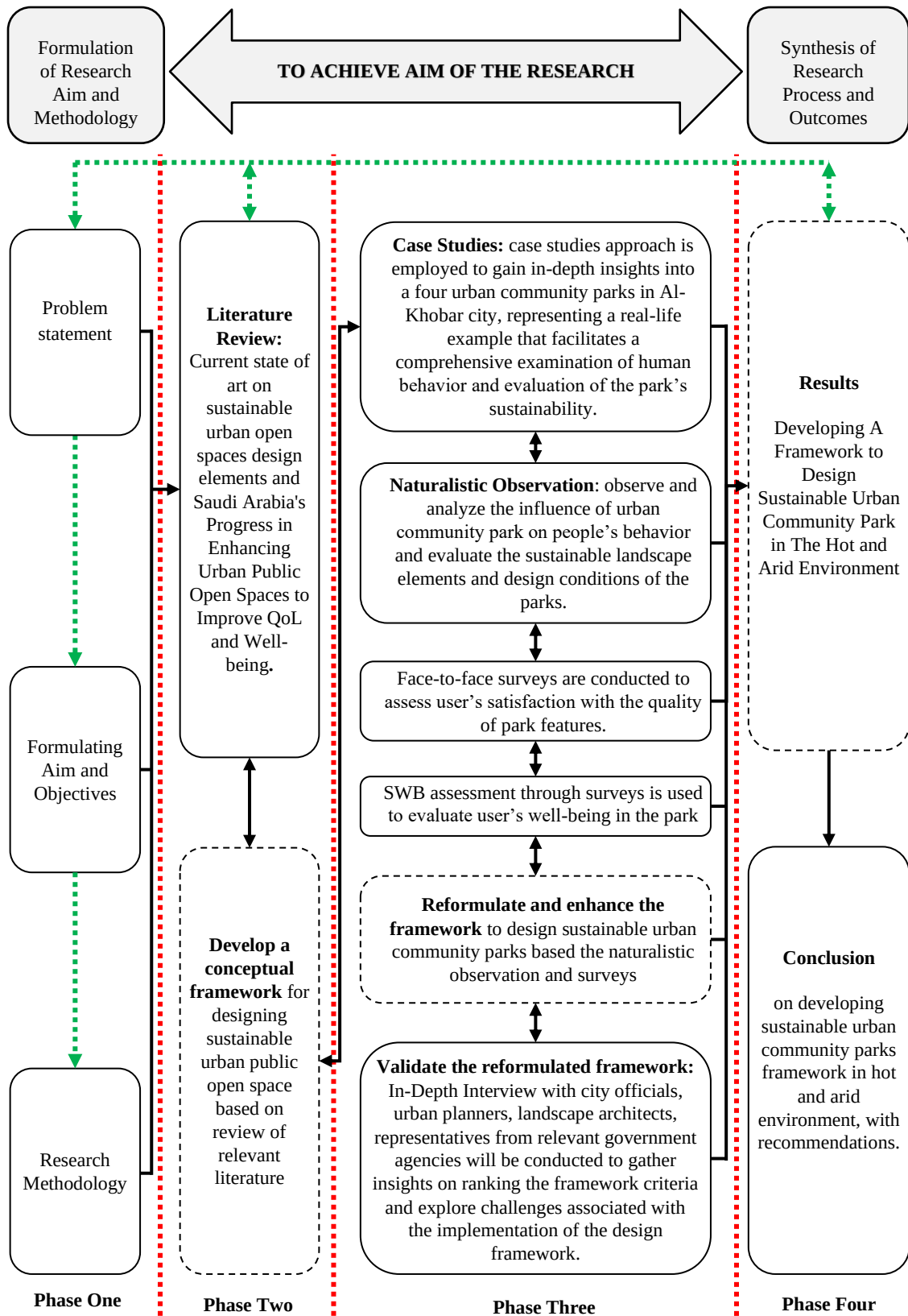


Figure 31. Methodological Framework.

3.2.1. Secondary Sources

The research utilized a combination of scientifically published research articles and governmental reports, for a comprehensive approach that draws from reliable and authoritative sources. Qualitative data collection focused on various key topics, including the concept, definitions, and typologies of POS, the importance and role of POS in urban areas, the key elements of sustainable design for urban public open spaces, the influence of sustainable public open spaces on human well-being, the integration of smart technologies in urban open spaces, and the current status of Saudi Arabia in designing sustainable urban open spaces.

This literature review aims to provide a solid foundation for understanding the challenges and opportunities, as well as identifying the research gap. By leveraging the wealth of existing knowledge, a framework was developed, as depicted in **Figure 32**, which served as a guideline in the analysis of the case studies. The analysis assessed the effectiveness of creating sustainable urban community parks in Al-Khobar, and their role in promoting the well-being and QoL for its residents.

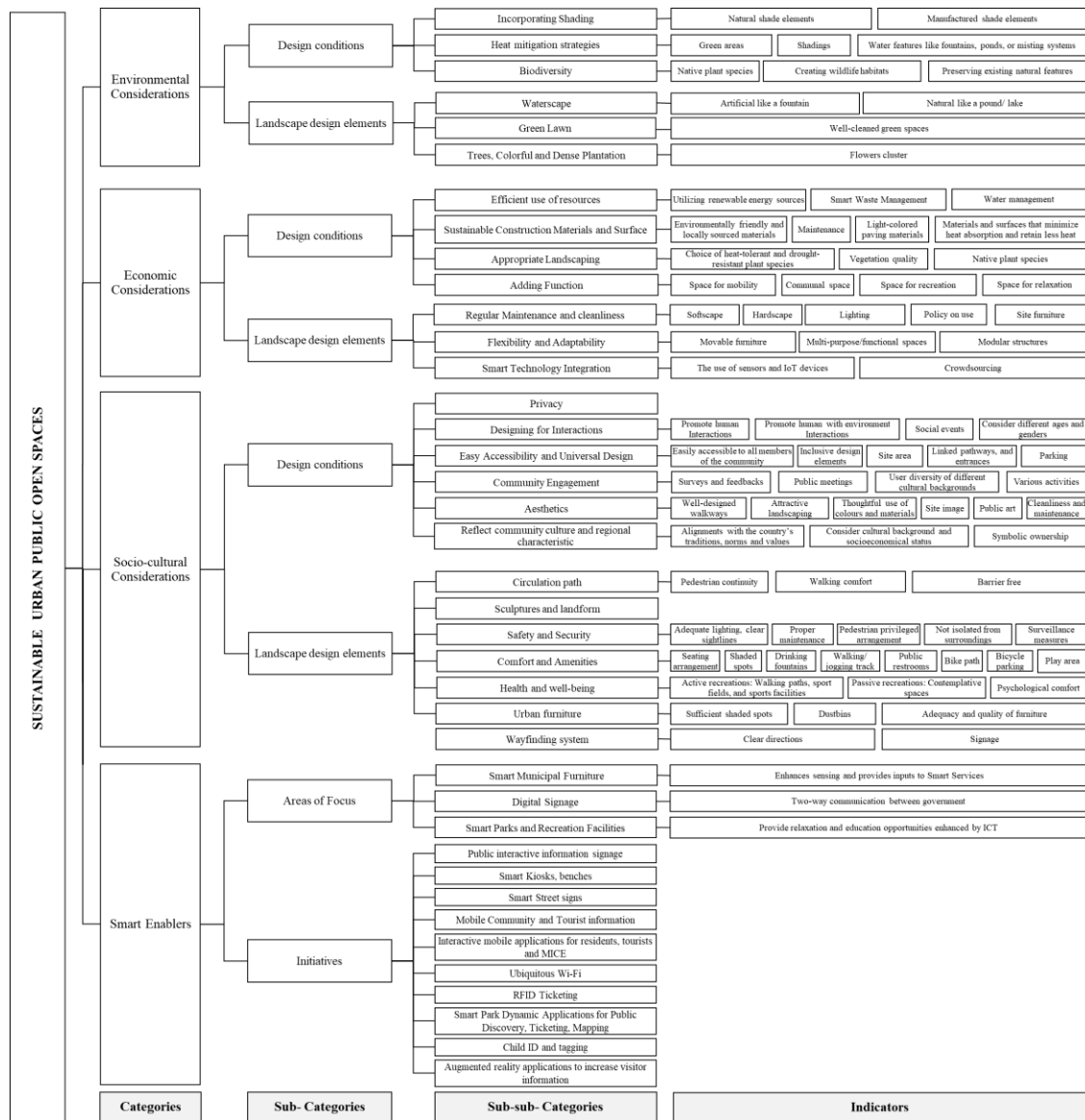


Figure 32. A Conceptual Framework for Designing Sustainable Urban Public Open Spaces. Extracted from the Literature.

3.2.2. Case Studies – Site Selection Criteria

A real-time case study approach employed to gather in-depth data about the current state of urban community parks in Al-Khobar. The case studies focused on a specific urban community parks and involved an examination of their design elements and conditions, as well as human behavior. Data was collected through a combination of naturalistic observation and surveys. Additionally, surveys were conducted with the park's users to

evaluate the sustainability of the parks' landscape elements and considerations. The collected data was analyzed using both qualitative and quantitative methods. Thematic and content analysis were employed on observation data to identify patterns and themes related to human behavior in the park. Statistical analysis of the SWB surveys and evaluations were performed to assess the impact of the park's design elements on users' well-being.

The study focuses on the neighborhood level of community parks, as illustrated in **Figure 33** below. This research adopted a comparative analysis of four urban community parks within Al-Khobar city, selected based on their establishment date. The selected community parks are located in Dhahran (Hills and Ithra Parks), Al-Olaya (Shells Park), and Al Khobar Al Shamaliah (Prince Ibn Jalawy Park).

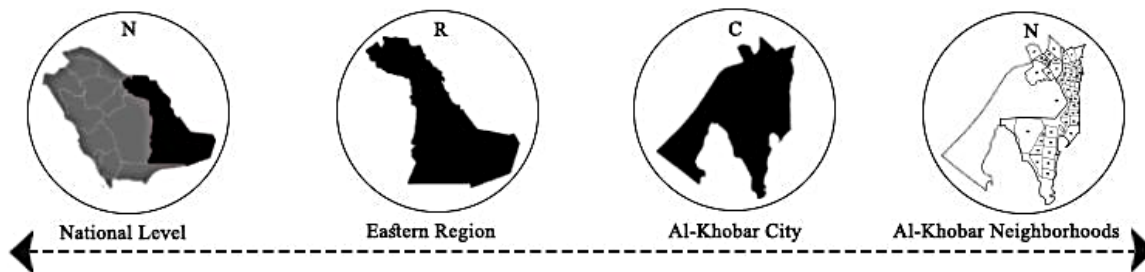


Figure 33. Scope of Case Studies.

3.2.3. Naturalistic Observation

Naturalistic observation is a research methodology used to systematically observe and document phenomena, actions and behaviors of individuals within an urban environment. This approach aims to capture a comprehensive understanding of human behavior, interactions, and patterns. Observations were conducted without any interference or manipulation, ensuring an unbiased representation of real-world activities. To facilitate data collection, several key aspects were prioritized. Firstly, the utilization of available

spaces was closely examined, with attention to how people navigate and use specific areas within the parks. Additionally, the duration of visits and the rate of visit frequency were recorded in real time. Furthermore, the framework developed from existing literature served as a basis for sites assessment and was further refined through the observational method. By identifying observable patterns related to park usage, the framework was enhanced and adjusted to better align with real-world practices.

To ensure a holistic understanding, the following aspects were documented, recorded, and analyzed:

1. **Record visits durations and frequencies:** The duration of time individuals spend in the park and the frequency of their visits were recorded. This data provided valuable insights into the patterns of park usage.
2. **Document and Observe activities, interactions, patterns, and movement:** Various activities, interactions among individuals, observable patterns, and movement within the park were documented. These observations aimed to uncover the diverse range of behaviours and social dynamics present in the urban park setting.
3. **Evaluate design conditions and landscape elements:** The design conditions and landscape elements of the selected community parks were evaluated based on the conceptual framework derived from the literature.

The data were analysed using thematic and content analysis. Thematic analysis involved identifying and coding patterns and themes within the data to gain a deeper understanding of behaviors and social dynamics in the urban park setting. Content analysis focused on

examining the data to identify any gaps or areas for improvement in the design conditions and landscape elements of the selected community parks.

3.2.4. Surveys

The research incorporated two surveys. The first survey involved face-to-face surveys conducted during the naturalistic observations of the parks, ensuring community engagement approach. A set of structured surveys was distributed to 20 park users, with 5 participants selected from each of the four parks under study. The primary objective was to gather insights into users' satisfaction levels regarding the quality of each park. This assessment aimed to evaluate the performance of the parks based on several key criteria within the conceptual framework. The surveys employed a Likert scale ranging from 1 to 5, where a score of 5 represented the highest level of satisfaction, 1 represented the lowest level of satisfaction, and “Not Applicable” indicated the absence of the evaluated element.

The second survey was designed to ensure the validity of the data collection process after the naturalistic observation. The primary objective of these surveys was to assess the impact of urban community parks on individuals' overall well-being. This survey incorporated a SWB assessment through semi-structured questionnaires administered at each observed site and randomly distributed to over 400 users. A randomized approach was adopted during the survey process to ensure unbiased and representative data collection.

As outlined in **Appendix A**, the online surveys contain three main sections. The first section comprises Likert-scale questions aimed at evaluating users' subjective well-being and emotional experiences during their park visits. These questions assess various

dimensions, including emotional state, sense of connection with nature, engagement in physical and social activities, and overall satisfaction. Responses are rated on a five-point scale, where 1 represents the lowest and 5 the highest degree of agreement or frequency.

The second section includes multiple-choice questions focused on behavioral patterns related to park usage. Participants were asked to indicate the frequency of their visits, the average duration of time spent in the park, and their primary motivations for visiting. This section provides contextual data that helps interpret the subjective responses and understand how different usage patterns may influence overall well-being.

The third section features open-ended questions designed to capture qualitative insights. Participants were invited to elaborate on their reasons for shorter or less frequent visits and to provide any additional comments or recommendations regarding park design, amenities, or experiences. This qualitative input complements the quantitative data, offering a richer and more comprehensive understanding of user satisfaction and expectations related to urban community parks. Descriptive statistical methods employed to summarize the key findings and characteristics of the survey responses.

3.2.5. In-depth Interviews

To support the development and validation of the revised framework during the naturalistic observation and surveys stages, a series of interviews with experts were conducted with a diverse group of 15 stakeholders, including city officials, urban planners, architects, landscape architects, and representatives from relevant government agencies, as outlined in **Appendix B**. The primary aim of these interviews was to assess the importance of the framework criteria and investigate the challenges in implementing the framework for

designing sustainable urban community parks within the context of Saudi Arabia. By utilizing both qualitative and quantitative approaches, valuable insights were gained into the challenges faced during the implementation of the design framework.

Appendix C provides an overview of the interview questions. The interviews were divided into four key sections, each addressing different thematic dimensions of sustainable park design. The evaluation employed both qualitative and quantitative approaches, including open-ended responses and Likert-scale ratings. A five-point Likert scale was used to assess the importance of various factors (1 = Extremely Unimportant, 5 = Extremely Important). The weighted mean, Relative Importance Index (RII) and rank of the framework criteria were calculated to quantify expert consensus on each design criterion.

To analyze the interview data systematically, the following steps were followed:

1. **Transcribed the interviews verbatim**, converting spoken responses into written text with accuracy and organization for easy reference. Key points were noted, and recurring themes or patterns were identified.
2. **Identified similarities and differences** within the data to create categories that captured the main ideas discussed by stakeholders.
3. **Condensed and summarized the data** to focus on the most relevant and significant information.
4. **Analyzed the summarized data** to uncover connections, relationships, and insights. Patterns, divergences, and overarching themes emerged from stakeholders' responses.

3.3. Chapter Summary

The research employs a mixed-methods approach, integrating both qualitative and quantitative data. Qualitative methods include secondary data analysis, case studies, naturalistic observations, and in-depth interviews with experts. Quantitative methods include satisfaction and SWB assessment surveys. The research focuses on urban community parks in Al-Khobar, selecting parks based on their establishment date. The parks include Dhahran's Hills and Ithra Parks, Al-Olaya's Shells Park, and Prince Ibn Jalawy Park in Al Khobar Al Shamaliah. The parks are evaluated using criteria derived from the literature review, with a focus on landscape elements and design conditions.

CHAPTER 4

DATA COLLECTION AND ANALYSIS

4.1.Introduction

In this chapter, an analysis and assessment of selected case studies of four community parks in Al-Khobar city will be conducted. The primary aim is to reevaluate and enhance the conceptual framework that has been derived from an extensive literature review. The objectives include observing and analyzing the influence of urban community park on people's behavior, as well as evaluating the parks' sustainable landscape elements and considerations. Additionally, while the naturalistic observation, surveys (questionnaires) were conducted at each site to measure users' satisfaction and SWB, assessing users' well-being. Then, the framework will be validated by interviews.

4.2. Naturalistic Observation

The selected community parks, as outlined in **Figure 34**, were chosen based on their establishment dates. These parks are located in Dhahran (Hills and Ithra Parks), Al-Olaya (Shells Park), and Al Khobar Al Shamaliah (Prince Ibn Jalawy Park).

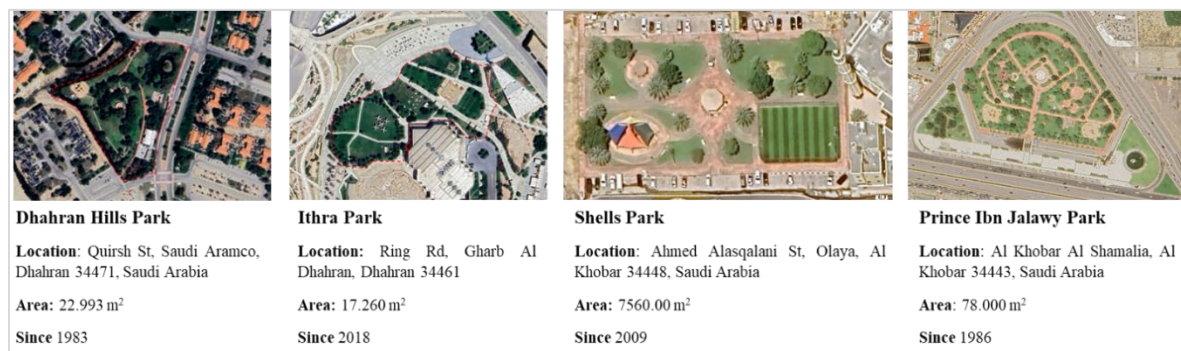


Figure 34. Case Study Selections.

4.2.1. Dhahran Hills Park – Site 1

Dhahran Hills Park was selected as the first case study for this research. Located within a gated community in Al-Khobar region in the Eastern Province of Saudi Arabia, the park was established in 1983, and it is accessible exclusively to Aramco camp residents.

As shown in **Figure 35**, the park is surrounded by residential complexes, spans approximately 22,993 square meters, and operates from 6:00 AM to 10:00 PM. Each year, the park closes for maintenance and development: this year, it adopted smart and sustainable practices. The observation was conducted on May 23, 2024.



Figure 35. Dhahran Hills Park: Location and Layout.

To thoroughly investigate the visit duration and visitor density within the park, a real-time crowd-counting tool available on Crowd Alerts website was utilized during the site visit and subsequently validated through surveys. The collected data revealed that visitors typically spent an average of 1.5 hours in the park, indicating a notable level of engagement

and interest. This finding underscores the potential for various activities and attractions to capture visitors' attention and encourage prolonged stay. Furthermore, the observed visitor density during the site visit ranged between 50 and 100 individuals. The lowest number of visitors, recorded at 6 AM, was 35. As illustrated in **Figure 36**, visitor numbers peaked at 6 PM, reaching 90, indicating a dramatic increase during the evening hours. This trend suggests that people prefer visiting the park after sunset.

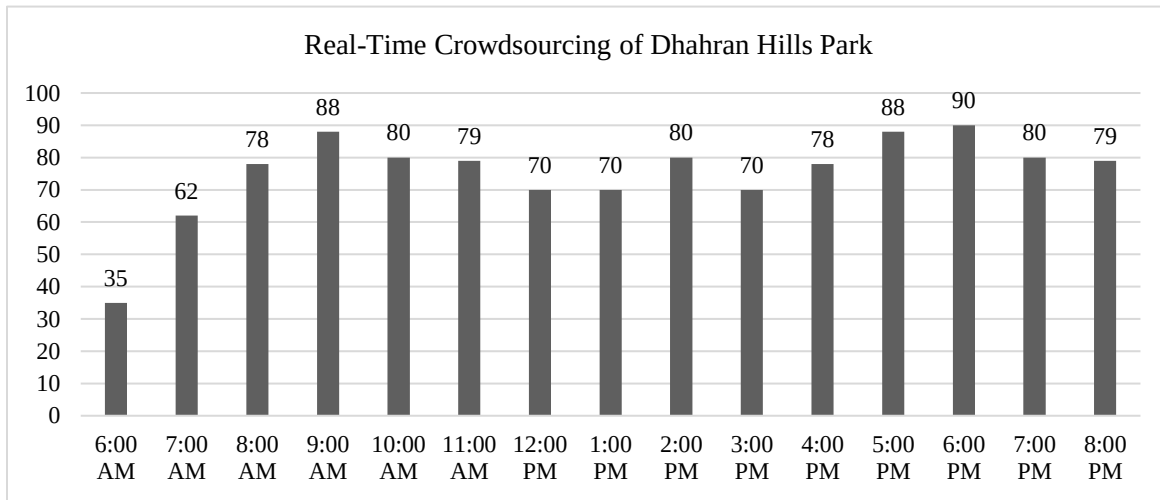


Figure 36. Real-Time Crowdsourcing of Dhahran Hills Park. Source: Crowd Alerts.

A. Human Behavior and Activities at Hills Park

During the naturalistic observation, a diverse range of activities were observed, reflecting the vibrant and dynamic nature of the site visit. These activities, depicted in **Figure 37**, encompassed various forms of human interaction and engagement with the environment. Observed activities included playing, such as engaging with recreational playground elements, as shown in **Figure 37-A**.

Additionally, individuals were observed participating in leisurely picnics, enjoying the serene surroundings while having a meal as illustrated in **Figure 37- B**. Moreover, the observation revealed a notable presence of individuals utilizing the shaded café area for

nourishment through food and beverages as illustrated in **Figure 37- C**. Notably, these individuals tended to have longer visit durations, suggesting that such amenities contribute to prolonged park engagement.



Figure 37. Hills Park Activities: A - Playground, B - People at a Picnic, C - Shaded Outdoor Café.

As illustrated in **Figure 38-A**, the observation highlighted various physical activity undertaken during the visit. Individuals were observed engaging in brisk walks, invigorating jogs, and exploring the natural surroundings, particularly under the shade of trees, immersing themselves in the beauty of the environment.

The site visits also revealed a strong sense of community spirit and togetherness. Community gatherings and events were observed, where people came together to celebrate and connect as depicted in **Figures 38- B** and **38- C** illustrates. These occasions provided opportunities for individuals to build meaningful relationships and foster a sense of belonging within the community.

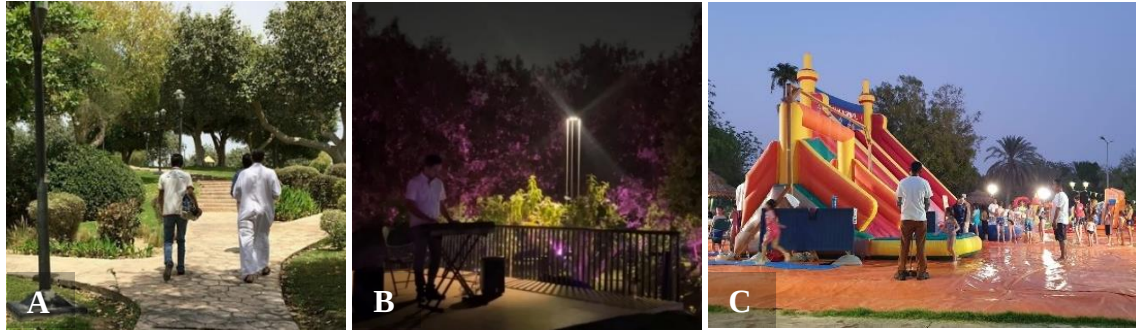


Figure 38. A - People Walking, B - Musical Events, C - Seasonal Activities for Kids at Hills Park.

B. Sustainable Considerations at Hills Park

The site visit underscored various sustainable practices considerations as depicted **Figure 39-A**, emphasizing the importance of environmental awareness and recyclability. Notably, most of the tree wood was recycled into outdoor furniture, reflecting efforts to promote sustainability, and advocating for ecosystem conservation. Additionally, sustainable waste management practices were observed, integrated within the design of the outdoor furniture. However, it was noted that the park is not a pet-friendly environment.

The observation also highlighted the presence of a lake, which offers significant socio-environmental benefits for the urban ecosystem and enhances user well-being. Until a few years ago, this lake was inhabited by a number of ducks as **Figure 39- B** illustrate. However, it is now devoid of any ducks, due to maintenance-related factors, as depicted in **Figure 39-C**. The presence of ducks in the lake not only contributes to the ecological balance but also serves as a key attraction for visitors, thereby enhancing their overall park experience.



Figure 39. A - Sustainable Recycling Bin, B - Lake Before, C - Lake Now at Hills Park.

During observations of the park, several restrictions were noted, as depicted in **Figure 40- A**. One of the prominent restrictions was the prohibition of smoking within the park. Another restriction was the limitation on dog-walking. Additionally, bringing food into the park appeared to be prohibited, as signs and notices indicated that outside food was not allowed. Cycling within the park was also restricted, with signage and barriers explicitly forbidding bicycles on the pathways. Furthermore, there was no designated bicycle parking available. However, efficient car parking facilities were provided, as illustrated in **Figure 40- B**.



Figure 40. A - Hills Park's Restrictions, B - Hills Park's Car Parking.

Great care was taken to design an environment that seamlessly blended aesthetics, functionality, and sustainability. The park featured multi-functional spaces that

transitioned smoothly between different uses. Whether a peaceful seating area, a pathway, or a vibrant gathering spot, the design accommodated the diverse needs of its visitors with ease.

As illustrated in **Figure 41- A**, naturalistic observation revealed that the landscape design elements in the park were well- maintained and in excellent condition. Over 50% of the park was covered with vegetation, creating a harmonious balance between softscapes and hardscapes. Additionally, the park showcased an impressive variety of native trees and vibrant, dense plantings, contributing to its visually appealing ambiance.

Recycled materials were extensively used throughout the park, demonstrating a conscious effort to reduce environmental impact. Pathways and structures were constructed using natural stones, as shown in **Figure 41- B**, and light, reflective materials, as depicted in **Figures 41- C and 41- D**, to effectively minimizing heat absorption from the sun.

The park's management prioritized maintaining its quality over the years. Regular annual maintenance activities ensured the park remained in optimal condition. The dedication to upkeep and preservation has significantly enhanced the visitor experience and demonstrated a strong commitment to the park's long-term sustainability.



Figure 41. A - Landscape Design, B - Natural Stone Pavement, C and D - Light/Reflective Pavement Materials at Hills Park.

To combine the heat, the park employed various strategies. The presence of a lake not only enhanced the park's aesthetic appeal but also contributed significantly to mitigating heat.

Strategically placed vegetation and well-designed shading spots created comfortable microclimates, ensuring a pleasant environment for visitors. The park demonstrated a clear priority for biodiversity and conservation. The preservation of natural landform and the use of native plants underscored a commitment to maintaining ecological balance.

A diverse range of plant species enriched the park's ecosystem, as shown in **Figure 42- A**. The naturalistic observation revealed specific measures taken to adapt to hot weather conditions. Notably, the park incorporated both artificial and natural shading elements, as depicted in **Figures 42- A, B, and C**. Pathways shaded by trees were particularly favored by visitors, offering much-needed relief from the intense heat, as illustrated in **Figure 42- A**.



Figure 42. A - Natural Shading, B and C - Artificial Shading Elements at Hills Park.

In addition, the park demonstrated a commitment to renewable energy sources. As shown in **Figure 43- A, B, C, and D**, solar panels were strategically installed to partially generate energy, demonstrating a conscious effort to reduce reliance on non-renewable resources.



Figure 43. A, B, C, and D - Lighting Generated by Renewable Solar Energy at Hills Park.

In terms of adaptability and flexibility, it was observed that the park did not feature movable outdoor furniture or modular structures. Instead, the park incorporated multi-functional spaces that catered to the diverse needs of its users. Additionally, as depicted in **Figure 44**, the park embraced the integration of smart technologies to enhance the overall experience.

Internet coverage was available throughout, allowing visitors to stay connected. The use of sensors and interactive shading elements, as depicted in **Figure 44- A, B, and C**, as well as projectors to depict art on the ground, as shown in **Figure 44- D**, and illuminated mirrors, as shown in **Figure 44- E**, contributed to the park's design.



Figure 44. A - Sensor of the Interactive Umbrella, B and C - Interactive Umbrellas, D - Projector Illustrating Art on the Ground, E - Illuminated Mirror at Hills Park.

During the observation, it was noticed that the circulation path was strategically designed to promote exploration and discovery as illustrated in **Figures 45- A, and 45- B, and C**.

Meandering through the park evokes a sense of intrigue, encouraging visitors to uncover the landscape. The path was thoughtfully integrated with the surrounding environment, weaving through lush greenery, vibrant plantations, and attractive lightings.



Figure 45. A, B, and C - Circulation Paths at Hills Park.

There were no sculptures incorporated into the landscape design. The park's focus appeared to be on the natural elements of the landform and the beauty of the surrounding environment, as depicted in **Figures 46- A, B, and C**. While sculptures can add artistic expression and visual interest to a landscape, the park's design, devoid of them, may allow for a more unobstructed appreciation of the natural surroundings. Visitors could immerse themselves in the serenity of the park, enjoying the peaceful ambiance and connecting with the beauty of nature.



Figure 46. A, B, and C - Landform at Hills Park.

During the observation, it was noted that the park demonstrated a commitment to creating a safe and secure environment for all visitors, as depicted in **Figure 47**. First and foremost, the park had a clearly defined and well-maintained gate and a pathway system. The park also has adequate lighting throughout its premises, including along the pathways, seating areas, and other key areas, as depicted in **Figures 47- A** and **47-B**. This not only enhanced the aesthetic appeal of the park but also improved visibility during the evening or nighttime hours, promoting a sense of safety. Furthermore, the park maintained a security presence in the form of trained personnel and surveillance systems. As **Figure 47- C**, a security guard was strategically stationed at the entrance of the park to monitor the surroundings and assist if needed.



Figure 47. A and B - Nighttime Ambiance, C - Hills Park's Entrance and Security Guide.

While observing the park, notes were made of the comfort and amenities provided to enhance visitors' experience and ensure their satisfaction. One of the key aspects contributing to visitors' comfort was the availability of seating areas throughout the park. These seatings were thoughtfully placed in strategic locations, such as near scenic spots, along pathways, or in shaded areas as illustrated in **Figures 48- A, B, C and D**. The seating options varied, ranging from benches and picnic tables to more relaxed arrangements, such as hammocks or lounge chairs. These seating areas provided offered visitors opportunities to rest, relax, and appreciate the park's natural beauty.



Figure 48. A, B, C, and D - Types of Seating within Hills Park.

As shown in **Figure 49**, the park also offered amenities to meet the diverse needs of its visitors. Restrooms were conveniently located, as shown in **Figure 49- A**, providing essential facilities for personal comfort and hydration. The restrooms were clean, well-maintained, and easily accessible, ensuring visitors' convenience. Additionally, these restrooms were designed with universal design considerations to accommodate all abilities as shown in **Figure 49- B**. The park provided amenities catering to recreational activities and entertainment, including playgrounds, and designated areas for picnics or barbecues, as illustrated in **Figures 49- C and 49- D**. These amenities encouraged active engagement and social interactions, allowing visitors to enjoy leisurely pursuits and create memorable

experiences within the park. However, there were no specific sport facilities available. The park emphasized providing a serene and natural environment for visitors to relax and enjoy the surrounding greenery. While there may not have been designated sports areas or equipment, the park still offered walking opportunities.



Figure 49. A - Restrooms, B - Universal Restrooms, C - Playground, D - Picnic Area at Hills Park.

During the observation of the park, it was noticed that a well-designed wayfinding system facilitated visitors' navigation and ensured a seamless exploration of the park's various areas. As depicted in **Figures 50- A** and **50- B**, the wayfinding system consisted of clear and strategically placed signage throughout the park. These signs provided directional information, indicating key points of interest, facilities, and amenities. They were designed with legible fonts and contrasting colors, ensuring they were easily visible and readable from a distance. Furthermore, the signs were equipped with illumination features, allowing them to shine brightly at night, continuing to guide visitors even after dark, as shown in **Figure 50- C**.



Figure 50. A and B - Signage System, C - Illuminated Signage System at Hills Park.

As shown in **Figure 51- A and B**, the observation noted numerous instances of positive interactions between individuals and the environment, highlighting the thoughtful design elements that encouraged social engagement and community interaction. Communal areas within the park also played a significant role in fostering these interactions.

Open grassy areas were transformed into vibrant spaces where families played games and friends gathered for picnics. The layout of the park itself facilitated interaction, with wide pathways allowing for easy movement and enabling visitors to cross paths, leading to spontaneous greetings and conversations.



Figure 51. A - Human-to-Human Interaction, B - Human-with-Nature Interaction at Hills Park.

Furthermore, the park's commitment to accessibility and inclusivity was evident in its design, as illustrated in **Figure 52- A**. The presence of accessible pathways, seating

options, and amenities ensured that individuals of all abilities could actively engage in the park's activities, fostering an inclusive environment that encouraged connections among diverse visitors.

As depicted in **Figure 52- A and B**, the park featured accessible pathways that ensured smooth, barrier-free navigation for individuals using mobility devices, such as wheelchairs or strollers. These pathways were sufficiently wide to accommodate multiple users simultaneously, allowing for easy passage and fostering a sense of inclusivity. Additionally, the surfaces of the pathways were designed to be slip-resistant, ensuring the safety of all visitors, including those with mobility challenges.



Figure 52. A and B - Accessibility and Pathways Surface at Hills Park.

The park's design elements and careful attention to detail created an atmosphere that was visually captivating and pleasing to the senses. The park's natural surroundings were a standout feature in its aesthetics.

The balanced landscape, lush greenery, vibrant flowers, the presence a lake, thoughtful lightening during the nighttime, and well-maintained landscaping created a picturesque

backdrop that seamlessly blended into the surrounding environment as shown in **Figures 53- A, B, and C**.



Figure 53. A, B, and C - Hills Park's Aesthetic Elements.

4.2.2. Ithra Park – Site 2

This park is situated in Dhahran, Saudi Arabia, and is part of King Abdulaziz Center for World Culture, commonly known as Ithra, which is a remarkable cultural hub. Established by Saudi Aramco, its grand inauguration took place on December 1, 2016, with the esteemed presence of King Salman bin Abdulaziz. Ithra became accessible to the public in 2018, offering a diverse range of experiences.

It spans across an expansive area of approximately 17,260 square meters, with various zones, as illustrated in **Figure 54**. The park operates from 9:00 AM to 11:00 PM. It is a seasonal park that acts as a multifunctional zone, hosting an array of engaging activities and events, primarily during the winter season. The observation took place on May 28, 2024, and the analysis duration lasted for 10 hours, starting at 11:00 AM and ending at 9:00 PM.



Figure 54. Ithra's Park Layout.

To thoroughly investigate the visit duration and visitor density within the park, a real-time tool crowd count tool available on the Crowd Alerts website was employed during the site visit and later validated through surveys. The collected data revealed that visitors typically spent more than 3 hours at Ithra but less than 30 minutes in the park itself. It appeared that people navigated through the park as a pathway to the Energy Exhibition Building. Furthermore, the observed visitor density during the site visit ranged between 11 and 46 visitors. The lowest number of visits occurred between 4 and 6 PM, with fewer than 10 visitors. The peak hour was at 1 PM, when the number of visitors dramatically increased to 46, as shown by the crowdsourcing system illustrated in **Figure 55**.

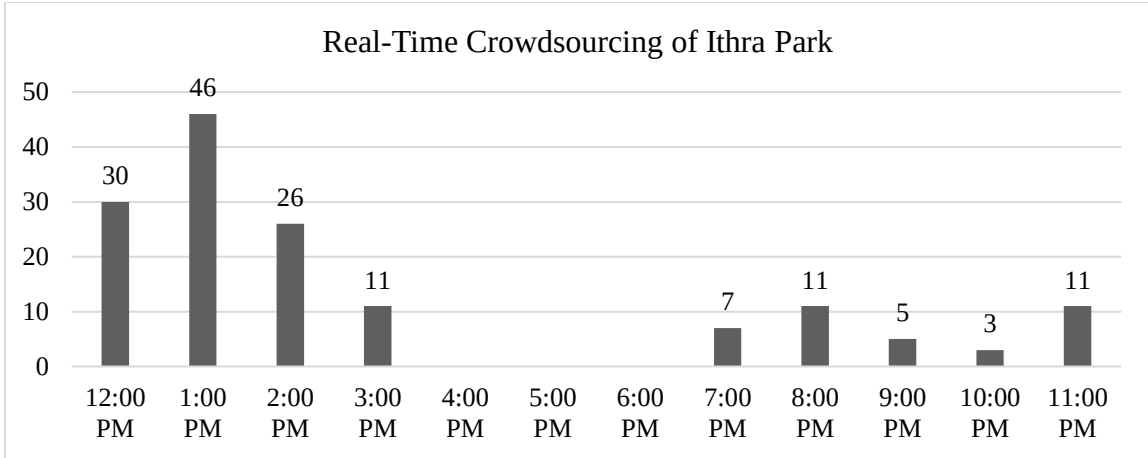


Figure 55. Real-Time Crowdsourcing of Ithra Park. Source: Crowd Alerts.

A. Human Behavior and Activities at Ithra Park

Ithra's Park occasionally hosts cultural events such as live music performances, art exhibitions, or theater shows, as illustrated in **Figure 56 – A** and **B**. Visitors to Ithra are motivated by a desire for exploration, as most activities focus on community events, education, and raising awareness about pertinent issues. At Ithra, visitors engage in a wide variety of activities that cater to diverse interests. Community events play a vital role in fostering a sense of togetherness and cultural appreciation. From vibrant festivals celebrating local traditions to interactive workshops that encourage creativity and collaboration, these events create a vibrant and inclusive atmosphere. On occasions such as Eid or Saudi National day, the number of visitors can exceed 1000.

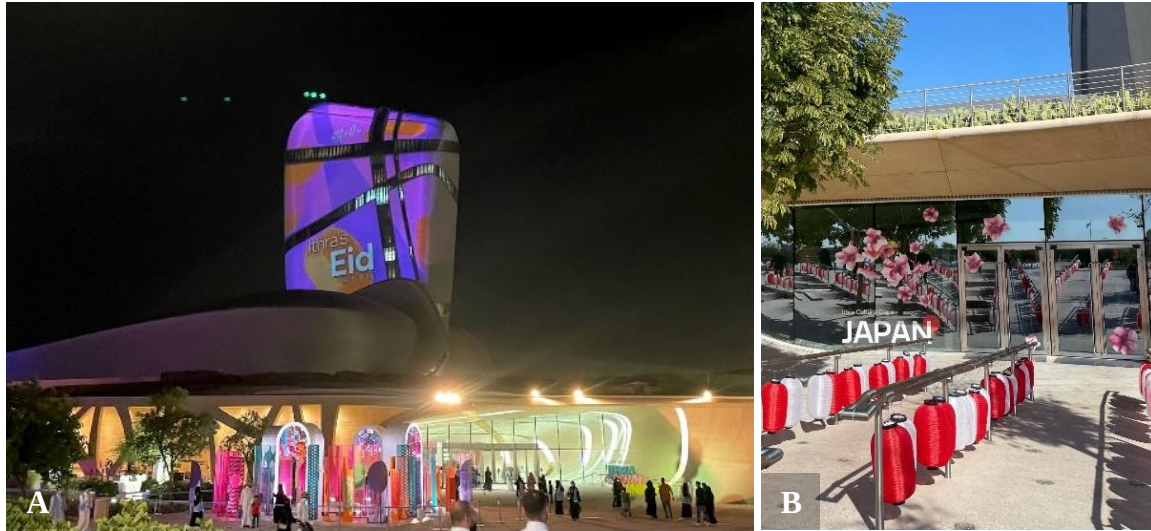


Figure 56. A and B - Cultural Events at Ithra's Park.

The first and most critical point to mention is that many of Ithra's visitors enter the park to check if there are any activities being hosted, if not they return to the indoor building to engage in climate-controlled indoor activities.

As observed in the park area within Ithra, in **Figure 57- A**, the presence of food and café trucks accompanied by tables and chairs appeared to attract visitors with tempting aromas. The trucks became bustling hubs of activity, serving as gathering points where individuals from diverse backgrounds came together to enjoy food or cold drinks, especially during the hot weather. Further into the park, the distinct types and zones of seating were observed to play a pivotal role in shaping human interactions.

As illustrated in **Figure 57- B** and **57- C**, the buffs, placed amidst the natural surroundings, provided a peaceful sanctuary for individuals seeking solace or a moment of respite. Laughter and conversations filled the air, fostering a vibrant atmosphere of human connection. Nearby, the chairs and tables within the food truck zone served as social hubs,

inviting groups of people to gather and enjoy. While some visitors chose to sit alone, others found comfort in the company of friends.



Figure 57. Seating Options at Ithra's Park: A - Tables and Chairs, B and C - Movable Buffs.

An enchanting area was discovered that had once been the captivating board game zone, as shown in **Figure 58- A** and **58- B**. However, it seems that this zone no longer exists, as evidenced by **Figure 58- C**. In the past, this space served as a vibrant of human interaction, where visitors gathered on picnic blankets adorned with board games provided by the park authorities. The atmosphere was filled with a palpable sense of anticipation and exhilaration. Unfortunately, it appears that this once-thriving board game zone has now become a thing of the past.



Figure 58. A and B - Board Games Picnic Zone Before, C - Board Games Picnic Zone Now.

B. Sustainable Considerations at Ithra Park

The pathway design of the park was well connected and meticulously maintained to promote walkability. A notable number of individuals were observed leisurely strolls within the park premises, particularly during the evening hours when the weather is cooler, as illustrated in **Figure 59- A**. While some visitors utilized the designated walkways, others opted for a more direct route by crossing through the lawn. To accommodate individuals requiring assistance or those with mobility challenges, the park provided golf carts as an alternative mode of transportation, as depicted in **Figure 59-B**.

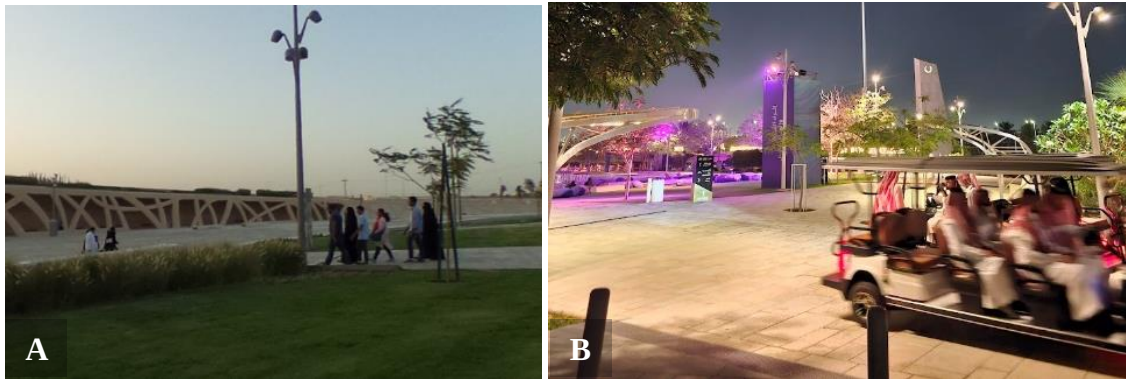


Figure 59. A - People Walking, B - Users in a Golf Cart at Ithra's Park.

Notably, the park authorities strategically prioritized the incorporation of shading elements along certain pathways, seamlessly integrating both natural and artificial components to create a harmonious interaction between visitors and their surroundings as depicted **Figures 60- A, B, and C**. This thoughtful approach to shading not only offered relief from the sun's intense rays but also enhanced the park's aesthetic appeal, contributing to its overall inviting atmosphere.



Figure 60. A and B - Artificial Shading Elements, C - Natural Shading at Ithra's Park.

Despite the park's commendable effort to prioritize shading within the seating areas and along pathways, it was observed that certain seats and walkways lacked adequate shade, as illustrated in **Figures 61- A, B, C, and D**. This observation underscores the need for a more comprehensive approach to ensure that all visitors can benefit from sufficient shade throughout the park.



Figure 61. A and B - Unshaded Walkways, C and D - Insufficient Shade in Different Seating Zones at Ithra's Park.

Continuing the naturalistic observation at Ithra Park, attention was directed towards the strategies employed to mitigate heat within the park's premises, particularly in its hot arid climate. One noteworthy feature was the presence of a fountain. However, it was unclear whether the fountain served solely as an aesthetic design element or if it was strategically implemented as part of a heat reduction plan. Notably, few birds were observed drinking from its water, as depicted in **Figure 62-A and 62- B**.

Ithra Park also demonstrates a commendable commitment to sustainability through the integration of renewable energy sources. A notable example is the utilization of wind

energy to power the operation of the park's fountain, as illustrated in **Figure 62-C**. By harnessing wind power, the park reduces reliance on traditional energy sources and minimizes its carbon footprint. Additionally, there exists an opportunity to further enhance sustainability by implementing solar panels, which could complement the existing renewable energy strategies.



Figure 62. A - Functioning Fountain, B – Non-Functioning Fountain, C - Wind Turbine at Ithra Park.

Additionally, it was observed that the tree canopy within the park appeared to be limited in width, as shown in **Figure 63- A**, and **63- B**. This suggests that the shade provided by the trees may not fully maximize its potential in mitigating the effects of heat. Expanding the tree canopy either by planting additional trees or fostering the growth of existing ones, could significantly enhance the park's shading capacity, thereby improving the overall effectiveness of its heat reduction strategies. Such an initiative would not only provide a cool and comfortable environment for visitors but also align with and strengthen the park's sustainability efforts.

During the visit, the park's commitment to preserving biodiversity was evident through its incorporation of native plants, such as palms and the safeguarding of natural features,

including the geographical characteristics and topography depicted in **Figure 63 – A, B, and C**. Additionally, the park showcased a harmonious balance between the lush green spaces and the preservation of the surrounding natural environment. The meticulous maintenance of the green lawns was particularly striking, contributing to a vibrant and inviting atmosphere for visitors.

While the presence of trees throughout the park added a layer of natural beauty, it became clear that increasing their abundance and strategic placement could further enhance both the aesthetic and environmental value of the space. The addition of more trees with broader canopies would provide greater shade, offering visitors respite from the sun and improving the overall cooling effect of the park, particularly in the arid climate. Furthermore, a denser tree canopy would promote biodiversity by attracting a wider variety of birds and insects, enriching the park's ecological diversity and reinforcing its role as a sustainable and inclusive urban retreat.



Figure 63. A and B - Tree Canopies, C - Biodiversity at Ithra Park.

In terms of tree diversity, the park featured a range of species, as captured in **Figure 64- A, B, C, D, E, and F**. However, it was notable that the selection predominantly towards greenery, with fewer vibrant and colourful displays. By incorporating a broader variety of

flowering trees and shrubs, Ithra Park could introduce dynamic bursts of colour throughout the seasons, enhancing the visual appeal of the landscape. Such additions would not only create a more captivating and picturesque environment but also foster a deeper connection between visitors and the natural surroundings.



Figure 64. A, B, C, D, E, and F - Ithra's Park Plantation Diversity.

Through the observation at Ithra Park, it became evident that there are opportunities to enhance its sustainability efforts. Specifically, the absence of recycling facilities, smart bins, and waste reduction initiatives within the park's premises was noticeable. Introducing recycling stations and encouraging visitors to participate in proper waste separation would be a significant step toward minimizing the park's environmental footprint. Moreover, the integration of smart bins equipped with sensors and compaction technology could streamline waste management by monitoring fill levels, ensuring timely disposal, and preventing the overflow of waste. These innovations would not only maintain cleanliness but also promote efficiency. Additionally, implementing waste reduction initiatives—such as encouraging the use of reusable bottles and advocating for visitors to bring their own bags—would substantially decrease the reliance on single-use plastics, further contributing to a more sustainable and eco-friendlier park environment.

At Ithra Park, sustainable construction materials and surfaces were strategically employed to enhance both environmental and aesthetic qualities. The use of light-colored and reflective surfaces plays a key role in mitigating the heat island effect, thereby improving

visitors' comfort and contributing to energy efficiency by reducing the need for excessive cooling measures. Notably, as captured in **Figure 65- A**, the primary walkways and main yard are constructed from locally sourced stone material. This deliberate choice supports sustainability by minimizing transportation emissions and preserving of the park's natural aesthetics. Additionally, the minor pathways within the park were constructed from a different type of stone material. While the specific nature of this material was not immediately clear during the observation, this variation likely serves multiple purposes. It could be a conscious design decision to add visual interest and create a distinct aesthetic, or it may reflect practical consideration, such as material's availability, cost, or durability for specific pathways uses within the park.

Ithra Park showcases a thoughtful designed layout that incorporates various functional zones to cater a wide range of needs and activities. These distinct zones include spaces for commerce, recreation, and mobility, each serving a specific purpose within the park. The park has designated areas for commerce, which primarily consist of spaces allocated for food trucks, as shown in **Figure 65- B**. For recreation, Ithra Park provides a dedicated performance area captured in **Figure 65- C**. This space serves as a focal point for various recreational activities, including live performances, concerts, cultural events, and artistic displays. In terms of mobility, the park features both open and shaded spaces that facilitate the movement of visitors, as illustrated in **Figure 65- D**. These areas are designed with accessibility in mind, ensuring that individuals can navigate through the park with ease and comfort.



Figure 65. A - Pavement Materials, B - Food and Beverage Zone, C - Performance Stage, D - Walkway at Ithra Park.

The park incorporates various elements that can be easily adjusted or repurposed to accommodate different needs and seasonal events. To enhance visitor comfort and provide flexibility in seating arrangements, Ithra Park offers movable buff seating, which can be rearranged or repositioned according to individual preferences or the requirements of specific events, as presented in **Figure 66-A**. as shown in **Figure 66- B**, the park features a multi-purpose yard that serves as a versatile space for hosting seasonal events. This area can be transformed to accommodate a wide range of activities, such as festivals, markets, exhibitions, or community gatherings. The flexibility of the multi-purpose yard allows for seamless transition between different event setups, ensuring that the park remains dynamic and engaging throughout the year.

Moreover, Ithra Park incorporates modular structures that offer adaptability in terms of their design, as illustrated in **Figure 66-C** and **D**. A prominent feature at Ithra Park is a captivating sculpture strategically placed near the main entrance. These sculptures serve as a focal point, captivating the attention of visitors and adding an artistic, visually stimulating element to the park's ambiance. The modular structures change according to the event and season, offering versatility and dynamic visual appeal.



Figure 66. A - Movable Buff Seating, B - Multifunctional Yard, C and D - Modular Structures in the Same Space During Different Seasons at Ithra Park.

It was observed that the park has made notable efforts to embrace smart technologies as part of its commitment to innovation and enhancing visitor experiences. The park has already implemented crowd-counting sensors, utilizing the available internet coverage. However, there is a clear opportunity for further incorporation of smart technologies to improve various aspects of the park's operations.

It was noted the park's thoughtful design and implementation of a well-planned circulation path provide visitors with a seamless and enjoyable experience as they explore the park's various attractions as depicted in **Figures 67- A, B, and C**. Furthermore, the park places significant emphasis on accessibility and universal design, ensuring that visitors of all abilities can fully enjoy the park's offerings. The park's commitment to inclusivity was evident through the provision of accessible walkways and entrances, making it welcoming and accommodating for individuals with mobility challenges. These walkways were thoughtfully designed to offer smooth and obstacle-free paths, facilitating easy movement for visitors using wheelchairs, strollers, or mobility aids. The surfaces were well-maintained, ensuring a comfortable experience. Additionally, as shown in **Figure 67 – B**, the walkways were wide enough to accommodate multiple visitors simultaneously, ensuring a seamless flow of movement. Alongside physical accessibility, Ithra Park also demonstrated a commitment to universal design principles. As illustrated in **Figure 67 –**

A, rest areas along the walkways were equipped with seating options that catered to various needs, including benches with backrests for added comfort.



Figure 67. A, B, and C - Accessibility and Universal Design Principles at Ithra's Park.

The park demonstrates a strong commitment to community engagement and fosters a sense of collaboration among its visitors. It actively encourages community involvement through various outdoor workshops, which provide a platform for community members, park visitors, and experts to come together and share knowledge, skills, and experiences in an inspiring outdoor environment. The workshops cover a wide range of topics, including environmental conservation, art, and cultural activities. Additionally, the park authority conducts regular surveys, offering opportunities for feedback, learning, and continuous improvement.

In terms of safety and security, the park's management has implemented several measures to address critical security aspects. Surveillance cameras equipped with advanced analytics have been installed to monitor and detect any suspicious activities, enhancing overall park security, as captured in **Figure 68-A**. A key feature was the emphasis on adequate lighting throughout the park. As the day transitioned into evening, Ithra Park's strategically placed lighting fixtures illuminated pathways and seating areas, creating a safe and inviting

atmosphere, as illustrated in **Figure 68-B**. Another noteworthy aspect was the clear sightlines within the park, as shown in **Figure 68-C**.

The park's management has implemented measures to ensure visitors have unobstructed views of their surroundings by regularly trimming trees and vegetation and thoughtfully arranging objects and structures. Additionally, the park's commitment to proper maintenance was evident. Throughout the observation, park staff diligently working to maintain the park's infrastructure. Pathways were consistently clean and well-maintained, contributing to a pleasant and secure environment for visitors.



Figure 68. A - Surveillance Cameras, B - Nighttime Lighting at Ithra's Park, C - Clear Sightlines.

A potential safety concern was identified regarding the movement of golf carts along the park's walkways, as shown in **Figure 69-A**. The presence of these vehicles alongside pedestrians poses a risk of accidents or collisions, raising significant safety concerns. Additionally, some electrical generators within the park were observed to be exposed, as depicted in **Figure 69-B**. Exposed electrical equipment presents a potential hazard, particularly if visitors unknowingly come into contact with it.

Addressing this issue requires the installation of appropriate enclosures or barriers around the generators, ensuring that they are securely contained and inaccessible to park visitors. These measures would significantly enhance safety within the park and mitigate potential risks.

The park's wayfinding system plays a crucial role in facilitating navigation and exploration of its various areas. A thoughtfully designed signage system has been implemented to guide visitors effectively and ensure a seamless experience, as illustrated in **Figure 69 - C**.

One of the system's notable features is the use of clear and strategically placed signage throughout the park. These signs are designed to be highly visible and provide essential information, including directions, details about key attractions, and the locations of important facilities such as restrooms and parking areas.

However, a limitation of the current wayfinding system was observed during nighttime, as the signage lacks illumination. This lack of lighting renders the signs unreadable in low-light conditions, potentially hindering the visitor experience and navigation after sunset.



Figure 69. A - Golf Cart Through the Walkway, B - Exposed Electrical Generators, C - Wayfinding System at Ithra Park.

While the park offers numerous positive aspects, certain areas could benefit from improvements to enhance visitor experience and comfort. A key observation was the discomfort experienced during the daytime due to extreme heat and insufficient shaded areas in specific parts of the park. The limited availability of shaded spots made it

challenging for visitors to spend extended periods outdoors, particularly during the hotter hours of the day. Increasing the number of shaded areas, either through additional vegetation or shading structures, would significantly improve the overall visitor experience.

Another notable observation was the absence of drinking fountains within the park. Providing accessible drinking fountains would address this gap, offering visitors a convenient way to stay hydrated and further enhancing comfort during their time at the park. Additionally, the park lacks designated bicycle parking areas. While the park offers a beautiful outdoor space for recreation, the absence of proper bicycle parking facilities may deter cyclists from visiting. Implementing bicycle racks or designated parking areas would encourage biking as a sustainable and eco- friendly mode of transportation, fostering a greener atmosphere.

On a positive note, restroom facilities are conveniently located within the park. These facilities were observed to be well-maintained and easily accessible, contributing to visitor satisfaction. Furthermore, the variety of seating options throughout the park enhances its appeal. Seating spots, including benches, tables, and open grass areas, offer visitors diverse option to suit their preferences, adding to the overall comfort and relaxation of the park.

4.2.3. Shells Park – Site 3

Shells Park, situated in Al-Olaya, Saudi Arabia, serves as a focal point within its residential neighborhood. Covering an area of 7560.00 square meters, the park was developed in 2009 and operates daily from 6 AM to 12 AM. As depicted in **Figure 70**, the park's layout and location.



Figure 70. Shells Park Layout.

The observation was conducted on September 6th, 2024, over a duration of 10 hours, beginning at 11:00 AM and concluding at 9:00 PM. To comprehensively analyze the visit duration and visitor density within the park, a real-time crowd-counting tool available on Crowd Alerts website was utilized during the site visit. This data was subsequently validated through surveys. The collected data revealed that visitors typically spent over three hours in the park. Most of the park's users comprised women and children under the age of 18. The observed visitor density ranged from 7 to 90 visitors throughout the day.

The lowest number of visits occurred during the morning hours, with a dramatic increase observed after 11 AM, as illustrated in **Figure 71**.

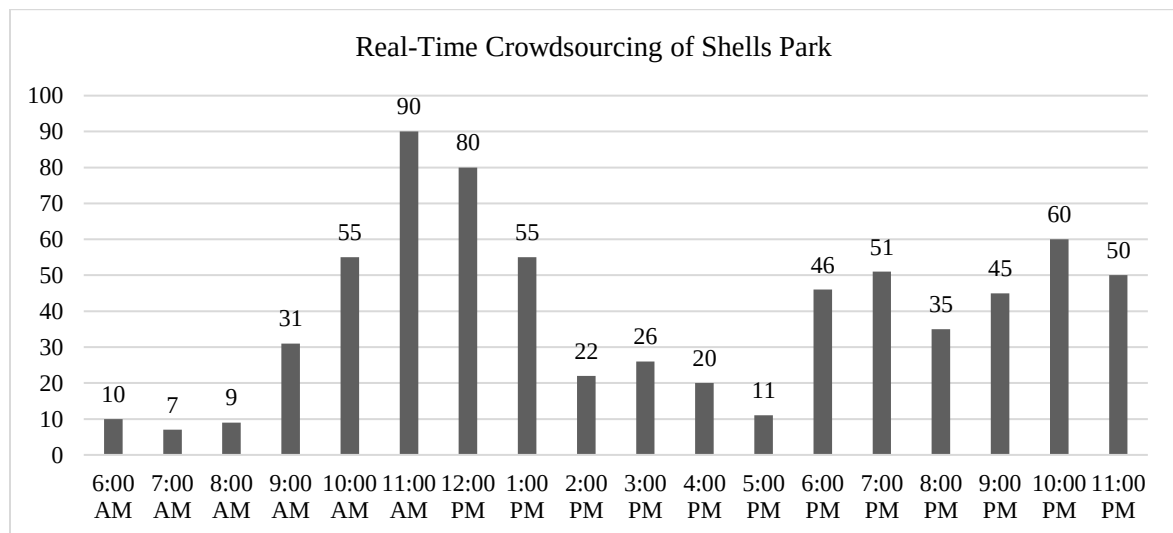


Figure 71. Real-Time Crowdsourcing of Shells Park. Source: Crowd Alerts.

A. Human Behavior and Activities at Shells Park

During the naturalistic observation, a diverse range of activities and behaviors were noted, reflecting various forms of human interaction and engagement with the environment. As depicted in **Figure 72- A**, common activity involved children playing football, which typically commenced at 3 PM and continued until midnight. Additionally, younger children were observed enjoying recreational playground equipment, as captured in **Figure 72- B**. However, the playground experienced significant crowding during the evening hours, with children often waiting for their turn to play, indicating a potential shortage of equipment. Moreover, several mothers were enjoying relaxed picnics while savoring the tranquil atmosphere and watching their children play, as illustrated in **Figure 72- C**. Physical activities were also a frequent occurrence, with numerous women engaging in a variety of exercises. Walking emerged as a popular activity, as depicted in **Figure 72- D**, with many

individuals strolling along the park's paths. The park serves as an ideal setting for physical fitness, offering visitors an opportunity to enjoy the outdoor environment, and promote their overall well-being through activities such as walking.



Figure 72. A - Kids Playing Football, B - Kids Playing in the Playground, C - Some Ladies Having a Picnic, D - People Walking at Night at Shells Park.

As shown in **Figure 73- A**, the park features a board listing prohibited activities, including smoking, cycling, playing football, and littering. Despite these established rules, observations indicate that many visitors fail to adhere to them. Instances of littering were observed, as illustrated in **Figure 73- B**, alongside activities such as playing football and cycling on the pathways, as captured in **Figure 73- C** and **73- D**.

This apparent disregard for regulations may stem from the park's design not adequately addressing the diverse needs of its users. For instance, the absence of a designated cycle path could contribute to cycling on pedestrian pathways. Introducing designated spaces or facilities to accommodate activities such as cycling could mitigate these issues, improve adherence to park rules, and enhance the overall visitor experience.



Figure 73. A - Park Prohibited Activities Board, B - Thrown Trash on Landscape, C - Kids Breaking the Rules by Cycling on the Pathways, D - Kids Playing Football on the Pathways at Shells Park.

B. Sustainable Considerations at Shells Park

The observation revealed that the existing shading in the park is insufficient, with many tree canopies lacking the breadth necessary to provide adequate shade. This deficiency was particularly evident in areas outside the playground, where visitors were left exposed to harsh sunlight. As shown in **Figure 74- A** and **74- B**, only the playground and two communal seating areas were equipped with artificial shading elements, highlighting an uneven distribution of shade across the park's zones. Introducing movable seating arrangements, adaptable layouts, and modular fixtures would increase the park's versatility, enabling dynamic use of spaces for various activities and events. Furthermore, the park design already fosters social interaction, particularly among children. Activities such as playing together in the playground or engaging with nature, like playing in the sand as depicted in **Figure 74- A**, highlight the potential of parks to create shared experiences and a sense of community.

Moreover, the observation underscored the critical role parks play offering mobility and walkability while offering communal spaces for gatherings, as illustrated in **Figure 74- B**. Enhancing shading through the planting of trees with broader canopies and the

incorporation of additional artificial shading elements could significantly improve the park's functionality and visitor comfort. Enhancing the functionality of parks with features like improved shading, movable furniture, and modular structures can encourage visitors to engage in physical activities, enjoy leisurely walks, and participate in social interactions and community events. Currently, the park's design lacks the flexibility and adaptability necessary to accommodate diverse needs and activities.



Figure 74. A - Shaded Playground, B - Shaded Communal Space at Shell Park.

The observation highlighted a significant lack of effective heat mitigation strategies within park's design. Although trees and green cover are present, their potential to provide shade and mitigate heat is diminished due to inadequate maintenance, including pruning and watering, as illustrated in **Figure 75- A** and **75- B**. The absence of water features and deliberate heat mitigation strategies further exacerbates thermal discomfort, reducing the park's overall usability during hotter periods. In addition to the thermal challenges, the park's Landscape design elements reveal areas needing improvement to enhance its aesthetics, functionality, and sustainability.

The condition of the park's lawn is notably poor, as shown in **Figure 75-B**. This deterioration is likely a result of heavy foot traffic combined with improper waste disposal,

both of which negatively impact the park's visual appeal and usability. Addressing these issues through improved maintenance, landscaping practices, and the introduction of sustainable design elements would improve the park's environment and visitors' experience. The park was observed to lack vibrant and dense vegetation, which negatively affected both its visual appeal and ecological value. The incorporation of colorful and diverse plant species is essential to enhance the park's aesthetic character while fostering biodiversity and supporting local ecosystems. As illustrated in **Figure 75-C**, the park exhibited limited biodiversity, with only 2-3 tree species dominating the landscape. This restricted diversity not only diminished the park's visual appeal but also raised concerns about its ecological sustainability. Introducing a broader range of tree and plant species would significantly improve biodiversity, attract local wildlife, and enhance the ecological resilience of the park. From a sustainability perspective, the park design demonstrated a notable gap in adopting environmentally conscious practices. Sustainable design elements, such as water-efficient landscaping, energy-efficient lighting, and community engagement initiatives, were absent. These features are vital for reducing environmental impact, conserving resources, and promoting long-term ecological balance.



Figure 75. A - Plantation Condition, B - Lawn Condition, C - Biodiversity at Shell Park.

The observation revealed a significant gap in the park's design regarding the use of sustainable construction materials and surfaces. The absence of eco-friendly materials and light-reflective surfaces was a prominent concern. These materials are crucial for

mitigating heat absorption, enhancing energy efficiency, and promoting environmental sustainability. However, as highlighted in **Figure 76- A**, the presence of permeable paving was noted as a positive feature. This paving not only aids in reducing heat absorption but also enhances water drainage.

Regular maintenance practices are critical to preserving the durability and functionality of park infrastructure. The current state of the park underscores the pressing need for consistent maintenance efforts to address wear and tear, ensure safety, and maintain the overall quality of the park. Effective maintenance is vital for extending the lifespan of park features and ensuring that the park continues to provide a safe, comfortable, and enjoyable environment for visitors.

The observation highlighted a significant deficiency in the integration of smart technologies within the park. The absence of features such as smart lighting, Wi-Fi connectivity, interactive displays, and mobile applications for visitor engagement limits the park's potential to provide a modern, user-friendly experience. Additionally, the lack of smart water irrigation techniques, such as moisture sensors and weather-based controllers, was noted. Incorporating these technologies could optimize water usage, improve irrigation efficiency, and align watering schedules with real-time weather conditions, promoting sustainability and resource conservation. The park's integration with the surrounding neighbourhood was observed to be seamless, offering convenient access for residents without a clearly defined entrance point. While this design approach enhances accessibility, it also indicates a potential oversight in emphasizing the park's identity and boundary. Furthermore, a misunderstanding of Universal Design principles was evident, as depicted in **Figure 76- B**. Specifically, the incorrect sizing of ramp angles poses

challenges for individuals with diverse mobility needs, potentially limiting the park's accessibility and inclusivity.

Community engagement initiatives are notably absent from the park's current operations. Activities such as organized workshops, surveys, or public meetings are essential for fostering a sense of belonging and ownership among residents. These initiatives would provide opportunities for collaboration, feedback, and collective decision-making, ensuring that the park's remains relevant and inclusive within its surrounding neighbourhood. Implementing such measures could significantly enhance the park's role as a community-centric space.

The evaluation of the park's aesthetic features highlights the pivotal role of the carefully planned walkways in fostering connectivity and seamless navigation throughout the park. As illustrated in **Figure 76- C**, the circulation paths are clearly defined and well-connected, allowing visitors to move effortlessly between different areas.

However, the analysis also underscores the need for ongoing landscape maintenance and further development. Enhancing the park's colour schemes and material choices is essential to elevate the overall visual appeal and coherence. The addition of vibrant and diverse planting schemes, complemented by durable and aesthetically pleasing materials, could significantly enhance the park's ambiance and visitor experience.

Furthermore, the park currently lacks sculptures and distinct landforms, which are essential for enriching the artistic and natural elements of the park environment. Introducing artistic installations and varied landforms would add layers of visual interest, promote cultural engagement, and create a dynamic and immersive park experience. These enhancements

would not only improve the park's aesthetic quality but also contribute to its identity and cultural significance.



Figure 76. A – Pavement Sustainable Materials (Permeable Paving), B - Ramp Measurement, C - Circulation Path at Shell Park.

In terms of safety and security considerations, the park faces notable challenges that require attention. One critical issue is the inadequacy of nighttime lighting, which results in poor visibility and creates a less secure environment for visitors during evening hours, as depicted in **Figure 77- A**. Ensuring proper illumination throughout the park is essential to enhance safety, prevent accidents, and deter potential security concerns.

Another concern is the park's direct exposure to surrounding streets, as illustrated in **Figure 77- B**. This proximity poses a significant safety risk, particularly for children, due to the potential danger from vehicular traffic. Measures such as protective barriers, fencing, or strategically positioned vegetation could help mitigate this risk and provide a safer environment for park users. Additionally, the observation highlights that the park was previously gated, as shown in **Figure 77- C**, which offered an added layer of security. The current lack of gating raises concerns regarding the safety and protection of visitors, especially children. Reintroducing gating or implementing other controlled access measures could help address these safety challenges while maintaining the park's accessibility and openness.



Figure 77. A - Illumination During Nighttime, B – Park Exposure to Street, C - Old Boundaries at Shell Park.

The comfort and amenities within the park are insufficient, with several areas requiring significant improvements to enhance the visitor experience. One notable issue is the limited availability of seating areas, many of which are unshaded and uncomfortable, as illustrated in **Figure 78-A**. As shown in **Figure 78 -B**, there is also a significant lack of shaded areas, particularly along walkways and around the football field. This deficiency makes it challenging for visitors to find relief from the sun, especially during periods of hot weather, impacting their ability to enjoy the park for extended periods. Furthermore, the absence of drinking fountains presents another challenge, particularly in extreme heat, where access to water is critical for visitor comfort and health. Additionally, the park lacks public restrooms facilities, compelling visitors to rely on nearby facilities, such as those in a mosque. This inconvenience detracts from the overall park experience and highlights the need for essential amenities to meet visitors' basic needs effectively.

The park presents a substantial opportunity to enhance its recreational offerings by incorporating both active and passive recreation options. The introduction of sports equipment and designated areas for various sports activities could encourage physical engagement among visitors. Establishing facilities such as football courts, volleyball nets, or outdoor fitness equipment can attract a diverse group of users and promote an active lifestyle. Furthermore, the addition of a separate bicycle lane and well-designed play areas

would support a broader spectrum of recreational activities, catering to different age groups and interests. These enhancements would contribute to creating a vibrant and dynamic environment that fosters community interaction and active living.

Another key observation is the park's lack of a wayfinding system, clear directions, and effective signage. This absence creates challenges for visitors attempting to navigate the park and locate its amenities and attractions. Implementing an effective wayfinding system with well-placed, visually appealing, and accessible signage would significantly improve the overall visitor experience. This system could include maps, directional signs, and markers for key facilities such as restrooms, play areas, and sports zones. By addressing this gap, the park can ensure that users have seamless experience exploring its features, thereby maximizing the park's potential to serve as a functional and welcoming public space. The park's lack of a pet-friendly environment is a notable shortcoming. This was evident from observations of individuals leaving cat food on the ground, as depicted in **Figure 78- C**, and **78- D**. Such behavior highlights the absence of designated spaces or facilities for pets, which could encourage more responsible pet care practices. Moreover, the practice of discarding food in undesignated areas poses potential health and safety concerns, including the attraction of pests and the creation of unsanitary conditions.

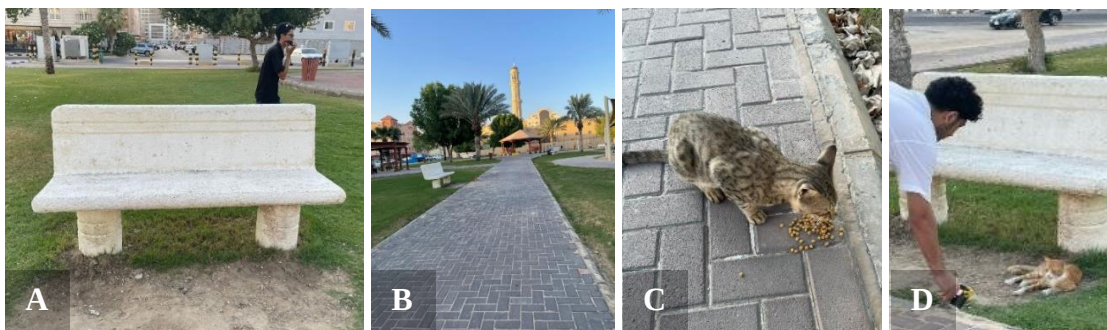


Figure 78. A - Bench, B - Unshaded Walkway, C and D - Anti-Pet-Friendly Environment at Shell Park.

4.2.4. Prince Ibn Jalawy Park– Site 4

This park, as illustrated in **Figure 79**, spans an expansive 78,000 square meter, with approximately 49,000 square meters devoted to verdant greenery. Strategically located at the intersection of four major streets, the park offers a serene retreat for families seeking leisure and tranquility. Equipped with a variety of amenities, the park has garnered recognition as one of the most picturesque in the Eastern Region. Established in 1986, it operates daily from 7:00 AM to 10:00 PM.



Figure 79. Prince Ibn Jalawy Park Layout.

The observation was conducted on September 6, 2024, with a duration of 10 hours, commencing at 11:00 AM and concluding at 9:00 PM. To thoroughly analyze visitor duration and density within the park, a real-time crowd-counting tool available on the

Crowd Alerts website was utilized during the site visit. This data was later validated through surveys.

The findings revealed that visitors typically spent over three hours in the park. During daytime hours, the majority of park users were women and children under the age of 18, emphasizing the park's role as a family-friendly environment. Conversely, nighttime usage reflected a more diverse demographic, attracting individuals of all ages and both genders. Visitor density throughout the day ranged between 7 and 90 individuals. The lowest visitation was observed in the morning hours, while a marked increase occurred after 11:00 AM, as shown in **Figure 80**.

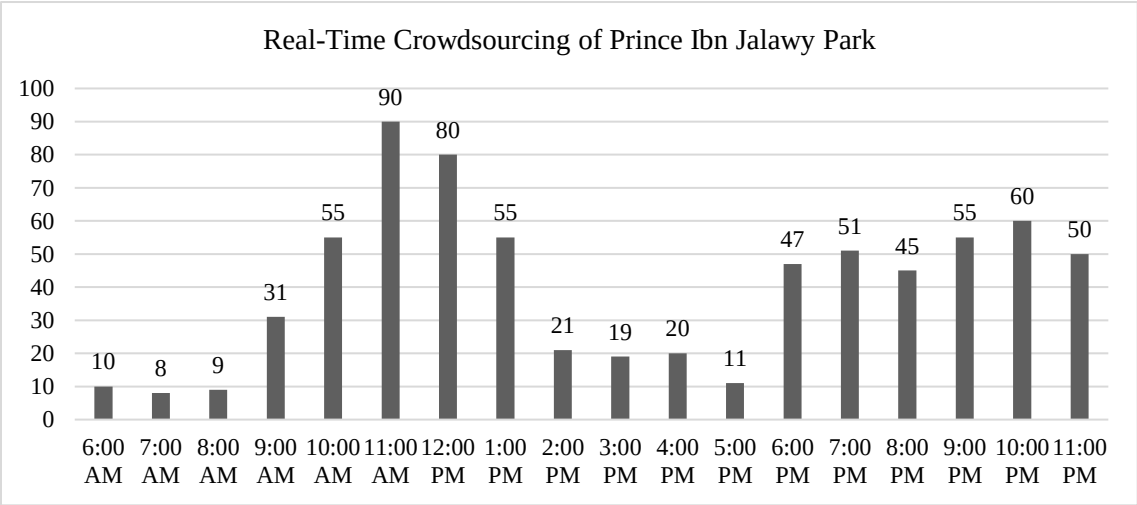


Figure 80. Real-Time Crowdsourcing of Prince Ibn Jalawy Park. Source: Crowd Alerts.

A. Human Behavior and Activities at Prince Ibn Jalawy Park

In the park, there is a list of prohibited activities, as depicted in **Figure 81- A**, which includes cycling, open flames, smoking, football playing, and dog walking. However, despite these restrictions, many children observed engaging in activities such as playing football in the green areas and cycling along the paths, as captured in **Figure 81- B**, and **81- C**. This behavior indicates a disconnect between the park's regulations and the

preferences of its users, suggesting that these activities are both popular and valued by the community. Addressing this discrepancy may require reevaluating the existing rules or designating specific areas for such activities, thereby creating a more inclusive and enjoyable experience for all visitors.

As illustrated in **Figure 81- B**, children energetically play football in the expansive green areas, their gleeful shouts resonating through the atmosphere. Despite the explicit ban on football and cycling, several children can be seen riding their bicycles, as shown in **Figure 81- C**. This dynamic scenario underscores the importance of prioritizing user needs and safety, indicating a clear need for additional designated sports areas and cycling paths to better accommodate the diverse preferences of park patrons.



Figure 81. A - List of Prohibited Activities in Prince Ibn Jalawy Park, B - Kids Breaking the Rules by Cycling, C - Kids Breaking the Rules by Playing Football at Prince Ibn Jalawy Park.

During the observation, a variety of human behaviors were recorded. During the daytime, activities were limited due to the hot weather. Physical activities such as walking, jogging, and cycling were common among visitors, as shown in **Figure 82 - A**. Conversely, some individuals were observed resting and relaxing as captured in **Figure 82- B**.

In the afternoon, families began arriving at the park, children engaging in play and mothers enjoying picnics in shaded areas, as depicted in **Figure 82- C**. As night falls, the park

undergoes a lively transformation, becoming a bustling center of activity that attracts numerous visitors. Families gather for picnics, spreading blankets on the grass, while cheerful chatter and laughter fill the air, creating a warm and inviting ambiance. Parents who were observed watching their children at play, frequently extending their visits to enjoy the cooler evening breeze and the serene surroundings.



Figure 82. A - Visitors Engaged in Physical Activities (Walking), B - Visitors Engaged in Relaxation Activities, C - Families Waiting for Their Kids to Play at Prince Ibn Jalawy Park.

The park features three vibrant playgrounds, however, during the daytime, they remained unused, as depicted **Figure 83- A**. In the evening, the playgrounds were alive with activities, as illustrated in **Figure 83- B**. One interesting observation is a child playing in the playground while using a smart device, as captured in **Figure 83- C**. This scene highlights the intersection of traditional outdoor play and modern technology, illustrating how today's children often combine physical activity with digital experiences. It raises important questions about the balance between screen time and outdoor play, as well as how parks can adapt to cater to the interests of younger visitors while still promoting active, unstructured play.



Figure 83. A - Playground in the Daytime, B - Playground in the Evening, C - Kids Engaged with Phones While Playing in the Playground at Prince Ibn Jalawy Park.

As shown in **Figure 84- A**, several people were observed climbing the park's sculpture, especially the park's main sculpture, while others were seen taking pictures, particularly near the sculptures. This added an adventurous spirit to the evening scene. This playful behavior not only demonstrated their enthusiasm but also highlighted the park's appeal as a place for discovery and enjoyment.

However, this spectacle raised safety concerns, emphasizing the need for well-defined regulations and designated climbing zones to ensure a safe environment for all park visitors. As depicted in **Figure 84- B** below, the arrangement of seating areas in the park emphasizes interaction between people and the natural environment, rather than focusing solely on human-to-human interaction. These strategically placed benches and grassy areas encourage visitors to connect with nature, offering views of beautiful landscapes and trees.



Figure 84. A - People Climbing the Sculpture, B - Seating Arrangement at Prince Ibn Jalawy Park.

B. Sustainable Considerations at Prince Ibn Jalawy Park

The design of the park incorporates various shading elements intended aimed at enhancing comfort and usability. As shown in **Figure 85- A**, natural shade is provided by strategically planted trees, while additional shading is created through manufactured structures, such as wooden pergolas, as depicted in **Figure 85- B**. However, the effectiveness of these shading elements is limited, as significant areas of the park remain exposed to direct sunlight. For example, the playgrounds are largely unshaded, making them uncomfortable for children during peak sunlight hours, as shown in **Figure 85- C**. Similarly, as illustrated in **Figure 85- D**, the designated prayer area lacks sufficient cover, which may detract from the spiritual experience. Additionally, some seating areas, as observed in **Figure 85- E**, are often left in direct sunlight, diminishing their appeal and usability, especially on hot days.



Figure 85. A - Natural Shading, B - Manufactured Shading, C - Unshaded Playground, D - Uncovered Praying Spot, E - Unshaded Seating Area at Prince Ibn Jalawy Park.

The park currently lacks the integration of efficient energy practices, particularly regarding renewable energy sources. This omission represents a missed opportunity to enhance sustainability and reduce the park's environmental footprint. While the park features expansive green spaces that provide a natural environment, it lacks effective heat mitigation strategies, particularly the inclusion of water elements. Features, such as ponds, fountains, or misting systems, could significantly reduce ambient temperatures and improve the overall comfort of the park. Incorporating these water elements would not only help cool the air but also create a more inviting atmosphere for visitors.

The park also displays rich biodiversity, primarily through its selection of native plants, consisting of six to seven species with a well-balanced landscape design incorporating fine, coarse, and medium layers, as illustrated in **Figure 86- A, B, C, and D**. This thoughtful selection enhances the ecological integrity of the area while supporting local wildlife, thereby creating a thriving habitat for various species.



Figure 86. A, B, C, and D - Plantation Biodiversity at Prince Ibn Jalawy Park.

The current state of the park's landscape design elements, including the green lawn, trees, and various plantings, require immediate attention. Numerous sections of the lawn exhibit significant dryness, with large patches turning brown and brittle, as illustrated in **Figure 87– A**, and **87-B**. This deterioration not only diminishes the park's visual appeal but also raises concerns about the overall health and sustainability of the grass.

Many trees show signs of stress, with leaves turning yellow or brown, as depicted in **Figure 87- C**. These symptoms may indicate nutrient deficiencies or water stress, exacerbated by the dry conditions. Furthermore, some trees exhibit dead branches on the ground, as shown in **Figure 87- D**, posing potential safety hazards to park visitors. The presence of fallen branches suggests a lack of regular pruning and maintenance.

The park also lacks effective water management strategies, including advanced irrigation techniques, moisture sensors, and weather-based controllers. The absence of such systems indicates that water resources may not be utilized efficiently, potentially resulting in overwatering or underwatering of plants. Addressing these issues through modern water management solutions could enhance the park's ecological health, safety, and visual appeal.



Figure 87. A - Network of Irrigation Pipes Laid Out on Sandy Ground, B - Patchy Dry Grass, C - A Tree with Numerous Brown, Dry Leaves, D - Dead Leaves at Prince Ibn Jalawy Park.

The absence of smart waste management systems in the park, including recycling facilities and smart bins, poses significant challenges for maintaining cleanliness and promoting sustainability. There are no designated recycling bins available for visitors to dispose of recyclable materials such as plastics, paper, and metals. This lack of infrastructure encourages improper disposal of recyclable items, contributing to increased landfill waste. As depicted in **Figure 88- A**, a considerable number of visitors were observed discarding trash on the grass, particularly during weekends. This behavior may indicate a lack of awareness or disregard for environmental cleanliness and the importance of maintaining public spaces, especially peak attendance periods. It also underscores the need for enhanced waste management resources and educational initiatives to encourage proper litter disposal. Additionally, an analysis of the park's design elements revealed the use of locally sourced materials for urban furniture as shown in **Figure 88- B**.

Additionally, while the park features permeable paving pathways, as depicted in **Figure 88- C**, which contribute to effective stormwater management and reducing runoff, many areas require maintenance, as illustrated in **Figure 88- D**.



Figure 88. A - Cleanliness, B - Locally Sourced Materials, C - Permeable Paving, D - Worn-Out Pavement at Prince Ibn Jalawy Park.

In terms of landscape design, the park has commendably embraced the use of native plants, which promotes local biodiversity and supports the ecosystem. It has successfully achieved

a balanced integration of softscape and hardscape elements, as illustrated in **Figure 89- A**, and **89- B**. However, the park features a limited variety of plant species, resulting in a landscape that showcases green hues, as illustrated in **Figure 89- A**. While the dominance of green contributes to a cohesive and calming environment, the lack of plant diversity may reduce visual interest and limit seasonal variation. Incorporating a broader selection of native plants could enhance the park's aesthetic appeal by introducing vibrant colors and varied textures throughout the seasons.

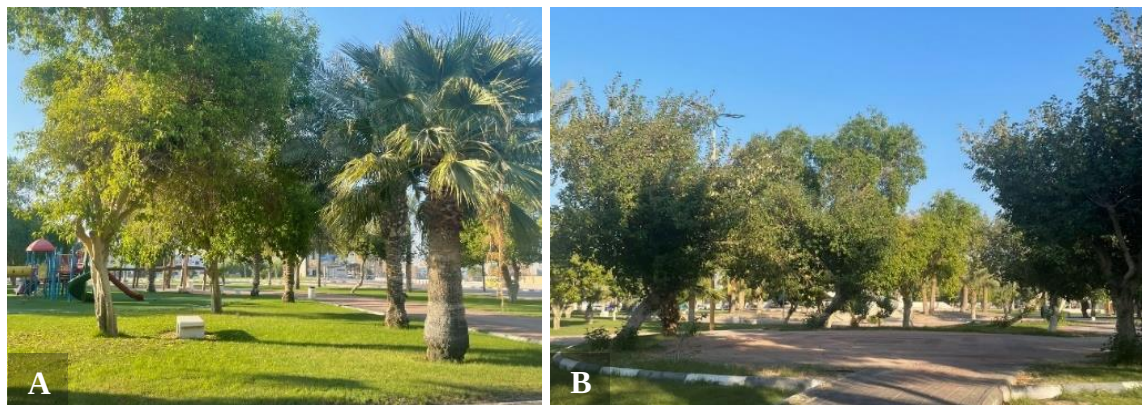


Figure 89. A - Softscape, B - Hardscape Design and Color Hue at Prince Ibn Jalawy Park.

The park offers a variety of functions and activities, catering to a diverse range of visitors. While the existing features facilitate recreation and relaxation, the lack of dedicated areas for social interaction or a communal activity restricts opportunities for community engagement. Additionally, in terms of flexibility and adaptability, the park does not incorporate movable furniture or modular structures that could be easily rearranged to accommodate various activities and events. Although multipurpose spaces are available, the absence of functional and adaptable elements limits the park's capacity to dynamically respond to the evolving needs of its users.

During the observation, it was noted that the park lacks the integration of smart technology. The absence of such innovations restricts opportunities for enhancing visitor experiences and optimizing park management. Furthermore, an evaluation of the park's design elements reveals that easy accessibility and universal design have not been fully realized. Many pathways are elevated with stairs, as shown in **Figure 90-A**, indicating insufficient consideration for individuals with mobility disabilities. The absence of essential features, such as ramps, poses significant challenges for individuals with mobility impairment to navigate the park. However, some efforts toward accessibility have been made in the parking area, which includes designated spaces for individuals with disabilities, as depicted in **Figure 90-B**. On a positive note, the park is well connected to its surroundings. A bus stop is located just 100 meters away, as shown in **Figure 90- C**, and a crossing path facilitates access from the opposite street, further enhancing the park's overall connectivity, as illustrated in **Figure 90- D**.

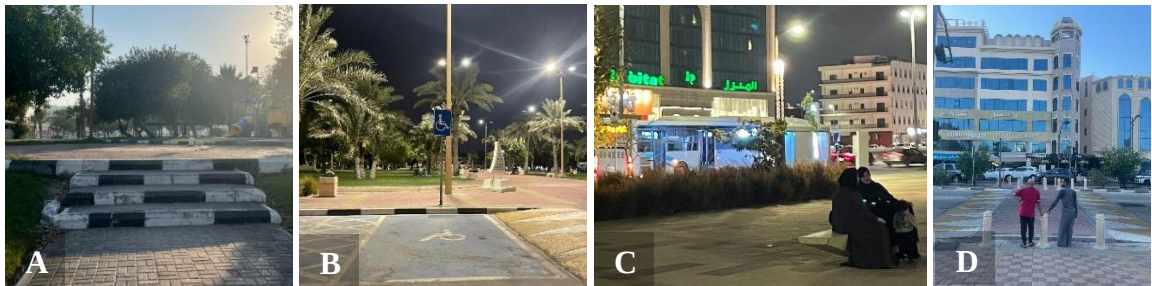


Figure 90. A - Accessibility within the Park Pathways, B - Universal Design Principles in Parking Slots Area, C - Bus Station Near the Park, D - Park Connectivity with Opposite Street at Prince Ibn Jalawy Park.

There is limited community engagement within the park, as evidenced by the absence of regular surveys, workshops, or meetings aimed at gathering input from local residents. This lack of involvement prevents the community's voices and needs from being adequately considered in the park's development and management.

The existing pathways are well-connected to key areas of the park, enabling visitors to move easily between different amenities. The pathways are wide and facilitate smooth navigation throughout the space. However, while clear signage is crucial for orientation, the park lacks sufficient directional markers or informational displays to help visitors navigate effectively. As depicted in **Figure 91- A**, a single sculpture serves as a focal point within the park, attracting visitors who gather, take photographs, and climb on it. However, the level of illumination in the sculpture zone is notably poor at night, which diminishes the area's usability and safety during evening hours.

In terms of safety and security, not all zones within the park are adequately illuminated, and some areas lack clear sightlines, potentially creating hazards for visitors. As captured in **Figure 91- B**, insufficient lighting in certain locations raises safety concerns, particularly during evening hours. Additionally, the inconsistent maintenance of pathways and surrounding areas further contributes to safety risks, as illustrated in **Figure 91- C**.

A particularly pressing issue is the proximity of the playground to the street, which exposes children to potential dangers from traffic, as depicted in **Figure 91- D**. This close distance is a significant concern for parents, emphasizing the need for improved barriers or strategic landscaping to mitigate risks and enhance safety.



Figure 91. A - Park Sculpture, B - Illumination at Night, C - Unmaintained Pavement, D - Exposure to the Street at Prince Ibn Jalawy Park.

In terms of comfort and amenities, the drinking fountain, as illustrated in **Figure 92- A**, was found to be non-operational, presenting a significant inconvenience, particularly on hot days when access to hydration is essential. The public restrooms are also in poor condition, characterized by inadequate maintenance and a lack of cleanliness, which detracts from the overall visitor experience. Furthermore, these facilities are not universally accessible, restricting their usability for individuals with disabilities, as shown in **Figure 92- B**.

Another notable absence in the park is the lack of designated bicycle parking and pathways, which could encourage cycling as a sustainable mode of transportation both to and within the park, thereby promoting a more active lifestyle.

During the observation, two individuals were seen selling snacks and beverages, as shown in **Figure 92- C**. Their presence contributed to a lively atmosphere in the evening, as they set up a small stand near a popular gathering area. The availability of snacks and drinks appeared to attract families and groups, enhancing the overall experience for visitors spending time in the park after sunset.

It was observed that the park is not pet-friendly, as evidenced by the presence of cats in poor condition, as shown in **Figure 92- D**. Visitors were seen throwing food and water on the ground to feed them, raising concerns about sanitation and the health of both park users and animals. The lack of proper facilities or policies that support pets effectively highlights an area in need of attention. Addressing these issues could contribute to a healthier and more welcoming environment for both pets and park visitors, fostering a more responsible and inclusive atmosphere.



Figure 92. A - Inoperative Drinking Fountain, B - Restrooms, C - Snacks and Beverages Kiosks, D – Anti-Pet-Friendly Environment at Prince Ibn Jalawy Park.

4.3.Users' Satisfaction with the Parks Sustainable Landscape

Elements and Design Conditions

The data presented in **Table 8** was gathered through a community engagement approach involving structured surveys distributed to 20 park users, with five respondents selected from each of the four parks. The survey aimed to evaluate users' satisfaction levels with the quality of sustainable landscape elements and design conditions in each park. Responses were measured using a Likert scale ranges from 1 to 5, where 5 represents the highest level of satisfaction. A score of 1 indicates the lowest level of satisfaction, while “Not Applicable” reflects the complete absence of the specific feature.

Site 1 demonstrates a high level of user satisfaction, consistently achieving the highest scores across most criteria. Notable strengths include environmental considerations such as biodiversity, with a mean score of (4.9 out of 5), and heat mitigation strategies, scoring a mean of (4.8 out of 5). Additionally, socio-cultural aspects such as accessibility a mean of (4.8 out of 5) and aesthetics (mean score: 4.5 out of 5) further highlight the site's well-rounded approach to sustainability, functionality, and user- centered design.

Site 2 performs moderately well, excelling in flexibility and adaptability with a mean score of (4.8 out of 5), as well as socio-cultural design elements such as universal design, scoring a mean of (4.6 out of 5). However, it reveals significant areas for improvement in environmental and economic considerations, particularly in resource management, which scores a mean (2.2 out of 5). These limitations hinder the site's overall sustainability and impact.

In stark contrast, Sites 3 and 4 exhibit significant deficiencies in multiple areas. Site 3 scores particularly low in critical aspects such as the presence of water elements and the integration of smart technology, both receiving a score of (0 out of 5). Similarly, Site 4 demonstrates weaknesses in safety and security, with a mean of (1.6 out of 5), and socio-cultural considerations, such as community engagement, which scored (0.0 out of 5). Both sites lack foundational sustainable infrastructure and essential design features, are reflected in their overall mean scores of (2.33 and 2.11 out of 5), respectively. These shortcomings underscore the need for targeted interventions to enhance their sustainability, functionality, and alignment with user needs.

The overall mean scores reveal a clear ranking among the sites, with Site 1 achieving the highest satisfaction level (mean score: 4.54), followed by Site 2 (mean score: 3.97), while Sites 3 and 4 fall significantly behind. These results underscore the need for substantial improvements in Sites 3 and 4 to address their deficiencies in quality and functionality.

Although some individuals expressed dissatisfaction with the parks' quality and amenities, their continued visits were justified by the parks' proximity, as they were either the only available option in the neighborhood or the closest to their residence. This highlights the

importance of accessibility while emphasizing the need for enhanced park features to better meet community needs.

Table 8. Users' Satisfaction with the Quality of the Park's Sustainable Landscape Elements and Design Conditions.

Users' Satisfaction with the Quality of the Park's Sustainable Landscape Elements and Design Conditions in Four Sites						
Criteria			Site 1	Site 2	Site 3	Site 4
Environmental Considerations	Design conditions	Incorporating Shading (Natural or manufactured shade elements)	4.6	3.2	2.5	3.5
		Heat mitigation strategies (Green areas, shadings, water features like fountains, ponds, or misting systems)	4.8	3.5	2	2.4
		Biodiversity (Native plant species, creating wildlife habitats, Preserving existing natural features)	4.9	4.2	2.8	2.9
	Landscape elements	Green Lawn (Well-cleaned green spaces)	4.6	4.8	4.1	3
		Trees, Colourful and Dense Plantation	5	3.1	2.4	2.2
		Water element/ blue space	4.8	3.4	Not Applicable	Not Applicable
Economic Considerations	Design conditions	Efficient use of resources: Water management (Smart irrigation techniques, Incorporate moisture sensors, Weather-based controllers) Smart Waste Management (Recycling facilities, Smart bins, Waste reduction initiatives) Efficient use of energy (Utilizing renewable energy sources)	3.1	2.2	Not Applicable	Not Applicable
		Sustainable Construction Materials and Surface (Environmentally friendly and locally sourced materials, Maintenance, Light-coloured paving materials, Choice of materials and surfaces that minimize heat absorption and retain less heat)	4.3	3.8	1.5	1.9
		Appropriate Landscaping (Vegetation quality, Choice of heat-tolerant and drought-resistant plant species, Native plant species)	4.8	3.2	3.2	2.5
		Adding Function (Open space for mobility, Open space for commerce, Open space for recreation)	4.3	4.5	4.1	2.6
	Landscape elements	Flexibility and Adaptability (Movable furniture, Multipurpose spaces, Modular structures)	4.5	4.8	2.7	2.3
		Smart Technology Integration (The use of sensors and IoT devices)	4.7	3.5	Not Applicable	Not Applicable
		Regular maintenance and cleanliness (softscape, hardscape, urban furniture, and lighting)	4.8	4.8	3.4	2.8
Socio-cultural Considerations	Design conditions	Designing for Interactions (Promote human Interactions, promote human with environment Interactions, social events and consider different ages and genders)	4.2	4.3	4.5	3.9
		Easy Accessibility and Universal Design (Easily accessible to all members of the community, linked pathways, and entrances, parking)	4.8	4.6	4.8	2.1
		Community Engagement & sense of belonging (Workshops, Surveys, Public meetings, User diversity of different cultural backgrounds, Various activities)	4.8	4.8	Not Applicable	Not Applicable

		Aesthetics (Well-designed walkways, Attractive landscaping, Thoughtful use of colours and materials, Site image, public art, Cleanliness, and maintenance)	4.5	4.6	4.1	3.2
	Landscape elements	Circulation path (Pedestrian continuity, barrier free)	4.8	4.2	4.7	2.8
		Sculptures and landform	4.1	4.5	1.1	1.5
		Safety and Security (Adequate lighting, clear sightlines, Proper maintenance, Pedestrian privileged arrangement, not isolated from surroundings, Surveillance measures)	4.9	4.6	2.1	1.6
		Comfort and Amenities (Seating arrangement, Shaded spots, drinking fountains, public restrooms, Bicycle parking, Walking/ jogging track, Dustbins, Play area)	4.2	3.8	2.3	3.5
		Health and wellbeing: Active and Passive Recreation (Sports facilities, play areas, Walking paths, Contemplative spaces)	4.4	3.9	2.1	3.7
		Urban furniture (Adequacy and quality of furniture, Sufficient shaded spots)	4.6	4.1	1.5	2.2
		Wayfinding system (Clear directions, Signage)	4.8	2.8	Not Applicable	Not Applicable
		Mean			4.54	3.97

Based on the evaluation of sustainable landscape design elements across the four sites, the following areas require targeted improvements:

- **Incorporating Shading:** Site 3 demonstrates a significant need for both natural and manufactured shading elements to enhance user comfort.
- **Heat Mitigation Strategies:** Improved strategies for heat reduction are particularly necessary in Site 3, which received the lowest score in this category.
- **Biodiversity:** Site 3 requires substantial efforts to increase the use of native plant species and the creation of habitats that support local ecosystems.
- **Efficient Use of Resources:** Both Sites 3 and 4 need considerable advancements in resource efficiency, particularly through the adoption of water conservation techniques and sustainable practices.
- **Flexibility and Adaptability:** Sites 3 and 4 lack movable and multipurpose spaces, limiting their ability to accommodate diverse activities and user needs.

- **Community Engagement:** The absence of community engagement initiatives in Sites 3 and 4 undermines the potential for fostering a sense of belonging among park users.
- **Accessibility and Universal Design:** Site 4 requires significant enhancements to ensure the park is accessible to all community members, including individuals with mobility challenges.
- **Safety and Security:** The low scores for safety in Sites 2 and 3 highlight the need for improved measures, in safety measures, such as adequate lighting, clear sightlines and surveillance.

4.4. Subjective Well-Being Assessment (SWB)

This section presents the analysis of data collected through randomized surveys administered to 202 users across the selected urban community parks. The primary objective of the analysis is to assess individuals' subjective well-being, drawing upon both quantitative and qualitative responses.

4.4.1. Hills Park SWB Analysis

The survey was distributed to over 100 individuals, with 32 participants responding. The chart in **Figure 93** highlights that the park generally offers a positive experience for visitors. The data reveals strong positive outcomes, with "Likelihood to recommend" achieving the highest mean score of (4.75 out of 5), followed closely by "Likelihood to revisit" at (4.63). These results suggest that visitors find their experiences highly satisfying and are motivated to share and repeat their visits. Metrics such as "Connection with nature" (mean: 4.50), "Positive mood and emotional state" (mean: 4.38), and "Promote physical

activities" (mean: 4.38) further illustrate the park's success in fostering tranquility, emotional upliftment, and physical engagement among users. The "Overall happiness" score (mean: 4.50) aligns closely with these findings, reinforcing the park's role in enhancing visitors' well-being.

A notable outlier is the relatively low score for "Encounter negative emotions" (mean: 1.69), indicating minimal occurrence of adverse feelings during park visits. This low score is a positive indicator, suggesting that the park effectively minimizes stressors or discomforts that could detract from the overall user experience.

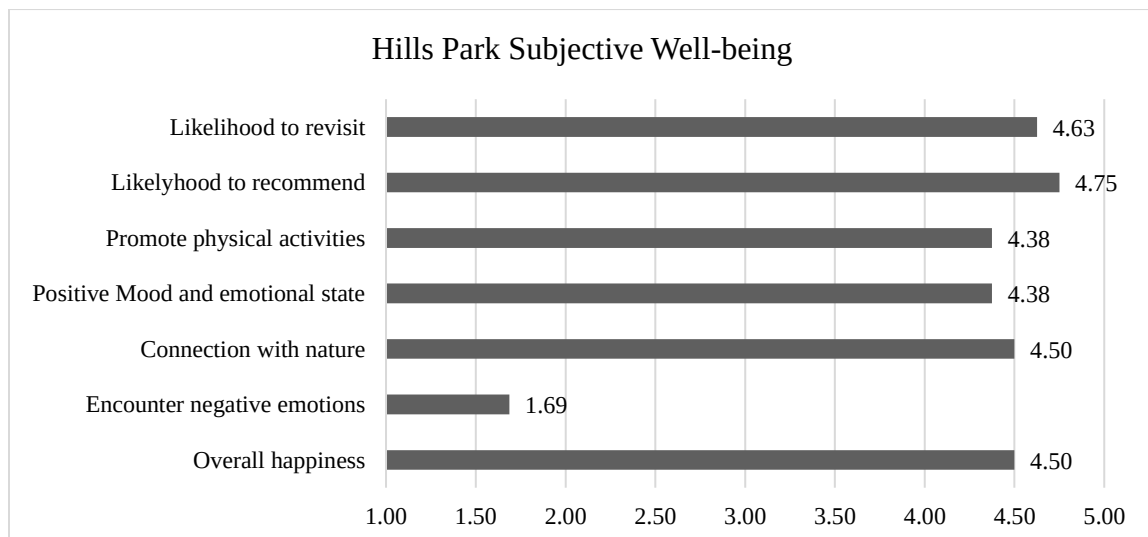


Figure 93. SWB Assessment at Hills Park.

The chart in **Figure 94- A** depicts the frequency of park visits based on 32 responses. A significant number of respondents, 43.8% reported visiting daily, indicating a strong pattern of regular attendance. Furthermore, 31.3% of participants visit the park several times a week, while 12.5% reported visiting once a week. Smaller segments of the population include those who visit every other week and those who visit occasionally (less than once a month), with one respondent indicating that it was their first visit.

The pie chart in **Figure 94- B** presents the duration of time respondents spent in the park. Notably, 50% reported spending 1-2 hours in the park, making it the most common duration of visit. Additionally, 43.8% of respondents indicated spending 3-4 hours, suggesting a substantial interest in longer stays. A smaller segment of visitors allocated 5-6 hours to their time in the park. Overall, the data highlights that while many visitors prefer shorter visits (1–2 hours).

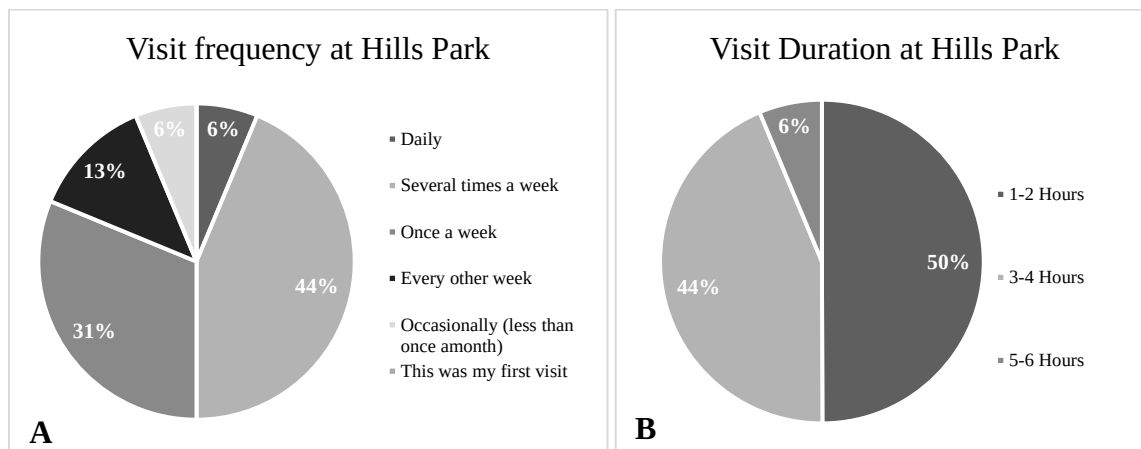


Figure 94. A - Frequency of Visits, B - Duration of Visits at Hills Park.

The bar chart in **Figure 95** illustrates the primary motivations for park visit as reported by respondents. The most frequently cited reasons were exercise and physical activities, as well as spending time with family and friends, each mentioned by 68.8% of participants. Relaxation and the enjoyment of nature and green spaces, along with children's activities, followed closely, with 62.5% of respondents identifying these as key motivators. In contrast, walking to a destination emerged as the least common reason, noted by only 12.5% of participants.

This data underscores the park’s primary role as a venue for active leisure and social engagement. Additionally, the significance of nature appreciation reflects the park’s appeal as a space for relaxation and connection with the natural environment.

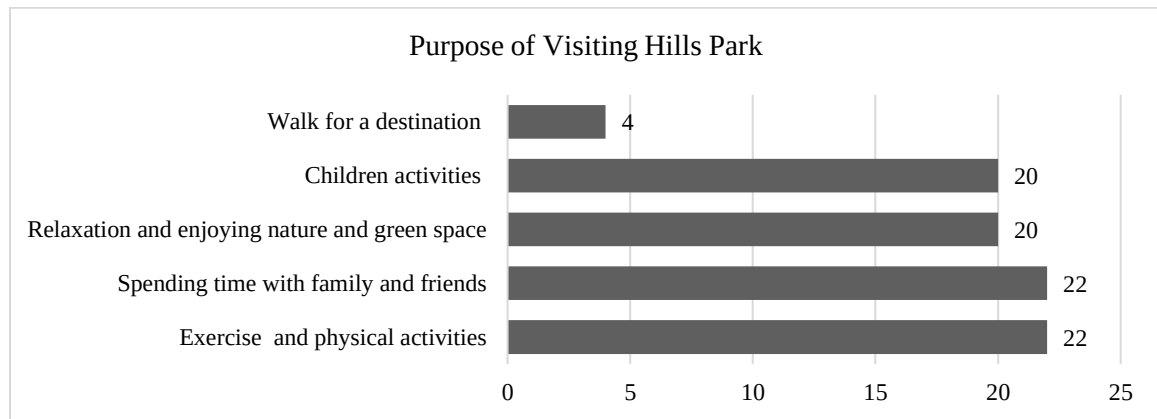


Figure 95. Purpose of Visiting Hills Park.

Several suggestions and comments have been raised regarding improvements to the park's facilities. One notable request is the addition of sports equipment and dedicated cycling paths, which would encourage visitors to bring their bicycles and promote a healthier, more active lifestyle. Another concern is the absence of vending machines for refreshments and water, a feature that would enhance visitor convenience, particularly during warmer months. Furthermore, many expressed a desire for restaurants and cafes to remain operational throughout the summer, as their seasonal closures contribute to a sense of emptiness within the park.

Additional recommendations include the development of a skateboarding area specifically designed for children. Overall, while the park is well-maintained, there is a strong demand for enhancements that prioritize physical activities, the inclusion of sports equipment, and interactive games for children.

4.4.2. Ithra Park SWB Analysis

The survey was distributed to over 100 park users, with 81 respondents participated. As illustrated in **Figure 96**, the chart presents respondents' SWB at Ithra Park, measured through various questions using a Likert scale ranging from 1 to 5.

The analysis of subjective well-being at Ithra Park reveals several key insights. The bar chart demonstrates high scores across multiple aspects of SWB. The data indicates strong positive outcomes, with the highest mean score recorded for "Overall happiness" (4.40 out of 5), followed closely by "Likelihood to revisit" (4.38). These results suggest that visitors are highly satisfied with their experiences and are eager to return.

Furthermore, "Connection with nature" (4.33) and "Positive mood and emotional state" (4.31) indicate that the park successfully fosters a sense of connection and promotes mental well-being. However, "Promote physical activities" scored a mean of (3.04) highlights an area requiring improvement in encouraging physical engagement among visitors.

In contrast, the notably low score for "Encounter negative emotions" (2.47) reflects a minimal occurrence of adverse feelings during park visits, suggesting that the park effectively minimizes stressors that could detract from the user experience.

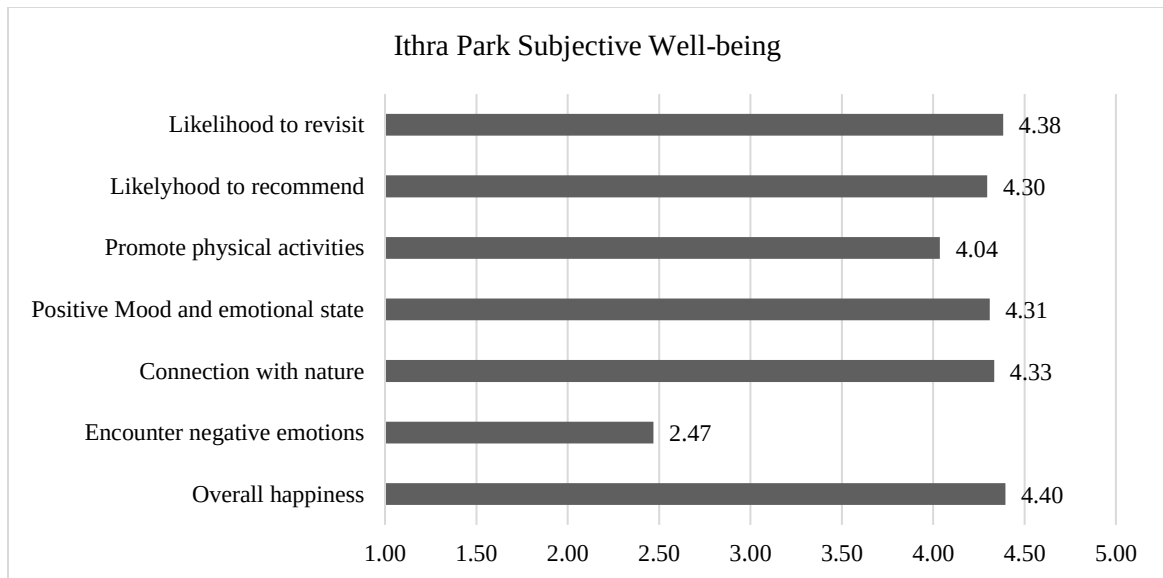


Figure 96. SWB Assessment at Ithra Park.

The pie chart in **Figure 97- A** illustrates the frequency of respondents' visit to Ithra Park, based on 81 responses. A significant portion, 38.3%, reported visiting the park daily, indicating strong regular engagement. Additionally, 18.5% visit several times a week, while 14.8% visit once a week. Approximately 11.1% of respondents visit every other week, and another 11.1% visit occasionally, defined as less than once a month. Lastly, 6.2% indicated that this was their first visit.

As **Figure 97- B** illustrates the amount of time respondents spend at Ithra Park. A substantial 69% of participants reported spending 1-2 hours in the park, making this the most common duration of stay. Meanwhile, 16% spend 3-4 hours, suggesting that a smaller yet notable group enjoys extended visits. Additionally, 9% of respondents dedicate 5-6 hours to their time at the park, while only 6% spend less than an hour, representing a minor portion of visitors with brief stays.

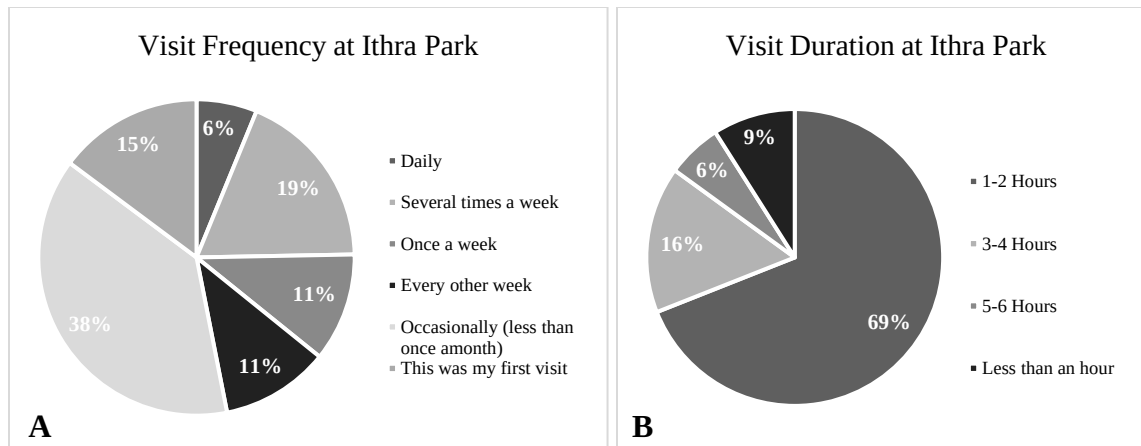


Figure 97. A - Visit Frequency, B - Visit Duration at Ithra Park.

The bar chart in **Figure 98** illustrates the various activities that respondents engage at Ithra Park. The most popular activity, reported by 58.8% of respondents, is relaxation and enjoying nature. This is followed by spending time with family and friends, which was selected by 50% of participants. Walking to a destination, such as another building, accounts for 45%, indicating a common purpose for visits. Exercise and physical activities are reported by 18.8% of respondents, while children's activities are noted by 6.5%. This data highlights that relaxation and social interaction are the primary reasons people visit the park.

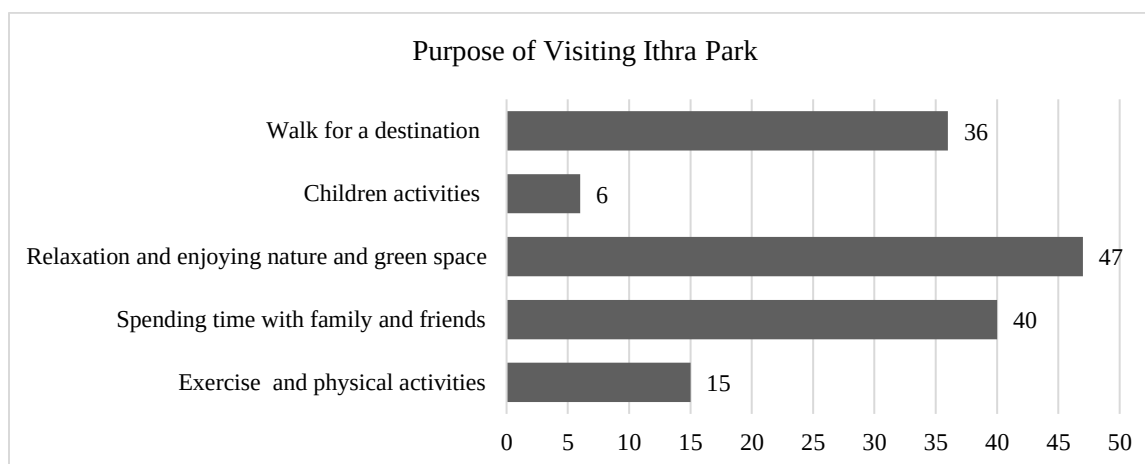


Figure 98. Purpose of Visiting Ithra Park.

Regarding the visit duration of less than 2 hours and frequency of every other week or less often, 21 responses were collected. The most common reason for brief visits is hot weather, cited by 19% of respondents. Additionally, four respondents mentioned taking a break from studying as their primary reason for visiting the park briefly. Feedback collected from 15 respondents regarding comments and suggestions provides valuable insight into enhancing the park experience. Several participants emphasized the need for more interactive elements, such as shaded seating areas and permanent food truck options, rather than relying solely on seasonal events. There were calls for establishing coffee shops within the park and expanding weekly activities for children to move beyond the current seasonal offerings. Overall, the responses reflect a strong desire for more consistent amenities and activities that cater to visitors' needs throughout the year.

4.4.3. Shells Park SWB Analysis

The survey was distributed to over 100 people, with 57 respondents participating. As depicted in **Figure 99**, the bar chart evaluates various aspects of SWB at Shells Park, revealing moderate outcomes. "Overall happiness" received a mean of (3.25 out of 5), indicating a generally satisfactory but not exceptional experience. The "Likelihood to revisit" scored (3.11), suggesting that some visitors may be hesitant to return, while the "Likelihood to recommend" was slightly lower at (3.02). Scores for "Promote physical activities" (3.32) and "Positive mood and emotional state" (3.23) suggest that the park provides some opportunities for physical engagement and emotional upliftment, although there is room for improvement. The score for "Connection with nature" stands at (2.93), indicating that many visitors may not feel a strong connection with the park's natural elements. Lastly, the mean score of "Encounter negative emotions" is (3.00 out of 5),

reflecting a neutral emotional experience among visitors. Overall, these findings highlight opportunities for improvement to enhance the well-being and satisfaction of visitors at Shells Park.

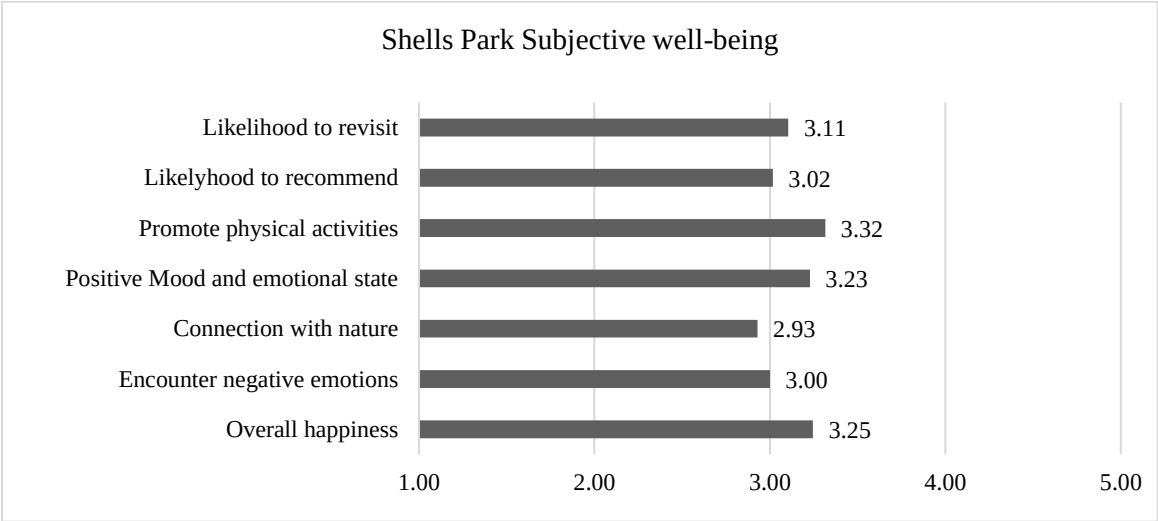


Figure 99. SWB assessment at Shells Park.

The pie chart in **Figure 100- A**, which depicts visitor frequency at Shells Park, provides valuable insights into user engagement. The largest segment, comprising 26.8%, represents visitors who attend the park several times a week. Some people visiting daily by 8.9%, and 16.1% once a week, indicating a strong base of frequent users. A further 17.9% of respondents visit every other week, while 14.3% visit occasionally. This diverse range of visitation frequencies indicates that Shells Park appeals to both regular attendees and newcomers. These findings suggest opportunities to enhance visitor retention strategies, particularly by converting occasional and first-time visitors into more frequent attendees to build a sustainable visitor base.

Figure 100- B illustrates the distribution of time spent in the park, as reported by survey respondents. A significant portion, 56%, indicated spending 1-2 hours in the park, making this the most common duration. Additionally, 26% of respondents spent 3-4 hours, while

13% preferred spending 5-6 hours. Only 5% reported spending less than an hour at the park.

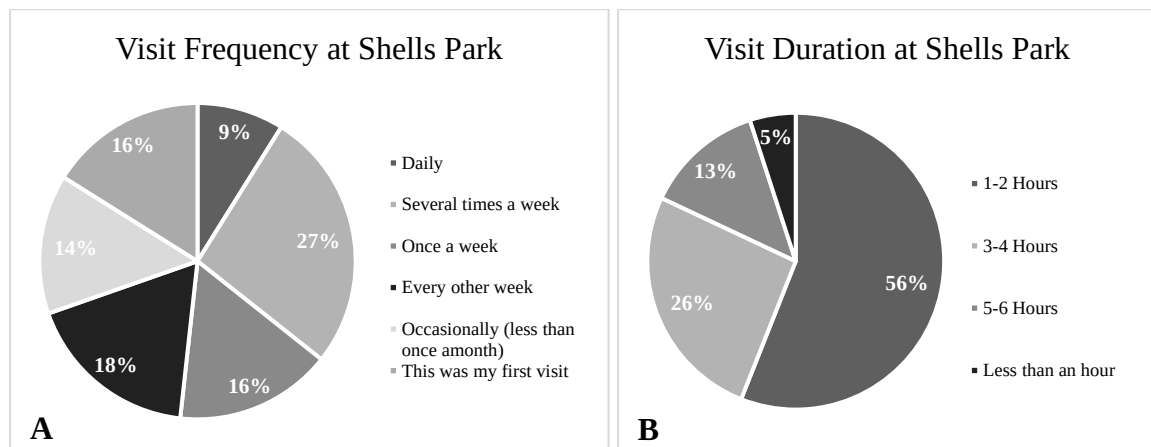


Figure 100. A - Visit Duration, B - Visit Frequency at Shells Park.

Figure 101 illustrates the primary reasons for visiting the park. The most frequently cited reason, selected by 61.1% of respondents, is "spending time with family and friends." Other significant motivations include "children's activities" 48.1%, "exercise and physical activities" 29.6%, "relaxation and enjoying nature" 27.8%, and "walking to a destination" 24.1%. These findings underscore the park's role as a social and family-oriented space. Feedback from respondents who reported visits lasting less than two hours and occurring every other week or less frequently revealed a variety of sentiments about the park.

Extreme weather conditions, particularly heat, were commonly mentioned as a factor influencing visitation patterns. Concerns about safety were also prevalent, particularly regarding children and traffic. Several respondents expressed hesitation to leave their children unattended due to the park's direct access and proximity to nearby roads. Additionally, some respondents highlighted a perceived lack of privacy for women in the park. Others noted insufficient amenities catering to adults, potentially impacting adult

visitation rates. Maintenance issues were also raised, including noise from the sports field, inadequate pathways, and cleanliness concerns, all of which were identified as areas requiring improvement.

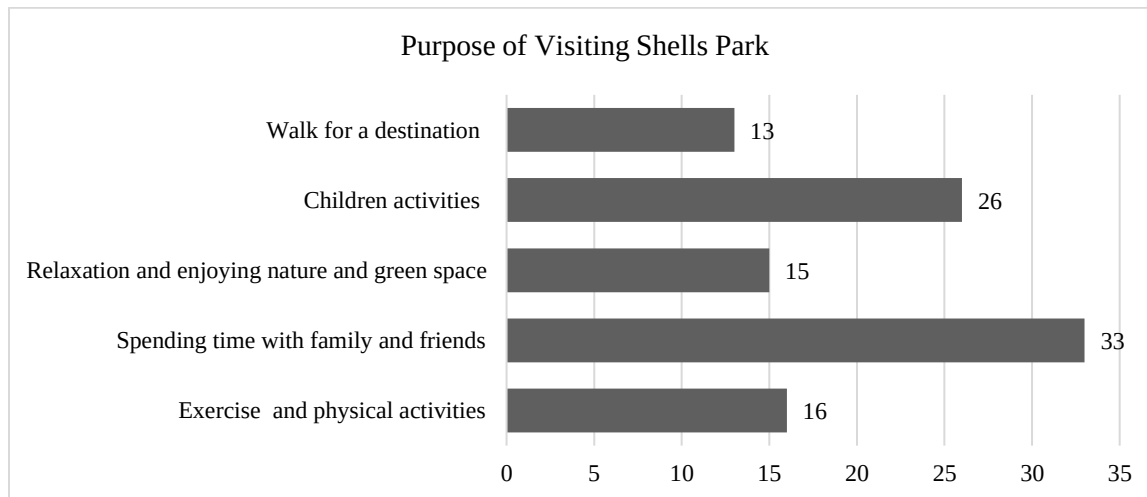


Figure 101. Purpose of Visiting Shells Park.

The 32 responses regarding comments and suggestions for the park highlight several key areas for improvement. Cleanliness and maintenance emerged as recurring themes, with many respondents advocating for better upkeep of facilities and more regular cleaning. Safety enhancements were also a significant focus, with suggestions including the installation of adequate lighting and the construction of a fence to protect children from nearby traffic.

Many respondents emphasized the need for additional children's play equipment/ area, noting that the current offerings are insufficient to accommodate the number of children in the park. Suggestions also included adding facilities such as restrooms and chairs/tables, improving landscaping, and introducing educational and physical activities to better engage families. A safer play environment was another priority, with some respondents recommending the use of softer surfaces instead of sand in play areas. Additionally, a few respondents highlighted the need for sports equipment and a tennis court, to expand

recreational opportunities. Overall, the feedback reflects a strong community desire for a more functional, safe, and enjoyable park that caters to the diverse needs of visitors, particularly children and families.

4.4.4. Prince Ibn Jalawy Park SWB Analysis

The survey was distributed to over 100 individuals, with only 32 participants responding. As illustrated in **Figure 102**, the bar chart evaluates SWB at Ibn Jalawy Park, revealing low satisfaction levels. "Overall happiness" received a mean score of (3.03 out of 5), indicating moderate satisfaction. The "Likelihood to revisit" scored a notably low mean of (2.66), suggesting that many visitors may be reluctant to return. Similarly, the "Likelihood to recommend" received an even lower score of (2.14), reflecting significant hesitance in endorsing the park to others.

Scores for "Promote physical activities" (2.91) and "Positive mood and emotional state" (3.09) indicate that while the park provides some opportunities for engagement and emotional upliftment, these are insufficient to deliver a compelling experience. The "Connection with nature" scored (2.75), signifying a weak bond between visitors and the park's natural elements. Lastly, "Encounter negative emotions" scored a mean of (2.72) suggests a moderate occurrence of adverse feelings during visits.

These findings highlight several areas for improvement to enhance the overall well-being and satisfaction of visitors at Ibn Jalawy Park.

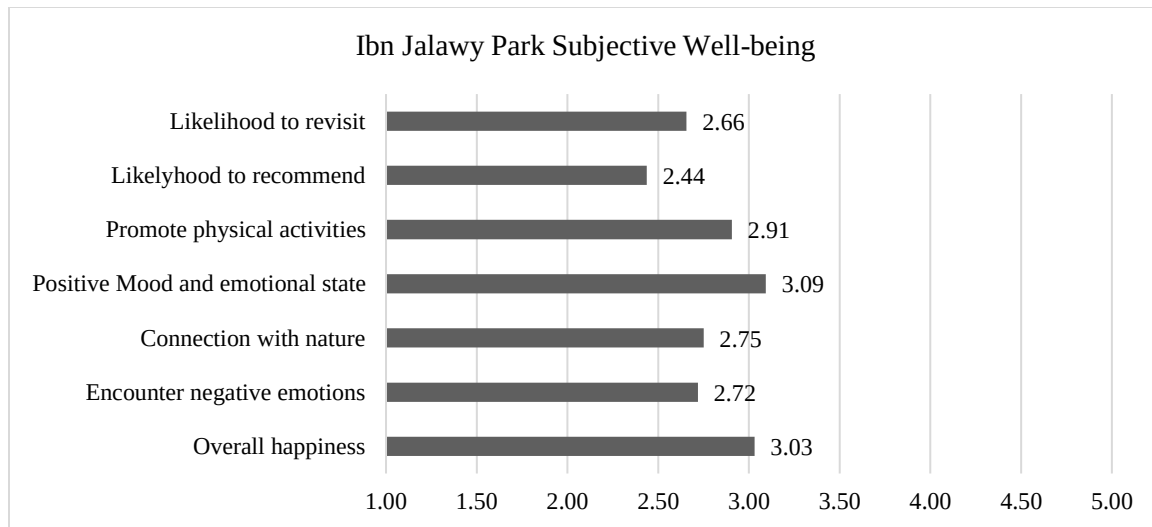


Figure 102. SWB Assessment at Ibn Jalawy Park.

The pie chart in **Figure 103- A** illustrates diverse visitation patterns to the park. The most common frequency is once a week, with 29% of respondents incorporating it a regular part of their routine. Additionally, 25.8% visit occasionally, less than once a month, indicating the park's popularity as a choice for infrequent visits. Meanwhile, 19.4% visit several times a week, reflecting a high level of engagement. Less frequent visitors include those who visit every other week, while daily visitors, comprising 6.5% of respondents, likely reflect strong attachment or proximity to the park. First-time visitors constitute 12.9% of respondents. As shown in **Figure 103- B**, the survey results reveal a significant preference for shorter visits to the park, with 58% of respondents spending 1-2 hours there. Additionally, 26% of participants reported spending 3-4 hours, reflecting a moderate level of engagement. Notably, only a small proportion of respondents 16% spent 5-6 hours or less than an hour, suggesting that extended visits are relatively uncommon.

The feedback regarding visits lasting less than two hours and occurring every other week or longer highlights a mix of motivations and concerns. Many respondents visit for

exercise, particularly jogging, or for family time, emphasizing its role as a convenient space for physical activity and recreation.

However, some respondents expressed dissatisfaction with the park's maintenance, highlighting issues such as cleanliness and the condition of facilities, which detracts from the overall experience. Additionally, the absence of amenities such as restrooms and insufficient safety measures for children near busy roads further reduces the park's appeal. Overall, while the park serves an important role for nearby residents, addressing these maintenance and safety concerns could significantly enhance its attractiveness and encourage more frequent visits.

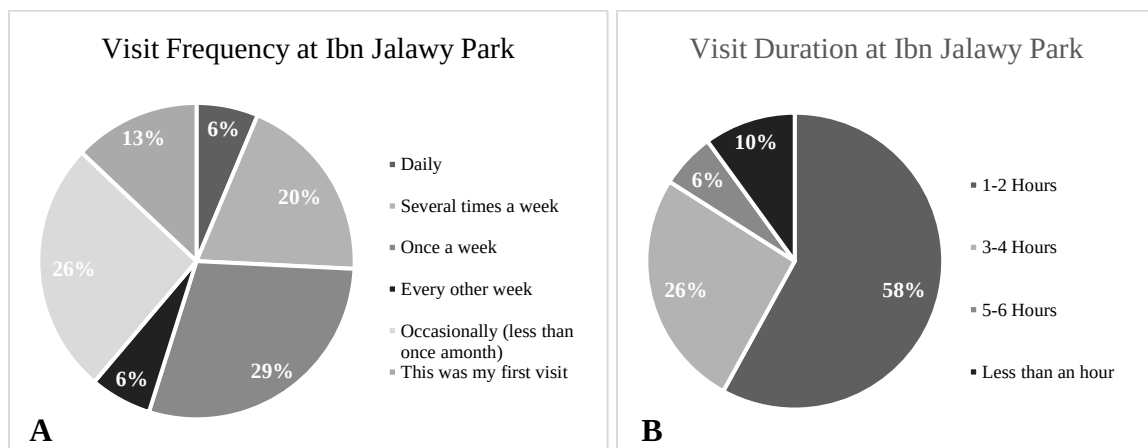


Figure 103. A - Visit Frequency, B - Visit Duration at Ibn Jalawy Park.

As illustrated in **Figure 104**, the survey results reveal that the primary reason for visiting the park is spending time with family and friends, selected by 64.5% of respondents. This finding indicates that the park is highly valued as a social space for gatherings and shared experiences. Following this, 41.9% of participants cited exercise and physical activities as their main motivation, emphasizing the park's role in promoting health and fitness. Other reasons include children's activities, 38.7% and relaxation 22.6%, suggesting that while the

park primarily functions as a social and recreational venue, it also serves as a space for physical engagement and leisure. The lower percentages for walking for a destination, 9.7% suggest that visitors are more likely to use the park for social and recreational purposes rather than as a transit route to other locations. These findings underscore the park's significance as a community hub, fostering family interactions and supporting physical well-being.

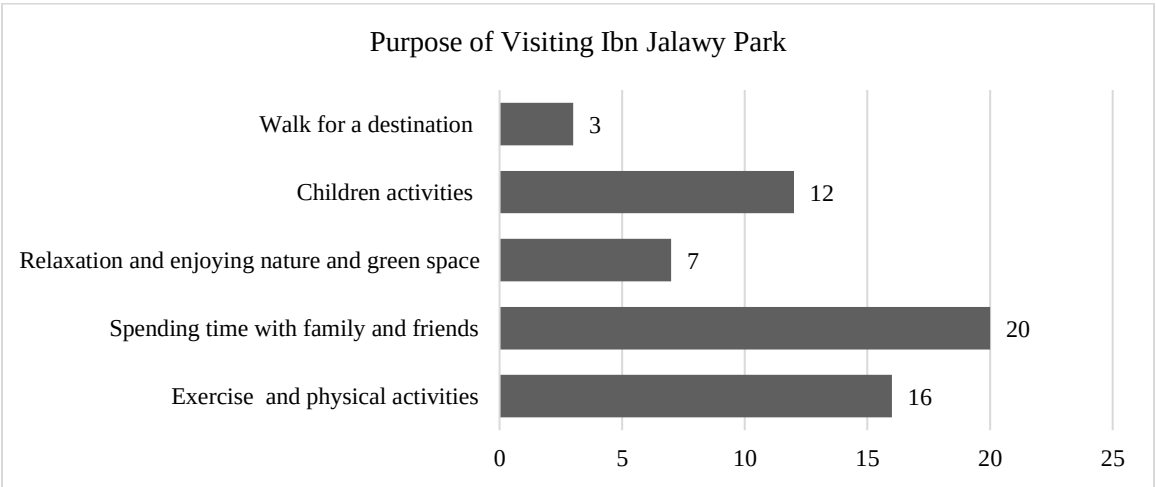


Figure 104. Purpose of Visiting ibn Jalawy Park.

Feedback from respondents highlights several key areas for improvement in the park. A recurring concern is the need for enhanced cleanliness and maintenance, particularly regarding restrooms, which many found unsatisfactory. Suggestions for additional amenities, such as more children's entertainment options and food kiosks, reflect a desire for facilities that encourage longer visits and enhance the overall experience.

Safety concerns were also prominent, especially regarding crowded play areas and inadequate lighting at night, underscoring the importance of creating a secure environment for families. Additionally, the need for more garbage bins and clearer rules about littering highlights opportunities for better management of the park's cleanliness. Overall, these

insights indicate that addressing maintenance issues, expanding facilities, and improving safety measures could significantly enhance the park's appeal and usability for the community.

4.5. Chapter Summary

Based on observations of the four parks (Dhahran Hills Park, Ithra Park, Shells Park and Prince Ibn Jalawy Park), several common trends, patterns and weaknesses were identified.

A notable trend was the thoughtful landscape design employed at each park to create harmonious, aesthetically pleasing spaces that balanced built and natural environments, particularly at Dhahran Hills Park. Features such as native plants, preserved topography and the incorporation of water elements like lakes and fountains significantly enhanced the visual appeal and ambiance of the parks.

A common positive trend across all parks was the presence of well-integrated pathway networks, which facilitated intuitive exploration and navigation, enhancing the overall visitor experience. Accessibility considerations were thoughtfully implemented to ensure inclusivity for visitors of varying abilities. The provision of diverse seating options as part of the urban furniture enhanced opportunities for relaxation and social interaction, fostering social cohesion within vibrant, activity-filled communal spaces.

In terms of safety, features such as surveillance systems, adequate lighting, and clear sightlines contributed to strengthening the security profiles at (Hills and Ithra Parks). However, certain hazards, such as park exposure to adjacent streets, require prompt attention and rectification to ensure visitors' safety.

In terms of sustainability efforts, two parks (Dhahran Hills Park, Ithra Park) demonstrated commendable practices, such as the adoption of renewable energy and the use of recycling-friendly materials. Another strength was their spatial flexibility, with multi-functional zones and movable structures that catered to diverse user needs.

A recurring weakness across three sites (Ithra Park, Shells Park, and Prince Ibn Jalawy Park) was the insufficient tree coverage and lack of flowering species. This limitation detracts from the parks' potential for biodiversity, shade provision and seasonal color variation. However, weaknesses were evident other two parks (Shells Park and Prince Ibn Jalawy Park), particularly the absence of comprehensive waste reduction and recycling systems. This highlights the need for more robust initiatives to minimize environmental impact. The absence of drinking fountains in (Dhahran Hills Park, Ithra Park, and Shells Park) with inadequate shading in (Ithra Park, Shells Park, and Prince Ibn Jalawy Park) negatively impacted on visitors' comfort and overall experience, particularly during extreme weather conditions.

In terms of creating a pet-friendly environment, it was observed that all parks lacked specific provisions to accommodate pets. The absence of dedicated facilities, such as water fountains or feeding stations for animals, compelled visitors to resort to practices like throwing food on the ground to feed cats. This not only raises sanitation concerns but also highlights a gap in the park's management in terms of addressing the needs of pets.

Cleanliness at both (Dhahran Hills Park and Ithra Park) was well-maintained, with hygienic conditions observed across the landscapes, pathways, and urban furniture. However, Hills Park stood out for its notable strength: the implementation of recycling and composting

systems aimed at minimizing waste and promoting sustainable practices. Regarding the maintenance, Hills Park demonstrated a clear commitment to upkeep, with annual activities conducted to ensure long-term quality. Hardscape features, such as walkways, were diligently repaired, while softscape elements, including vegetation, were carefully pruned and replanted as necessary. To summarize the common weaknesses across the analysed park, the following issues were identified:

- Insufficient shaded areas
- Unattractive landscape design
- Limited consideration for heat mitigation strategies
- Insufficient use of sustainable materials
- Lack of community engagement
- Anti-pet-friendly environment
- Minimal integration of renewable energy and smart technologies
- Inadequate waste management
- Limited sustainability awareness
- Inconsistent maintenance and cleanliness
- Absence of essential park services, such as restrooms and drinking fountains
- Inadequate wayfinding system
- Safety concerns, including park boundaries and inadequate lighting at night
- Lack of sports equipment and facilities
- Minimal consideration of universal design principles
- Insignificant attention to users' needs and human behavior in the design process

It is recommended that a unified approach to these insights empower decision-makers to enhance strengths, address vulnerabilities, and elevate each park's performance in serving surrounding communities.

The radar chart in **Figure 105** below illustrates the distribution of various activities across four sites. Site 1 shows a high engagement in physical activities such as walking and jogging, as well as spending time with family and friends, relaxation, and children's activities. Site 2 stands out with the highest scores for relaxation, spending time with family and friends, and walking for a destination, highlighting its role as both a social hub and a transit area.

In Site 3, children's activities are notably favored, although spending time with family and friends received the highest score, followed by children's activities. While children's activities are present across all sites, they are most strongly correlated with spending time with family and friends in Site 4, suggesting a particularly family-friendly atmosphere. Walking to a destination score lower, indicating that visitors primarily perceive these parks as spaces for socializing and recreational activities rather than transit points.

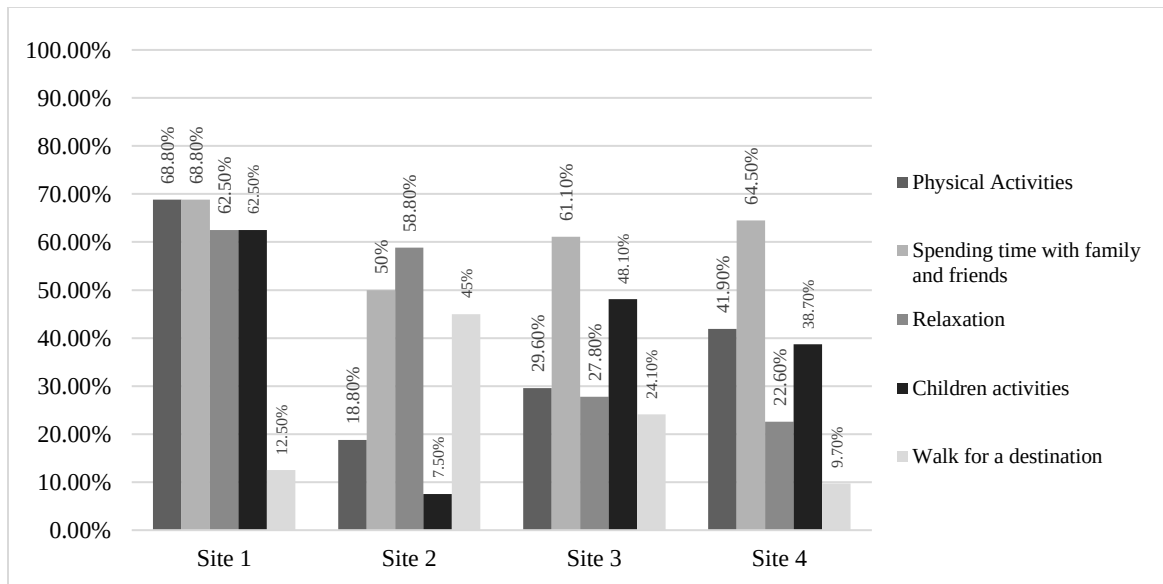


Figure 105. Purpose of Visiting the Parks.

The radar chart in **Figure 106** analyses five key aspects across four sites: Site 1, Site 2, Site 3, and Site 4.

Overall happiness averages are consistently high, particularly at Site 1 and Site 2. Negative emotions are the least prevalent across all sites, though they are more noticeable at Site 3 and Site 4. Connection to nature is strongest at Site 1 and Site 2, slightly lower at Site 3 and Site 4, but remains positive. The likelihood of recommending the park is high at all sites, with Site 1 and Site 2 performing best in this regard. Similarly, the intention to revisit the park is consistently high, with Site 1 leading.

Overall, Sites 1 and 2 demonstrate the most positive responses, while Sites 3 and 4 show comparatively less favorable outcomes, particularly concerning negative emotions.

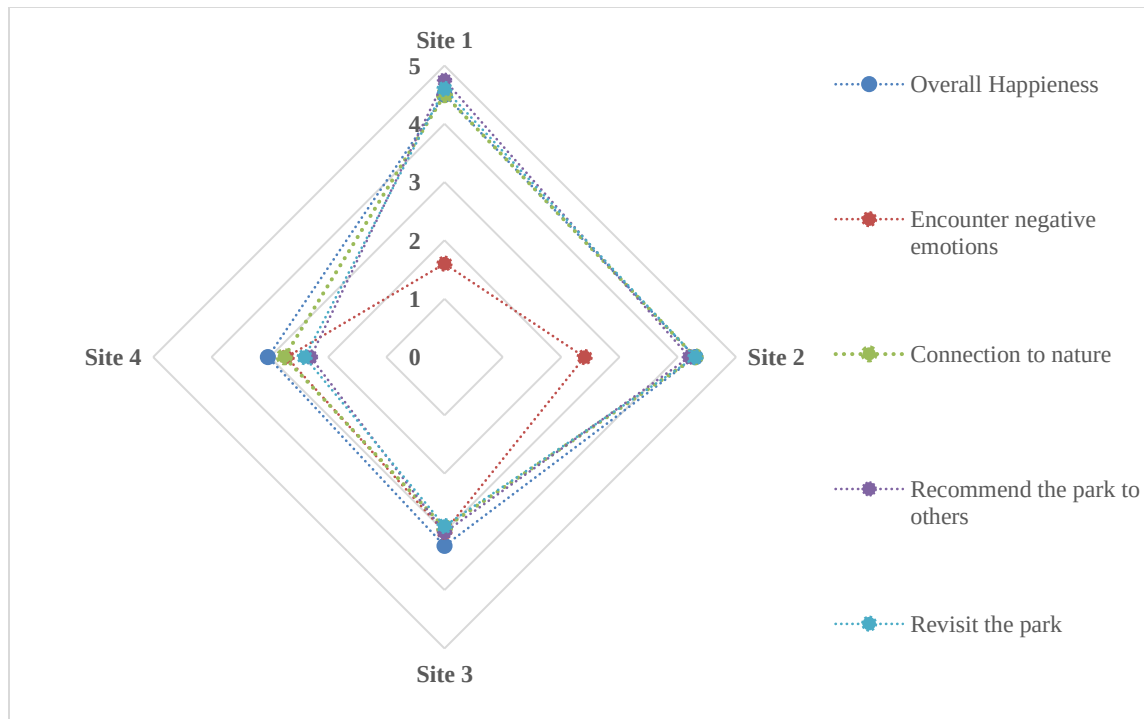


Figure 106. SWB Mean Across the Four Parks.

Based on the analysis of (SWB) across four community parks (Hills Park, Ithra Park, Shells Park, and Ibn Jalawy Park) several key conclusions can be drawn regarding their impact on visitors' overall well-being:

- **Comparative Analysis and Visitors Satisfaction:**

Hills Park and Ithra Park consistently outperform Shells Park and Ibn Jalawy Park in terms of overall happiness and connection to nature. This indicates that visitor experiences at Shells Park and Ibn Jalawy Park may be less fulfilling, suggesting potential areas for development.

Both Hills Park and Ithra Park demonstrate high levels of visitor satisfaction. This is evident from the high mean scores for likelihood to revisit, with Hills Park scored 4.63 and Ithra Park scored 4.38. Similarly, the likelihood of recommending these parks to others is

reflected in mean scores of (4.75) for Hills Park and (4.30) for Ithra park. These results indicate that both parks effectively meet the needs and expectations of their users.

In Shells Park, visitor satisfaction is moderate, with identified areas for improvement in maintenance and safety features. Concerns about cleanliness and the safety of children were frequently reported, indicating the need to enhance these aspects to improve the overall visitor experience.

In Ibn Jalawy park, while visitor engagement is moderate and emotional experiences are balanced, significant improvements are needed in maintenance and safety. Although the park serves as a notable social hub, addressing issues related to cleanliness and safety could significantly enhance its appeal.

- **Primary Motivations:**

Across all parks, social interactions and physical activities are the primary drivers for visitation. The majority of respondents cited spending time with family and friends and engaging in exercise as their main motivation for visiting.

4.6. Reformulating the Framework for Designing Sustainable Urban Community Parks

The newly reformulated framework, depicted in **Figure 111**, offers a comprehensive approach by tailoring its design to the context of Al-Khobar city. This framework integrates observational methods to collect real-world data on behaviors, interactions, and the evaluation of landscape and design conditions, providing a holistic understanding of park usage. To incorporate community perspectives, assessments of users' well-being, overall happiness, and satisfaction are included through surveys. These surveys aim to assess

individual experiences and perceptions, thereby complementing the qualitative insights derived from observational data.

The interrelationship between the principles influencing sustainable urban community parks is essential to achieving a balanced and holistic development, as illustrated in **Figure 107**. Sociocultural considerations promote community engagement and inclusivity, ensuring that parks address diverse community needs and respect cultural values. Economic considerations prioritize financial viability, incorporating cost-efficient practices and generating economic benefits to sustain long-term maintenance and growth. Environmental considerations emphasize biodiversity preservation and minimizing ecological impact, resulting in resilient and resource-efficient parks.

These principles are interconnected, collectively enhancing the quality of life. This framework is further supported by smart enablers, such as innovative technologies and strategic planning, which strengthen and integrate these principles. Together, they create a cohesive framework where each principle complements the others, facilitating the successful implementation of sustainable practices and fostering the continuous improvement of sustainable urban community parks.

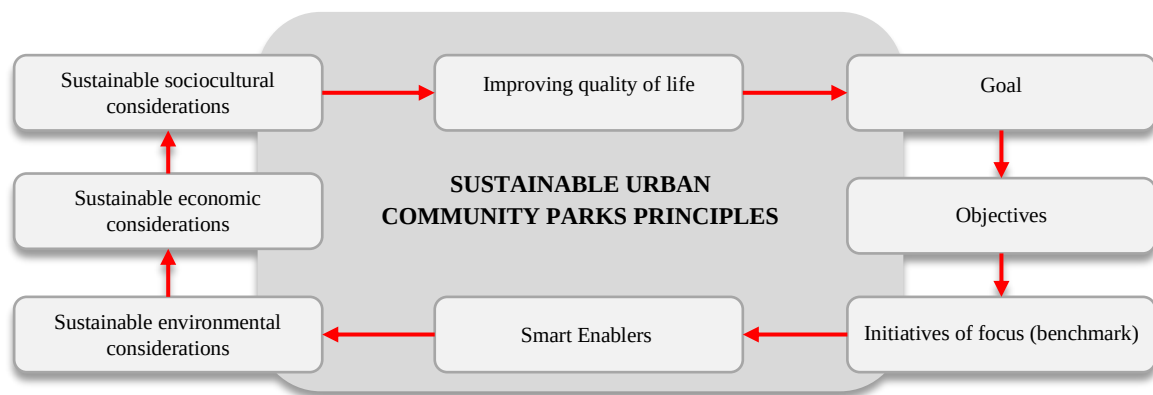


Figure 107. Interrelationship Between the Principles Affecting Sustainable Urban Community Parks.

In Saudi Arabia, urban community parks are shaped by the region's hot climate and culture context, as illustrated in **Figure 108**. The interrelationship between several factors and design elements is crucial for creating functional and inviting spaces.

Climate considerations necessitate the incorporation of green lawns, dense plantations, and water features to provide natural cooling and shade, ensuring comfort in high-temperature environments.

Culturally relevant elements, such as sculptures, enhance the park's identity by reflecting local culture and aesthetics. Sustainable construction materials promote durability and environmental compatibility, while urban/park furniture provides shaded, comfortable seating areas for visitors.

The integration of smart technology improves park management and enhances user experiences, while regular maintenance practices ensure longevity, cleanliness, and appeal of the park. Circulation paths enhance connectivity and accessibility, facilitating seamless movement and encouraging social interaction.

Additionally, safety and security measures, coupled with features promoting health and well-being, ensure a safe and inclusive environment for all visitors. Collectively, these elements not only address the challenges posed by the hot climate but also foster cultural resonance and user-friendliness, resulting in sustainable and engaging urban community parks.

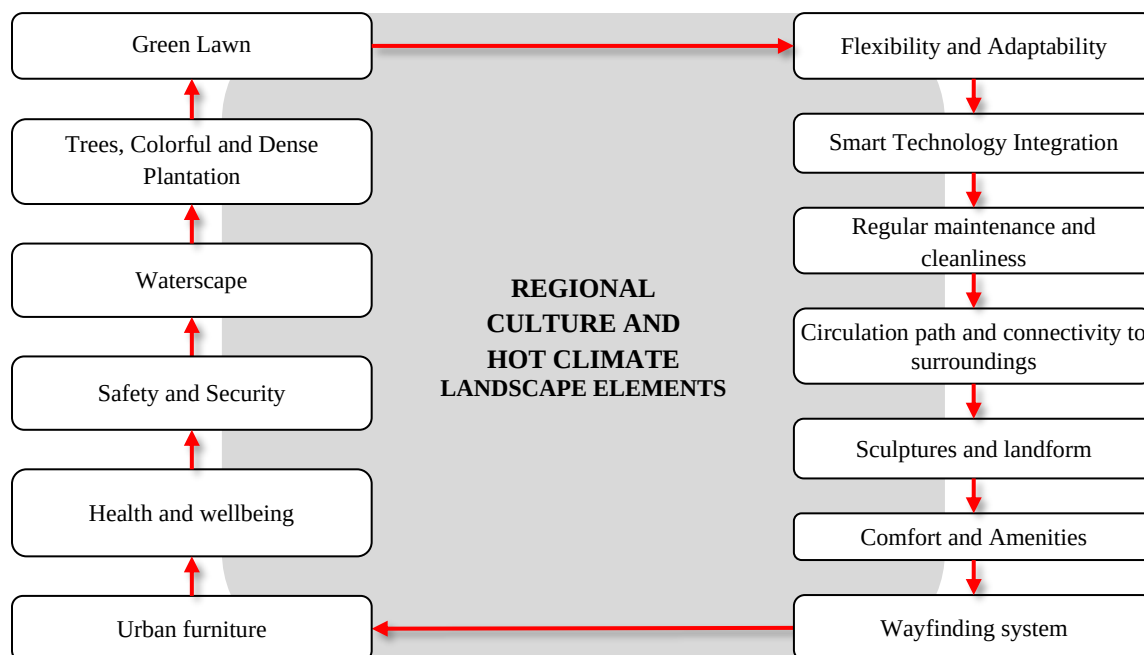


Figure 108. Interrelationship Between Landscape Elements of Urban Community Parks Influenced by Regional Hot Climate and Culture.

As illustrated in **Figure 109**, three additional criteria (pet-friendly environment, sustainability awareness, and prioritize people's needs and behavior) have been incorporated into the framework based on findings from naturalistic observation and SWB analysis. The design conditions of urban community parks in hot climates are intricately linked to environmental, economic, and cultural factors. To address the challenges posed by the climate, the integration of shading and heat mitigation strategies is essential for creating comfortable outdoor spaces.

Biodiversity and appropriate landscaping not only enhance ecological health but also improve visual appeal, aligning with sustainability awareness and aesthetic values. The efficient use of resources reinforces environmental responsibility, while the addition of functional elements supports diverse activities and interactions. Culturally, urban community parks must prioritize people's needs and behaviors, fostering a sense of

community engagement and belonging. Pet-friendly environments and the application of universal design principles ensure inclusivity and accessibility for all users. Additionally, designing interactions promotes socialization and community building, reflecting cultural values and enhancing the overall user experience.

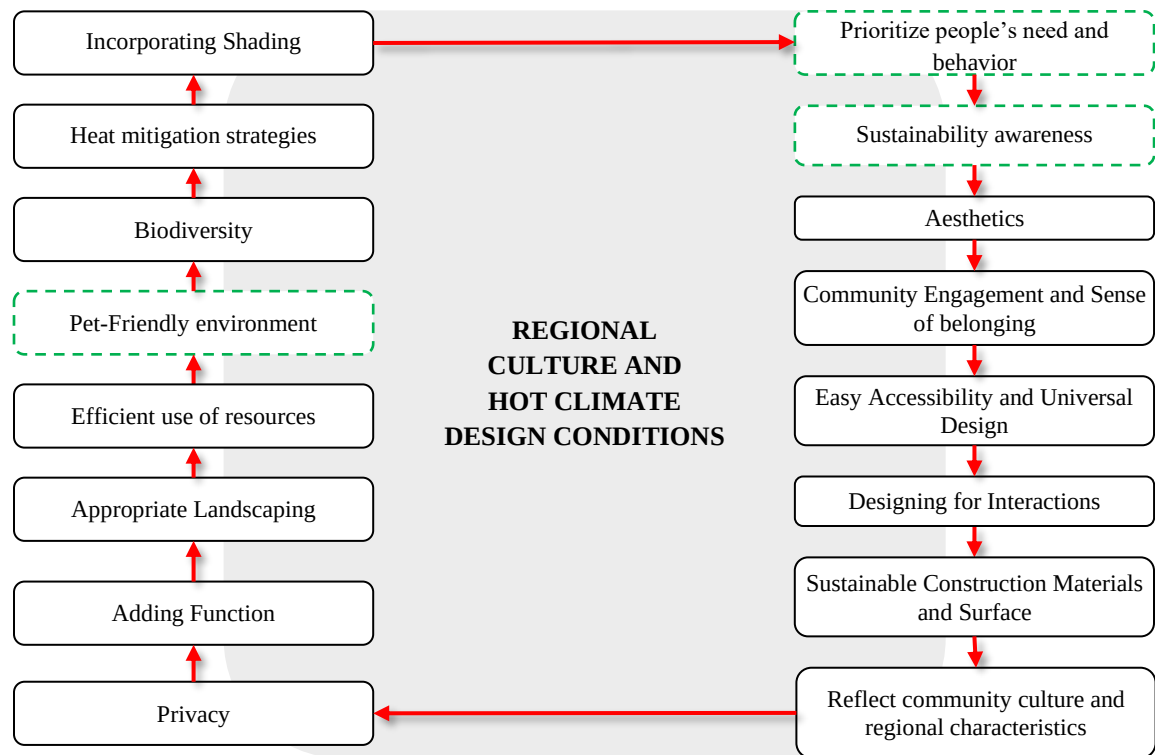


Figure 109. Interrelationship Between Design Conditions of Urban Community Parks Influenced by Regional Hot Climate and Culture.

As depicted in **Figure 110**, the landscape elements and design conditions are interdependent, working collectively to create parks that are resilient to the climate while remaining culturally meaningful and user-friendly. This integrated approach ensures that parks in hot arid environments not only survive but thrive as valuable community spaces.

In designing community parks in such challenging environments, independent elements such as shading, sustainable construction materials, smart technology integration, and

wayfinding systems provide foundational benefits. These elements function autonomously, offering immediate relief from heat and enhancing park management.

Conversely, dependent elements, such as green lawns, plantations, water features, safety and security measures, health and wellbeing enhancements, and community engagement, rely on the successful integration of various design aspects. For example, vegetation necessitates efficient irrigation and regular maintenance, while water features depend on sustainable resource management. Safety measures and overall comfort are influenced by the park's layout and accessibility, which also play a critical role in fostering community engagement and inclusiveness.

Together, these elements form a cohesive design strategy that balances independent functionality with dependent adaptability. This ensures the creation of parks that are not only climate-resilient but also culturally resonant and inclusive, providing meaningful and enjoyable experiences for all users.

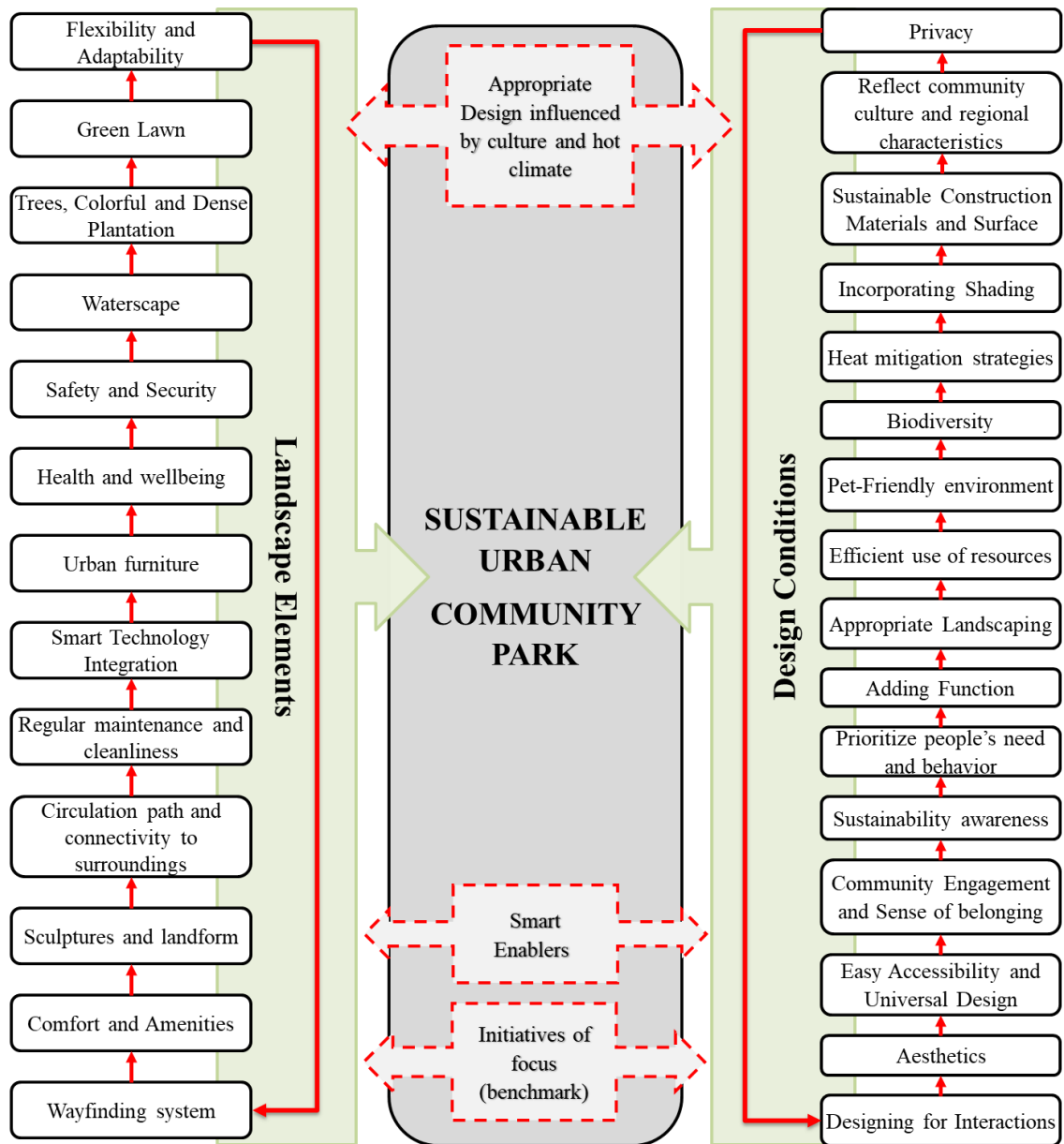


Figure 110. A Design Framework for Landscape Elements and Design Conditions of Effective Community Parks in Hot Arid Environments.

The additional criteria and Sub-criteria address various aspects, the incorporation of a pet-friendly environment within the design conditions under the environmental considerations. This promotes inclusivity, fosters a sense of community, and contributes to creating cleaner and healthier parks.

Under socio-cultural considerations, additional landscape design elements have been introduced:

- **Park boundaries:** were added as a sub-criterion under (safety and security). Clearly defined boundaries are essential for effective space management and ensuring the safety of all users, particularly children, as this issue was frequently highlighted by visitors in the observed sites.
- **Picnic spots** were introduced as a sub- criterion under (comfort and amenities). Designated picnic areas would provide spaces for social gatherings and leisure activities, enhancing the park's recreational value.
- **Food and beverage stations** were added as a sub-criterion under (comfort and amenities). The availability of food and beverage options enhances visitor convenience and comfort, encouraging longer stays and increasing the likelihood of repeat visits.

Furthermore, two additional criteria for design conditions have been incorporated under the Socio-cultural considerations:

- **Sustainability awareness:** incorporating elements that promote sustainability awareness helps educate visitors on environmental issues and encourages eco-friendly behaviors, fostering a more sustainable mindset within the community.
- **Prioritizing people's needs and behavior:** understanding and addressing the needs and behaviors of users, through methods such as observations or surveys, ensures that the space is functional, inclusive, and enjoyable for all visitors.

These criteria enhance the socio-cultural dimensions of park design, supporting the creation of spaces that are both educational and user centered.

In the Smart Enablers layer, several initiatives have been excluded from the framework as they fall outside the scope of this study. These initiatives include (Mobile Community and Tourist information), (RFID Ticketing), (Interactive mobile applications for residents, tourists, and MICE), and (Smart Park Dynamic Applications for Public Discovery, Ticketing, Mapping).

As **Figure 111** illustrates, this framework comprises 13 design conditions and 16 landscape elements, highlighting the importance of integrating technology with environmental and community-focused strategies. This approach aims to create efficient, sustainable, and engaging community parks.

These additions ensure that the framework is both comprehensive and adaptable, effectively addressing the diverse needs and preferences of its users. This makes it a robust tool for designing functional, inclusive, and sustainable environments.

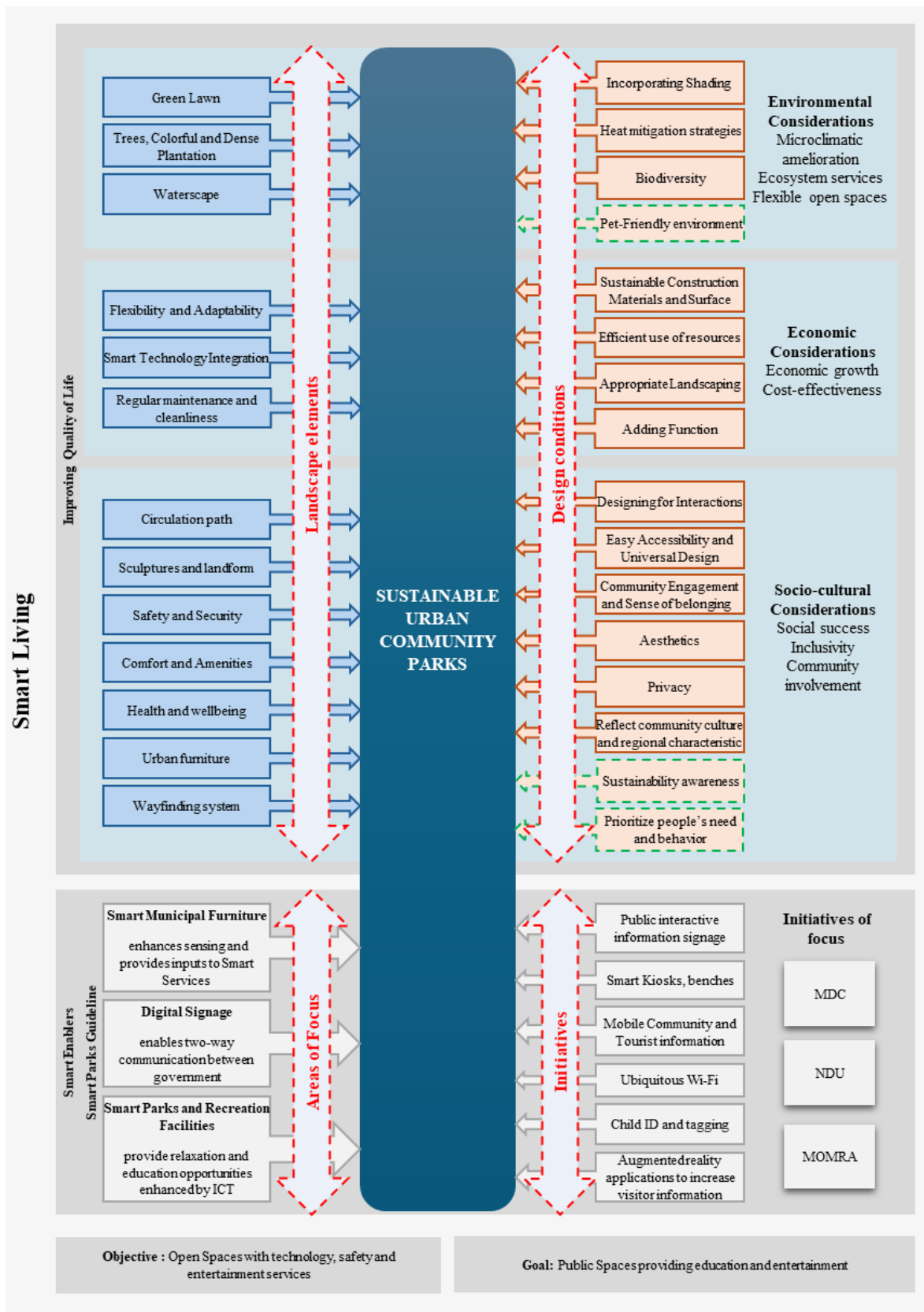


Figure 111. Reformulated Framework for Designing Sustainable Urban Community Parks.

CHAPTER 5

DATA VALIDATION

5.1. Introduction

The primary objective of these interviews was to validate the enhanced framework (**Figure 111**) developed for designing a sustainable urban community park in Al-Khobar. Key objectives included evaluating the significance of each criterion within the framework and identifying challenges associated with its implementation in the hot, arid climate characteristic of Al-Khobar. A series of interviews were conducted with 15 stakeholders, including academics specializing in architecture and urban design, city officials, urban planners, landscape architects, and representatives from relevant government agencies. To ensure the consistency and reliability of the data collected, a semi-structured questionnaire was employed throughout the interview process. This approach balances guided questioning with the flexibility to explore emerging topics in greater depth.

5.2. The Role of Sustainable Community Parks in Enhancing Quality of Life and Well-Being in Al-Khobar

Experts emphasize the vital role of sustainable parks in enhancing the QoL and well-being of communities in Al-Khobar. According to Expert A, parks function as essential urban spaces that promote community well-being. Expert B highlights the multifaceted benefits of these green spaces, including health promotion, social interaction, environmental conservation, and relaxation. Expert C underscores the integral role of well-designed,

sustainable parks in urban settings, enriching residents' lives. Expert D stresses the importance of communal outdoor spaces, which allow residents to connect with nature and engage in physical activities, thereby improving overall quality of life.

Similarly, Expert E notes that sustainable parks provide opportunities for physical activity, mental relaxation, and social interaction while fostering environmental sustainability and urban resilience. Expert F advocates for sustainable park design and management, asserting that high quality parks lead to healthier and more connected communities. Expert G links the development of sustainable parks to Vision 2030, emphasizing that improving park facilities is vital for enhancing citizens' QoL.

Expert H highlights that sustainable parks contribute to improved air quality and provide spaces for social interaction, fostering community awareness and enhancing well-being. Expert I emphasizes the significance of community involvement in the design process, as this engagement fosters a sense of belonging. The concept of placemaking is also noted as critical, aiming to create engaging environments that cater to diverse community groups. Expert J asserts that sustainable parks not only enhance physical and mental health but also strengthen residents' connection to nature, further enriching their quality of life.

Expert L reiterates that sustainable parks help reduce stress, enhance air quality, and promote environmental awareness, ultimately fostering healthier and more connected communities. Expert M highlights that thoughtful landscaping and design not only enhance the visual appeal of neighbourhoods but also contribute to a community's identity and sense of pride. Aesthetic green spaces often increase property values and attract visitors, further enriching the community. Access to well-maintained green spaces is strongly associated with improved mental and physical health. Parks provide opportunities for physical

activities, including walking, jogging, and sports, which support healthier and more active lifestyles.

Experts propose various strategies to achieve aesthetically pleasing park designs while aligning with sustainability objectives.

Expert A emphasizes the importance of financial sustainability and social responsibility initiatives as foundational elements in park design. Expert B advocates for xeriscaping, a landscaping approach that utilizes native plants to reduce water consumption. This strategy not only enhances the park's aesthetics appeal but also minimizes irrigation requirements. Furthermore, the incorporation of thoughtfully designed furniture is highlighted to elevate the visual quality of the park.

Expert C suggests that planners should review relevant studies and case literature to inform them about their designs. Conducting surveys to gather direct feedback from community members about their needs and preferences is also deemed crucial for creating spaces that resonate with users. Expert D emphasizes the importance of actively involving the community in the design process. Engaging residents ensures that parks reflect their unique values and needs. Additionally, incorporating art and innovative ideas can enhance the aesthetic appeal of space while fostering a sense of ownership among community members. Expert E proposes the use of natural water management systems, renewable materials, and multifunctional spaces that support biodiversity. This balance of form and function enhances both visual appeal and environmental resilience of park designs. Expert F recommends incorporating native plants that are adapted to local climates, as they support local wildlife while reducing reliance on irrigation and pesticides. Small ponds or fountains can serve as aesthetic focal points while simultaneously providing habitats for wildlife.

Additionally, the inclusion of educational signs can enhance visitor engagement with local ecology.

Expert G recommends conducting benchmarking exercises to analyze successful park designs and adopting elements that align with sustainability objectives while maintaining aesthetic appeal. Expert H underscores the importance of engaging the community early in the design process to ensure that local needs are met. Additionally, integrating renewable energy sources and eco-friendly materials is emphasized as a strategy to enhance both sustainability and cost-effectiveness.

Expert I notes that while aesthetics can be subjective, creating visually appealing spaces is essential for encouraging longer visits. Expert J emphasizes the use of native plants and shaded areas created by trees and pergolas, which enhance both beauty and sustainability. Attractive lighting is also highlighted as a key element in improving the park's environment. Expert L suggests strategies such as integrating green infrastructure, utilizing natural materials, and incorporating energy-efficient lighting to balance aesthetic appeal with environmental responsibility. Expert M believes that creating aesthetically pleasing park designs that align with sustainability objectives requires a thoughtful approach that integrates beauty, functionality, and ecological responsibility. For example, designing flexible areas that accommodate various activities, such as picnicking, sports, gardening, or community events is crucial.

Interviewees emphasized the significance of various features in parks that enhance user comfort and promote sustainability, particularly in Al-Khobar's hot and arid climate.

Below are the key insights gathered from the experts:

- **Shaded Pathways:** Experts B, C, E, H and K emphasized the necessity of shaded pathways and seating areas. Structures such as trees, pergolas, and shade sails are essential for providing relief from the sun.
- **Water Features:** Experts B, D, E, and F recommended incorporating water elements, such as fountains and misting systems, to cool the environment and enhance comfort.
- **Native and Drought-Tolerant Landscaping:** Experts E, M, and L stressed the importance of using native, drought-resistant plants that thrive in local conditions. This approach reduces water consumption and maintenance needs while enhancing the park's visual appeal.
- **Microclimate Enhancement:** Effective strategies to improve the park's microclimate include planting trees to create shade, using permeable pavements to manage heat and stormwater, and considering wind patterns to enhance air movement. These insights were provided by Experts I and M.
- **Community Engagement and Amenities:** Expert D highlighted the importance of designing parks that reflect local demographics and preferences. For example, parks in areas with a significant elderly population should offer age-appropriate amenities. Engaging the community in the design process is crucial for addressing their specific needs.

- **Functional and Aesthetic Design:** A holistic approach that combines aesthetic appeal with functional infrastructure is essential. This includes adequate lighting for safety, multifunctional areas for diverse activities, and community gathering spaces that encourage social interaction, as noted by Experts G and H.

Experts agree that parks play a crucial role in promoting health, social interaction, and environmental sustainability. By fostering community involvement and adopting thoughtful design strategies, parks not only enhance physical and mental health but also create a sense of belonging, contributing to vibrant and resilient urban environment.

To design aesthetically pleasing yet sustainable parks, experts recommend a multifaceted approach. This includes the use of native plants, community participation, and natural water management systems. Emphasizing financial sustainability and social responsibility, these strategies aim to create spaces that are visually appealing, environmentally resilient, and reflective of community values.

In Al-Khobar's hot climate, experts advocate prioritizing shaded areas, water features, and native plant landscaping to enhance comfort and sustainability. Additionally, community engagement and functional design are essential to ensuring parks reflect local needs and preferences. This approach ensures that parks not only offer aesthetic appeal but also serve as valuable and inclusive communal spaces.

5.3. Sustainable Urban Community Park Framework Validation

Table 9 presents the importance of each criterion as ranked by experts. The evaluation utilized a five-point Likert scale, with 5 (extremely important), 4 (high importance), 3 (moderate importance), 2 (low importance), and 1 (extremely low importance). The weighted mean and Relative Importance Index (RII) were then calculated for each design criterion.

Figure 112 illustrates a detailed ranking of the framework design conditions based on their importance. "Incorporate shading" emerges as the most critical design aspect, with a mean score of (4.9 out of 5), reflecting its significant impact on user comfort in Al-Khobar's hot climate. The importance of cultural resonance is evident in the mean score of (4.5 out of 5) for "Reflect community culture and regional," highlighting the value of aligning park designs with local identity.

"Easy Accessibility and Universal Design" also ranked highly, with a mean of (4.5), underscoring a commitment to inclusivity and ensuring usability for individuals of all abilities. "Heat mitigation strategies," and "Sustainable materials and surfaces" scored slightly below (4.4). "Appropriate Landscaping" and "Prioritize people's needs and behavior" similarly received high prioritization, with a mean of (4.3), reflecting its aesthetic and ecological significance in park design. Other key factors, such as "Community Engagement," "Designing for Interactions," scored a mean of (4.2).

In contrast, criteria such as "Pet-Friendly Environment," "Biodiversity," and "Sustainability Awareness" scored below 4, suggesting they are perceived as relatively less

critical by experts. However, their inclusion in the framework underscores their potential value in creating comprehensive, sustainable, and inclusive urban parks.

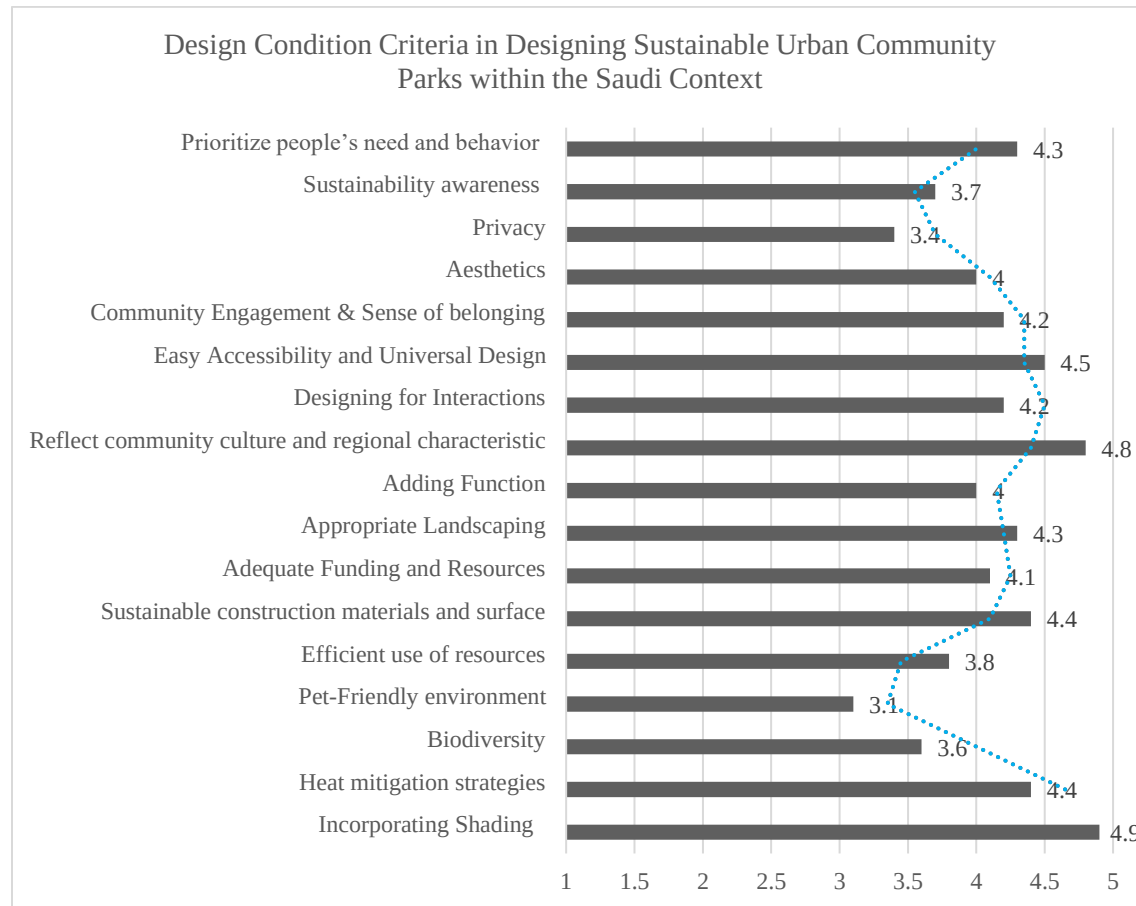


Figure 112. Ranking the Importance of Design Condition Criteria in Designing Sustainable Urban Community Parks within the Saudi Context.

Figure 113 ranks the importance of landscape elements in a sustainable urban community park. "Safety and Security" emerges as the top priority, with a mean score of (4.8 out of 5), emphasizing its critical significance in sustainable parks design. Elements such as "Comfort and Amenities" and "Regular maintenance and cleanliness" also rank highly, with mean scores of (4.6) each. "Trees, Colorful and Dense Plantation" follows closely with a score of (4.5), reflecting a strong emphasis on user comfort, ecological considerations, and the ongoing maintenance of parks in Saudi Arabia.

Other criteria, such as “Health and Well-being” and “Circulation Path and Connectivity to Surroundings” achieve a mean score of (4.3), reflecting their importance in enhancing accessibility and overall user experience. "Wayfinding System" and "Urban Furniture" each score a mean of (4.1), indicating their moderate yet valuable role in park design. The inclusion of “Waterscape” scores a mean of (4), underlining its aesthetic and environmental benefits. In contrast, "Smart Technology Integration" and "Sculptures and Landform" are rated lower, with mean scores below (3.5). This suggests that, while these elements contribute to the overall design, they are considered less essential compared to other landscape features.

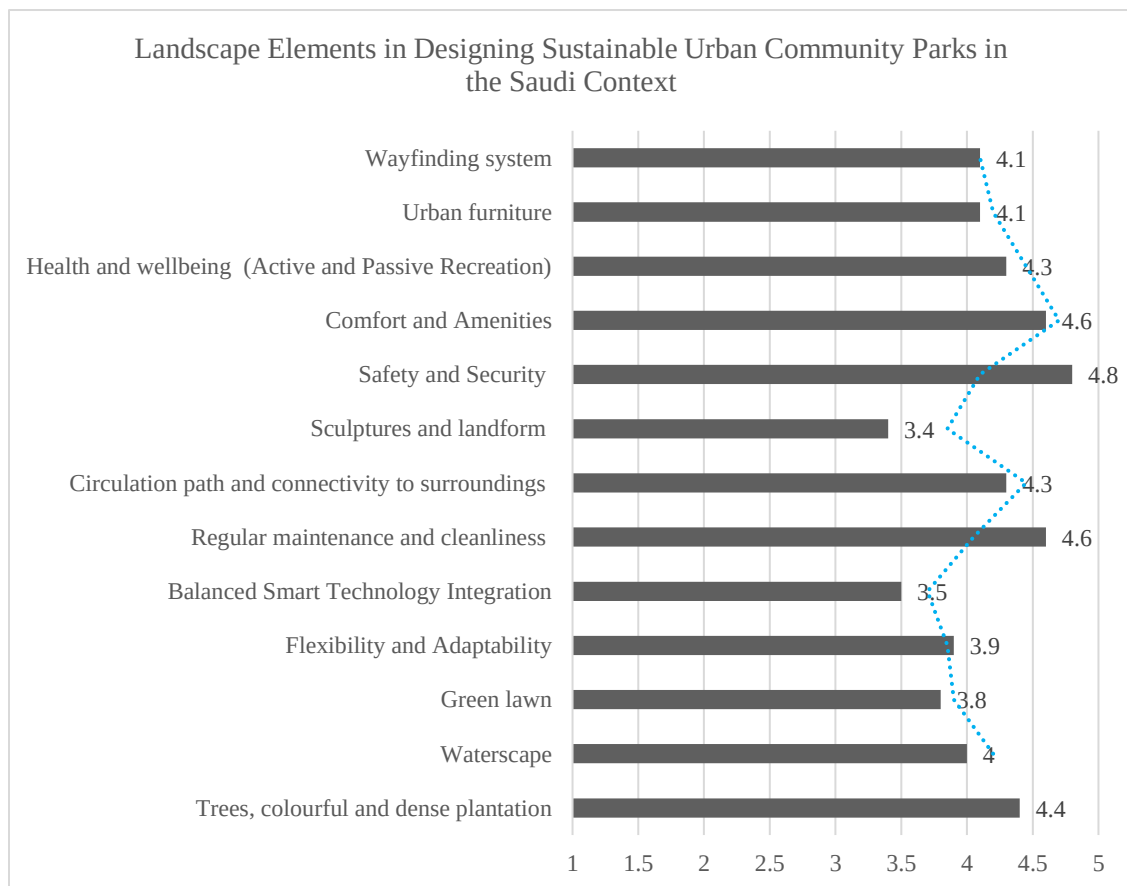


Figure 113. Ranking the Importance of Landscape Elements in Designing Sustainable Urban Community Parks in the Saudi Context.

The chart in **Figure 114** highlights the importance of integrating smart technologies into urban community parks to enhance functionality and user experience, as well as the role of various smart enablers. "Smart Municipal Furniture" is ranked the highest, with a mean score of (3.9 out of 5), indicating its significant contribution to improving urban environments. "Smart Parks and Recreation Facilities" and "Digital Signage" both score a mean of (3.6 out of 5), indicating their importance, although they are slightly less prioritized compared to municipal furniture.

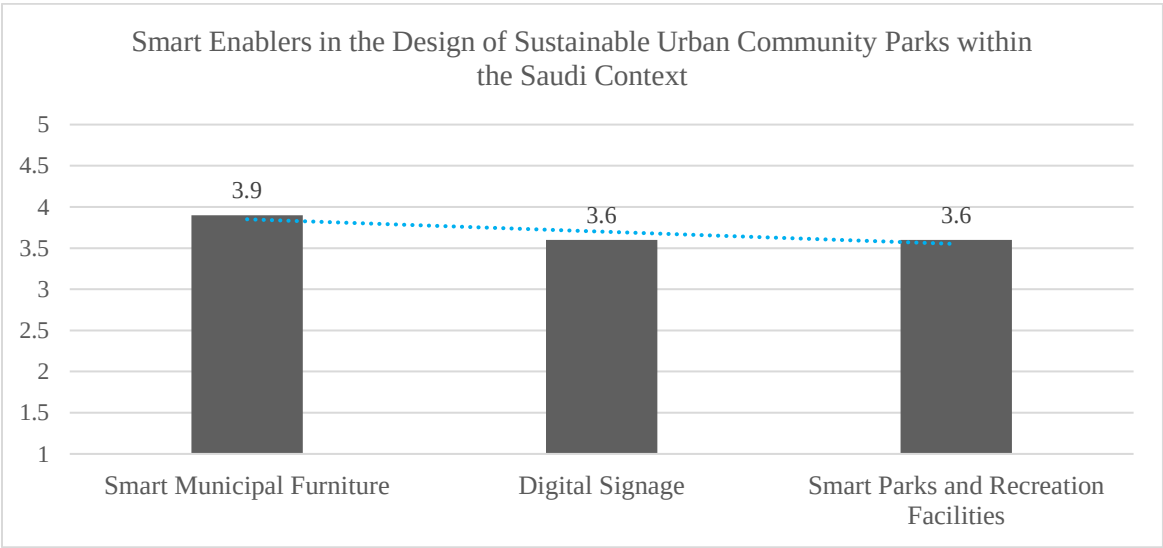


Figure 114. Ranking the Importance of Smart Enablers in the Design of Sustainable Urban Community Parks within the Saudi Context.

The radar chart in **Figure 115** benchmarks various enablers for smart park design. "Ubiquitous Wi-Fi" emerges as the top priority, with a mean score of (4.15 out of 5), underscoring its critical role in enhancing connectivity and user experience.

"Child ID and Tagging" and "Smart Kiosks, Benches" both score (3.69), highlighting safety and multifunctional infrastructure as significant considerations. "Public Interactive

Information Signage" follows with a score of (3.62), showing the relevance of accessible information for visitors.

"Augmented Reality Applications to Increase Resident/Visitor Information" scores (3.54), indicating a moderate interest in immersive and interactive technologies. "Mobile Community and Tourist Information" has the lowest score, with a mean score of (3.38), reflecting comparatively less emphasis on this enabler.

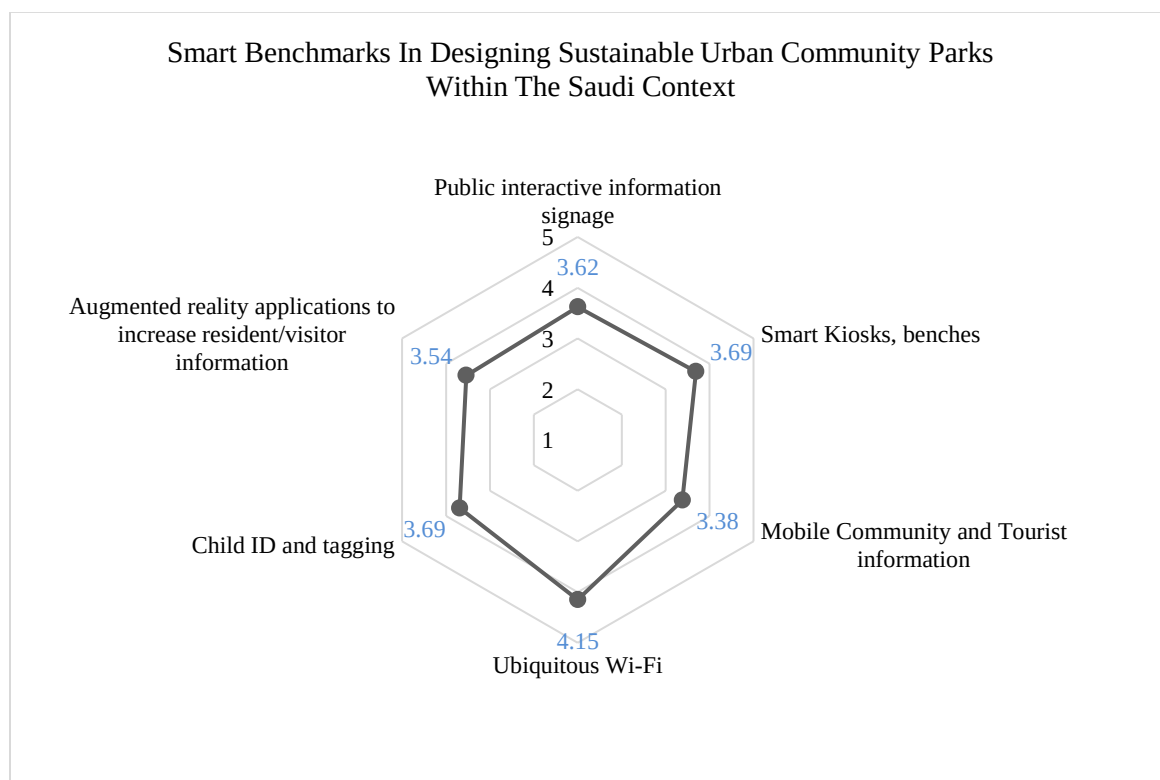


Figure 115. Ranking the Importance of Smart Benchmarks in the Design of Sustainable Urban Community Parks within the Saudi Context.

Figure 116 provides a comprehensive overview of the prioritization of various landscape elements, design conditions, and smart enablers for designing a sustainable urban community park in the hot, arid climate of Al-Khobar City.



Figure 116. Weighted Mean of the Importance of Criteria for Designing Sustainable Urban Community Parks in the Saudi Context, Considering Cultural and Regional Climate Factors.

Table 9 presents various criteria, sub-criteria, and their associated weighted mean, rank, and Relative Importance Index (RII) within the framework of designing sustainable urban community parks. These criteria are categorized into landscape elements, design conditions, and smart enablers, addressing environmental, social, and economic considerations. The table covers multiple aspects of park design, including environmental impact, economic efficiency, social engagement, safety, and smart technology integration.

Environmental considerations, particularly the incorporation of shading, received the highest weighted mean of (4.9 out of 5), ranking first in the framework due to its essential role in providing shade and improving thermal comfort in extreme hot weather. Heat mitigation strategies, such as greenery and water features, also rank highly, highlighting the need for effective heat management. Safety and Security, with a mean of (4.8) also rank highly, emphasizing the importance of creating safe park environments. Biodiversity and Pet-Friendly environment rank lowest criteria in the framework with weighted means of (3.6 and 3.1, respectively), suggesting these are seen as secondary compared to other more immediate environmental needs, such as shading and heat mitigation.

Socio-culturally, the alignment of park design with community traditions and values scored a high mean of (4.8 out of 5), indicating the importance of fostering a sense of belonging and inclusivity. Design for human interactions, such as group seating arrangements, also shows significant importance with a mean of (4.2), indicating that fostering social connections is a key element in sustainable park design in Saudi Arabia. Accessibility features, received a mean of (4.5 out of 5), underscoring the necessity of creating spaces that cater to all demographics.

Economically, regular maintenance and cleanliness scores the highest and the first criterion in this dimension, with a weighted mean of (4.6). Adequate funding and resources criterion also scores a mean of (4.1), highlighting the importance of financial planning for long-term sustainability. Efficient resource management, such as water conservation and the use of renewable energy sources, scored a mean of (3.8 out of 5), emphasizing the necessity to ensure the long-term viability of parks.

Among smart enablers, ubiquitous Wi-Fi stands out with a high mean of (4.1), demonstrating the relevance of digital infrastructure for modern parks. Smart municipal furniture and digital signage rank lower, with means of 3.6 and 3.5, respectively, suggesting that while technology is important, it is still secondary to other more physical and environmental considerations in park design.

In **Table 9**, "Incorporating Shading" has a high RII of 0.98, meaning it is considered one of the most principal elements in park design in terms of environmental considerations, particularly for thermal comfort and shade in hot climates in Saudi Arabia. Reflecting community culture and regional characteristics is another top-ranking criterion, with a high RII of 0.96. This emphasis on cultural relevance highlights the importance of creating spaces that resonate with the community and promote a sense of belonging and inclusivity.

The safety and security of park users is also considered top priorities, as indicated by the high RII of 0.96. Safety features, such as proper lighting, clear sightlines, surveillance, and well-maintained spaces, are fundamental to ensuring that parks remain welcoming and secure for people of all ages and backgrounds.

The moderate RII of 0.77 for water management emphasizes the importance of sustainable water practices, such as efficient irrigation and stormwater management. However, it is ranked lower than factors like shading, suggesting that while water conservation is important, it may not be viewed as critically urgent in comparison to other elements.

While elements like smart municipal furniture, digital signage, and Wi-Fi are important, they receive moderate RII scores of 0.72 and 0.78 respectively, indicating that respondents consider them less crucial than more tangible, physical design elements. This suggests that while smart technology can enhance the user experience and functionality of parks, it is not as critical to the core sustainability goals as aspects like shading, water management, and safety.

The lowest RII of 0.62 for pet-friendly environment, indicating that this factor is considered the least critical in the context of sustainable park design in Saudi Arabia. Although some communities may value pet-friendly spaces, this is a lower priority compared to factors that directly address the environmental, safety, or social needs of the park. This lower ranking suggests that, while pet-friendly features may contribute to park inclusivity, they are not as essential as other sustainability or user-centered features.

Table 9. Ranking of Criteria Based on Their Importance According to Expert Insights.

Considerations	Physical and digital attributes	Criteria	Sub-criteria	Weighted Mean	Rank among all criteria	Rank among sustainable /smart dimension	RII
Environmental Considerations	Design conditions	Incorporating Shading	Tree canopy size	4.9	1	1	0.98
			Manufactured shading element				
			Vegetation cover				
		Heat mitigation strategies	Greenery	4.4	7	2	0.88
			Shading solutions				
			Water features like pound/ fountain				
			Misting system				
			Native plant species				
			Non-electrical fans				
		Biodiversity	Creating wildlife habitats	3.6	28	6	0.72
			Preserving existing natural features				
			Native plant landscaping				
		Pet-Friendly environment	Specific zone for wild cat's food/water stations and waste management	3.1	39	7	0.62
	Landscape elements	Trees, colourful and dense plantation	Flowers cluster	4.4	7	2	0.88
			Vegetation quality and quantity				
		Waterscape	Artificial fountain	4	20	4	0.8
			Natural water feature like pond/ lake				
		Green lawn	Well-cleaned and maintained green spaces	3.8	25	5	0.76
Economic considerations	Design conditions	Efficient use of resources	Water management	3.8	25	7	0.76
			Smart Waste Management				
			Renewable energy sources				
		Sustainable construction materials and surface	Locally sourced materials	4.4	7	2	0.88
			Environmentally friendly and recycled materials				
			Light-colored paving				
		Adequate Funding and Resources	Long-term Financial Planning	4.1	16	4	0.82
			Government Grants and Funding				
			Proposal Development				
		Appropriate Landscaping	Choice of heat-tolerant and drought-resistant plant species	4.3	10	3	0.86
			Native plant species				
			Balanced landscape (Fine, Coarse, Medium)				
		Adding Function	Space for mobility	4	20	5	0.8
			Communal space				
			Space for recreation				
			Space for relaxation				
	Landscape elements	Flexibility and Adaptability	Movable furniture	3.9	23	6	0.78
			Multipurpose spaces				
			Modular structures				

Socio-cultural Considerations	Design conditions	Balanced Smart Technology Integration	Crowdsourcing	3.5	34	8	0.7
			Interactive Learning/ Entertainment Stations				
			Air Quality Sensors				
		Regular maintenance and cleanliness	Softscape	4.6	4	1	0.93
			Hardscape				
			Lighting				
			Site furniture				
		Designing for Interactions	Promote human Interactions (Group Seating Arrangements)	4.2	14	8	0.84
			Promote human with environment Interactions				
			Social events				
			Consider different ages and genders				
		Easy Accessibility and Universal Design	Easily accessible to all members of the community	4.5	6	4	0.9
			Linked pathways, and entrances				
			Parking slots				
			Safe Surfacing				
			Universal Restrooms				
			Wide Pathways				
			Inclusive activities				
		Community Engagement & Sense of belonging	Surveys and Feedback	4.2	14	8	0.84
			Workshops				
			User diversity of different cultural backgrounds				
			Diverse Amenities				
		Aesthetics	Seasonal Festivals	4	20	12	0.8
			Well-designed walkways				
			Attractive landscaping				
			Thoughtful use of colours and materials				
			Site image				
		Sustainability awareness	Public art	3.7	27	13	0.74
			Cleanliness and maintenance				
		Privacy	Educational Signage	3.4	36	14	0.68
			Recycling and Waste Management				
			Designated family areas				
		Prioritize people's need and behavior	Placement of quiet zones away from playgrounds or sports fields, and use of natural sound barriers	4.3	10	5	0.86
			Visual Privacy				
			Behavioral Observations				
		Reflect community culture and regional characteristic	Community Input	4.8	2	1	0.96
			Age-Appropriate Facilities				
			Alignments with the country's traditions, norms, and values				
			Consider cultural background and socioeconomical status				
			Symbolic ownership				

	Landscape elements	Circulation path and connectivity to surroundings	Clear Pathways	4.3	10	5	0.86
			Pedestrian continuity				
			Barrier free				
			Bicycle and Walking Trails				
			Public Transit Accessibility				
			Multiple Entrances				
			Safe Crossings				
			Walking comfort				
		Sculptures and landform	Interactive Installations	3.4	34	14	0.68
			Functional Landforms				
			Cultural Representation				
		Safety and Security	Adequate lighting, clear sightlines	4.8	2	1	0.96
			Proper maintenance				
			Pedestrian privilege arrangement				
			Surveillance and Monitoring				
			Not isolated from surroundings				
			Park boundaries				
			Analysis of Usage Patterns				
		Comfort and Amenities	Seating arrangement	4.6	4	3	0.92
			Shaded spots				
			Drinking fountains				
			Public restrooms				
			Sufficient play areas				
			Bicycle parking				
			Picnic spots				
			Food and beverage stations				
			Privacy				
			Sport field based on community outputs				
		Health and wellbeing	Exercise Equipment	4.3	10	5	0.86
			Play areas				
			Walking and Jogging Trails				
			Contemplative spaces				
			Nature Observation Areas				
		Urban furniture	Quality of furniture	4.1	16	10	0.82
			Shade Structures				
			Recycling and Dustbins				
			Flexible Use				
			Wise position				
			Weather-Resistant Materials				
			Ergonomic Design				
			Sufficient Benches and Seating				
			Regular Upkeep				
		Wayfinding system	Clear directions	4.1	16	10	0.82
			Signage, and information				
			Focal Areas				
			Map Kiosks				
			Universal Symbols				
			Braille and Tactile Maps				

Smart Enablers	Enablers	Smart Municipal Furniture	Enhance sensing and provide inputs to smart services	3.9	23	2	0.78
		Digital Signage	Two-way communication between government and community	3.6	28	3	0.72
		Smart Parks and Recreation Facilities	Relaxation and education opportunities enhanced by ICT	3.6	28	3	0.72
	Benchmark	Public interactive information signage		3.6	28	3	0.72
		Smart Kiosks, benches		3.6	28	3	0.72
		Mobile Community and Tourist information		3.3	38	9	0.66
		Ubiquitous Wi-Fi		4.1	16	1	0.82
		Child ID and tagging		3.6	28	3	0.72
		Augmented reality applications to increase resident/visitor information		3.5	34	8	0.7

The chart in **Figure 117** illustrates the weighted mean of the considerations included in the Sustainable Urban Community Park Framework in Saudi Arabia.

Among the considerations, Smart Enablers has the lowest weighted mean of (3.64), indicating that while smart technology and digital infrastructure are considered, they are relatively less prioritized compared to other dimensions of the framework. Socio-cultural considerations scored the highest weighted mean of (4.18), emphasizing their critical importance in sustainable park design in Saudi Arabia. This reflects a strong emphasis on designing parks that align with community traditions and values while promoting inclusivity and social interaction.

Environmental considerations achieved a weighted mean of (4.03), closely followed by the economic considerations with a mean of (4.08). This underscores the importance of

addressing environmental challenges, such as heat mitigation, shading, in urban park design. The small difference in scores between the environmental and economic considerations highlights their interlinked significance in achieving sustainability goals.

This data suggests a balanced approach to sustainability, with a slight emphasis on social and cultural relevance, reflecting the community-centric priorities of park design in Saudi Arabia.

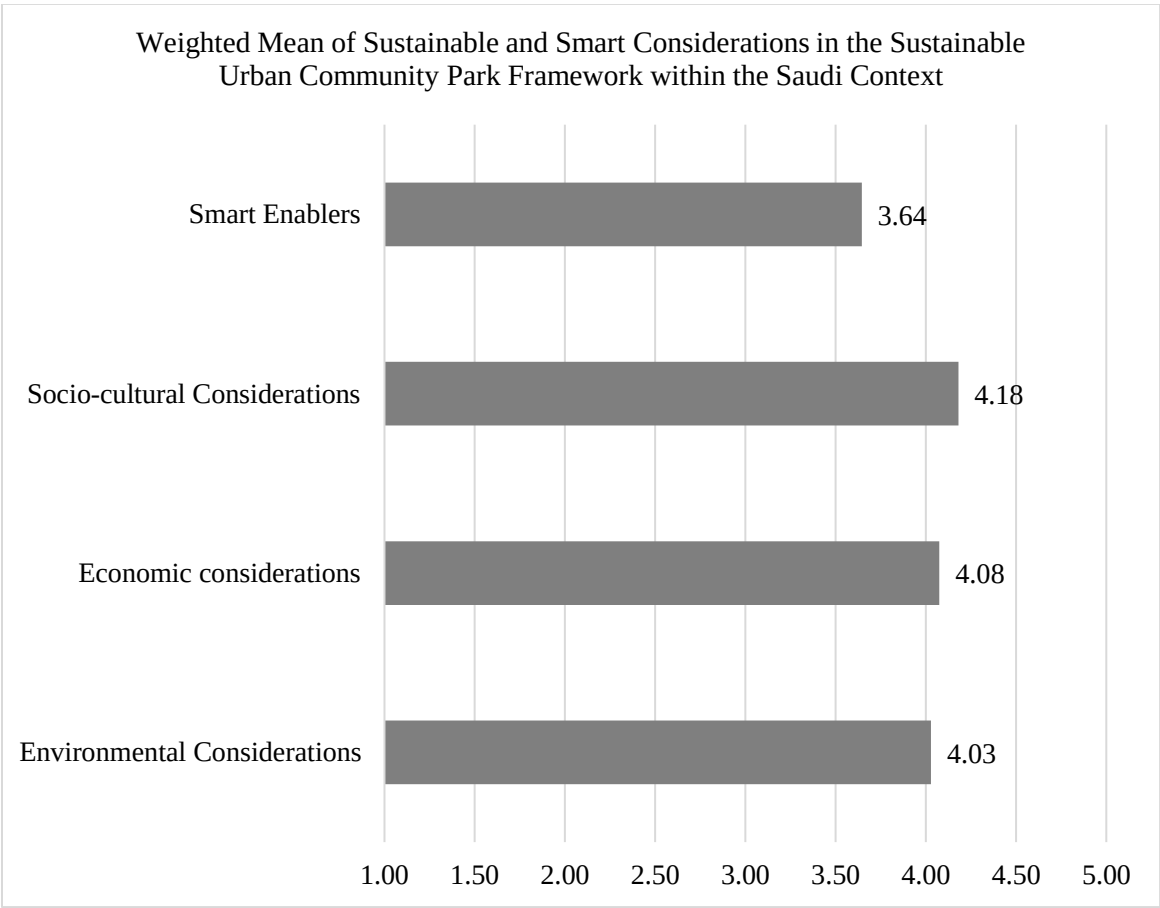


Figure 117. Weighted Mean of Sustainable and Smart Considerations in the Developed Framework.

5.4. Challenges in Implementing the Framework for Designing Sustainable Urban Community Parks in Al-Khobar

Interviewees were asked to share their perspectives on the primary challenges in designing sustainable community parks in Al-Khobar.

Expert A identified development funds and governance as key issues, noting the need for sufficient financial resources and effective management frameworks. Expert B highlighted the harsh climate of the arid region as a significant obstacle, alongside the high costs of implementation for sustainable features, such as advanced irrigation systems and shading structures. Expert F highlighted funding and resource limitations as major constraints. Expert H raised concerns about the high costs associated with sustainable materials and technologies, the limited availability of native plants suitable for the local climate, and the ongoing issue of water scarcity for irrigation. Other challenges included resistance to changes in traditional park designs and the difficulty of balancing aesthetics appeal with sustainability goals in a hot urban environment.

Expert I criticized top-down strategies for often neglecting community input, emphasizing the importance of involving residents in the design process to ensure that park features align with their actual needs and preferences.

Similarly, Expert G noted that insufficient funding and inadequate maintenance quality could hinder effective park management. Expert G also emphasized that a lack of public awareness might limit community engagement and suggested that municipalities focus on initiatives to enhance funding opportunities and improve maintenance practices. Expert D emphasized the importance of public awareness and education about sustainability

practices, particularly among government officials who, despite recognizing the benefits of sustainable strategies, may be hesitant in adopting innovative approaches.

According to Expert C, finding suitable spaces for parks is a critical hurdle, especially in neighborhoods where land availability is limited. Additionally, maintenance poses an ongoing challenge, with cleanliness and proper lighting requiring constant attention to ensure parks remain safe and welcoming. Expert C also noted that integrating smart technologies can be problematic due to the need for robust infrastructure and public awareness, particularly among older community members who may be unfamiliar with these innovations.

Expert E identified specific challenges, including managing water scarcity, ensuring the use of drought-tolerant plants, and balancing urban development with the preservation of green spaces. Additionally, securing adequate funding and fostering community engagement in both design and maintenance processes were noted as crucial hurdles.

Expert J reiterated the challenges of high temperatures, water scarcity, and the difficulty of maintaining greenery in an arid environment. Expert K highlighted the need for proper coordination between hardscape and softscape elements to achieve cohesive and functional park designs.

Expert L summarized key challenges, including managing the hot climate, ensuring efficient water use, balancing budget constraints, integrating eco-friendly materials, and maintaining community engagement throughout the park's lifecycle.

Expert M added that climate changes could affect the effectiveness of current design strategies, emphasizing the importance of planning for adaptability and resilience in sustainable park designs.

Experts shared lessons they have learned from previous projects of designing sustainable urban community parks in Al-Khobar. Their collective insights underscore the critical importance of integrating community engagement, climate-conscious design, efficient resource use, and ongoing evaluation in the creation of sustainable urban community parks.

Expert A emphasized the importance of community involvement in the design process. Expert B suggested engaging stakeholders from the beginning to identify their needs and mitigate potential issues during later stages of development. Expert C highlighted the necessity of involving the community in discussions about their preferences, ensuring that technological solutions are user-friendly and accessible. They also stressed the importance of establishing a clear maintenance strategy from the outset to maintain parks as clean, safe, and inviting spaces. Expert F underscored the importance of monitoring and evaluation through feedback mechanisms to assess the effectiveness of park design and amenities. Expert G noted that considering proposed services and amenities while involving users in decision-making results in better outcomes. Expert M emphasized that actively involving the community fosters a sense of ownership and responsibility, and recommended methods such as surveys, workshops, and focus groups to identify local needs and preferences, ensuring the park reflects community values.

Expert I emphasized that the built environment encompasses not only physical aspects but also socio-cultural factors that influence how people perceive and use spaces.

Understanding these elements is critical for creating parks that meet community needs, and maintaining open communication with users throughout the development process is essential.

Expert D advocated for a top-down approach to sustainability initiatives, asserting that leaders and government officials must drive the transformation of parks into sustainable spaces. Delegating this responsibility solely to the community, they warned, could lead to uncertainty and delays in finding effective solutions.

Expert L reiterated the importance of using native plants for water efficiency, creating shaded areas to combat heat, and designing flexible spaces that can adapt to evolving community needs.

Expert E pointed out the significance of integrating local climate considerations, such as using native and drought-resistant plants to conserve water and creating shaded areas for user comfort. They emphasized the inclusion of multifunctional spaces to enhance social and environmental benefits, and the use of sustainable materials and efficient irrigation systems to ensure long-term viability. Expert K advised aligning solutions with regulations and incorporating native trees, plants, and natural hardscape elements into the design.

Expert J highlighted the benefits of utilizing local resources and materials, such as local stone, which are often better suited to the regional climate.

Experts provided valuable insights into designing parks in Al-Khobar that align with the region's unique climate and cultural identity. Their collective insight emphasizes the importance of integrating climate adaptability, cultural sensitivity, and community engagement in park designs, ensuring they meet environmental goals while enriching the social fabric of Al-Khobar. Key themes emerged from their recommendations:

1. Climate Adaptability:

- **Shading and Cooling:** Experts (A, C, F, H, K, J, L) highlighted the need for shade through trees, pergolas, canopies, and structures to mitigate heat. Incorporating cooling elements like water features, non-electrical fans, and shaded areas ensures comfort.
- **Drought-Resistant Landscaping:** Experts (B, E, J, L, M) advocated for the use of native and drought-tolerant plants to conserve water, reduce maintenance, and support local biodiversity.
- **Efficient Water Management:** Expert G suggested integrating water-efficient irrigation systems to maintain greenery while addressing arid environmental challenges.

2. Cultural Sensitivity:

- **Cultural Reflections:** Experts (H, D, E, M) recommended using traditional architectural elements, locally sourced materials, and aesthetics that resonate with Al-Khobar's heritage.
- **Privacy and Inclusivity:** Experts (B, E, J) emphasized the importance of providing spaces for family gatherings, outdoor prayer areas, and private spaces for women to align with cultural values.

3. Community Engagement:

- **Inclusive Spaces:** Experts (C, M, D) emphasized creating multi-functional areas for social gatherings, cultural events, family activities, and recreational facilities like sports courts.
- **Community Involvement:** Experts (M, D, G) stressed the value of engaging residents during the design process to ensure parks meet their needs and foster a sense of ownership.

4. Sustainability Practices:

- **Renewable and Locally Sourced Materials:** Experts (H, M) recommended using materials that minimize environmental impact and enhance cultural authenticity.
- **Energy Efficiency:** Expert J highlighted the integration of water-efficient systems and renewable energy options to reduce resource use.

5. Connectivity and Accessibility:

- **Neighbourhood Integration:** Experts (H, K) suggested designs that improve connectivity with surrounding areas to encourage frequent usage.
- **Accessibility and Visibility:** Experts (M, I) recommended creating safe, well-lit spaces that welcome diverse users while promoting safety and visibility.

6. Enhancing User Comfort:

- **Nighttime Use:** Expert I noted the importance of adequate lighting to support social activities after dark and enhance safety.
- **Resilient Furniture:** Expert G suggested durable furniture to withstand harsh environmental conditions while maintaining aesthetic appeal.

Experts were asked how incorporating a smart layer into the framework would influence efficiency. While the integration of a smart layer is regarded as beneficial for both operational efficiency and user experience, experts recommend a balanced approach that prioritizes community needs and the natural environment. The insights are summarized as follows:

- **Cost Considerations:** Expert A noted that high costs could hinder the delivery of community parks and suggested a phased approach to implementation.
- **Enhanced Monitoring:** Experts (B, C, E, and L) emphasized that smart technologies, such as IoT sensors, can provide real-time data on usage, environmental conditions, and maintenance needs. This data improves resource management— particularly for water and energy—optimizing operations and reducing waste.
- **Improved Safety and User Experience:** Experts (D, F, and H) stated that smart technologies enhance safety through monitoring and automated systems for irrigation and lighting. This not only improves the overall park experience but also fosters community engagement by making environments more responsive to user needs.
- **Community Engagement and Education:** Expert M highlighted the role of mobile apps and interactive kiosks in enhancing visitor engagement and raising awareness of park features. Additionally, sustainability tracking tools enable the ongoing evaluation of the park's impact.

- **Critical Perspective:** Expert I raised concerns about an overemphasis on data collection, arguing that the focus should remain on enhancing user experience and community interaction rather than simply gathering data.

5.5. Recommendations for the Effective Implementation of the Framework

The successful implementation of a Sustainable Park Framework hinges on a multifaceted approach that engages various stakeholders and prioritizes community needs. This section outlines key expectations and recommendations drawn from expert insights:

- **Interdisciplinary Collaboration:** Foster collaboration among architects, landscape designers, environmental scientists, and local authorities to create a well-rounded approach that addresses various aspects of sustainability, as noted by Experts (B, E, H, and M).
- **Community Involvement:** Actively engage local residents throughout the design and implementation process. This fosters a sense of ownership and ensures the park meets community needs, as recommended by Experts (A, B, C, E, F, H, I, J, K and M). Continuous community engagement and feedback will also help refine and sustain the park's impact over time.
- **Clear Vision and Goals:** Establish clear, achievable goals for sustainability, biodiversity, and community engagement to guide the project and measure success, as emphasized by Expert M.
- **Maintenance Plan:** Experts (F and M) recommend developing a comprehensive maintenance plan that outlines responsibilities, schedules, and funding to ensure the

park remains vibrant and functional over time. Expert I also recommended establishing two-way communication with the community to foster continuous dialogue, allowing for adjustments and improvements based on user feedback.

- **Monitoring and Adaptation:** Establish a system for ongoing monitoring and evaluation to assess the park's performance and adapt strategies as needed based on feedback and environmental changes, as suggested by Experts (B and M). Expert F also suggested establishing channels for ongoing feedback from park users to continuously improve the park experience.
- **Adequate Funding and Resources:** Secure sufficient funding from public and private sources to support both initial development and ongoing maintenance as suggested by Experts (B, E and M).
- **Education and Awareness:** Implement educational programs and signage to inform visitors about the park's sustainable practices and the importance of environmental stewardship, as suggested by Experts (B, C, H, K and M).
- **Balance:** Educate users on the importance of balancing smart technology with sustainable practices, reinforcing that technology should support, not overshadow, environmental goals, as expressed by Experts (C and I).
- **Regulations to safeguard communal spaces:** Establish strict rules and enforcement mechanisms, such as a ticketing system for violations, to serve as deterrents to undesirable activities. This strategy not only aims to reduce infractions but also fosters a culture of respect and accountability among park users, as suggested by Expert D.

5.6. Chapter Summary

A series of interviews were conducted with 15 stakeholders. The primary aim of these interviews was to validate the enhanced framework presented in **Figure 111**, for designing sustainable urban community parks in Al-Khobar. The interviews sought to assess the significance of each criterion within the framework and identify challenges related to its implementation, particularly in the region's hot, arid climate.

Experts emphasize the critical role of sustainable parks in enhancing the QoL and well-being of Al-Khobar's communities. Experts highlight that sustainable park designs contribute to improved air quality, urban resilience, and community pride, aligning with broader goals such as Vision 2030. Strategies for achieving aesthetically pleasing and sustainable parks include the use of native and drought-tolerant plants, natural water management systems, renewable materials, and green infrastructure. Community involvement is considered vital, with recommendations for surveys, workshops, and direct engagement to align designs with local values and needs.

In Al-Khobar's hot and arid climate, shaded pathways, water features, and microclimate-enhancing elements, such as permeable pavements and wind management, are prioritized to improve comfort and sustainability. Experts advocate combining functionality and aesthetic appeal through well-designed amenities, lighting, and multifunctional spaces that support diverse activities. By fostering environmental awareness, ensuring financial and ecological sustainability, and engaging the community in design and maintenance, parks can serve as vibrant, inclusive spaces that enhance both individual well-being and urban vitality.

Among the dimensions considered in sustainable park design, Smart Enablers received the lowest weighted mean (3.64), indicating that while smart technologies and digital infrastructure are acknowledged, they are relatively less prioritized compared to other factors. Socio-cultural considerations scored the highest weighted mean (4.18), highlighting their critical importance in aligning park designs with community traditions and values while promoting inclusivity and social interaction. Environmental considerations followed with a weighted mean of (4.03), slightly behind Economic considerations, which scored (4.08). This close alignment underscores the interconnected significance of addressing environmental challenges, such as heat mitigation and shading, alongside economic sustainability to achieve broader sustainability goals. These findings reflect a balanced approach to sustainable park design, with a slight emphasis on socio-cultural relevance, highlighting the community-centric priorities that are particularly significant in Saudi Arabia.

The graph below in **Figure 118** presents a summary of the challenges and recommendations of implementing a framework to design sustainable urban community parks in Al-Khobar city.

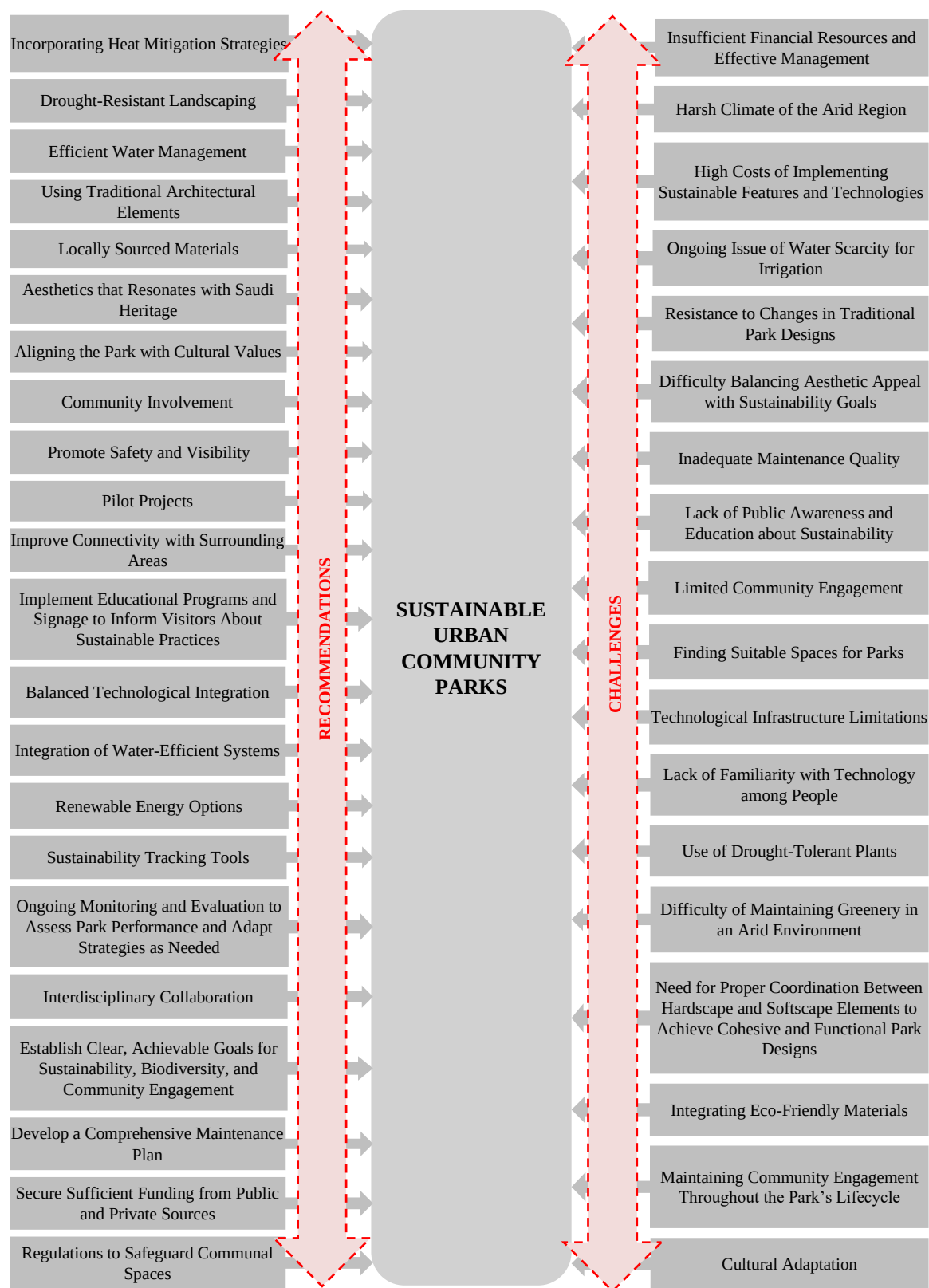


Figure 118. Challenges in Implementing the Sustainable Urban Community Park Framework and Corresponding Recommendations.

CHAPTER 6

RESULTS

6.1. Introduction

Designing sustainable urban community parks in hot arid environments poses unique challenges, particularly in regions such as Al-Khobar city, where extreme climatic conditions and rapid urbanization necessitate innovative solutions. Parks are not merely functional spaces but also critical assets that enhance the QoL, promote social inclusivity, support ecological balance, and contribute to cultural enrichment. This chapter introduces a comprehensive framework developed to address these multifaceted objectives and address the research gaps.

The proposed framework integrates four key pillars: environmental, economic, socio-cultural considerations, and the integration of smart technologies. It synthesizes insights from diverse sources including literature reviews, case studies, naturalistic observations, community feedback, and expert interviews to offer a robust and adaptable model tailored to the distinctive culture and environmental conditions in Saudi Arabia.

6.2. Framework for Designing and Assessing Sustainable Urban Community Parks in Hot and Arid Environments

The proposed framework, illustrated in **Figure 123**, is designed to promote environmental sustainability, social inclusivity, economic viability, and cultural enrichment. These interconnected elements aim to ensure that parks are not only functional and accessible but also aligned with the values and needs of the community. This section provides a detailed analysis of the framework's development, based on literature reviews, observation, surveys conducted with park users and interviews conducted with experts. **Table 10** presents the matrix of criteria and sub-criteria used in the development of the framework.

Table 10. Matrix of Criteria and Sub-criteria Creation.

Dimensions	Environmental	Economical	Socio-cultural	Smart Enablers
Criteria Extracted from literature	6	7	13	9
Sub-criteria Extracted from literature	14	23	50	3
Criteria Extracted from Observation and SWB	1	0	2	
Sub-criteria Extracted from Observation and SWB	2	2	24	
Criteria Extracted from Interviews	0	1	0	
Sub-criteria Extracted from Interviews	1	8	8	
Total Criteria	7	8	15	39
Total Sub- Criteria	17	33	82	135

Sustainable Environmental Considerations:

In the sustainable environmental considerations of the framework, as depicted in **Figure 119**, the inclusion of "Tree Canopy size" as a sub-criterion under the criterion of "Incorporate Shading" represents a vital enhancement. Wide tree canopies play a crucial role in moderating urban temperatures, providing shade, and creating more comfortable outdoor spaces for visitors. Additionally, a well-designed tree canopy enhances the visual appeal of parks, fostering inviting spaces for relaxation.

In the criterion of "Heat mitigation strategies," a newly added sub-criterion, "Non-electrical fans," was identified through expert interviews. Its inclusion is expected to enhance natural airflow, reduce humidity and heat, and create a more comfortable environment for visitors, while aligning with sustainability goals.

The addition of the sub-criterion "Vegetation quality and quantity" under the criterion of "Trees, colorful and dense plantation" is essential. High-quality vegetation, specifically adapted to arid climates, can thrive, providing much-needed shade and contributing to the cooling of the park environment. Additionally, high-quality plants enhance air quality and soil health, while increased plant density supports urban greening initiatives and strengthens climate adaptation strategies.

To enhance environmental considerations in park design, incorporating a "Pet-Friendly Environment" criterion is essential. Establishing a designated zone with pet-friendly features would promote inclusivity and community engagement. Additionally, this approach can help address food waste by providing specific areas for disposing of leftovers, which could benefit local wildlife, such as cats. Furthermore, implementing landscape

designs tailored to cat waste management can mitigate concerns about waste in playground sand, thus reducing potential health risks for children.

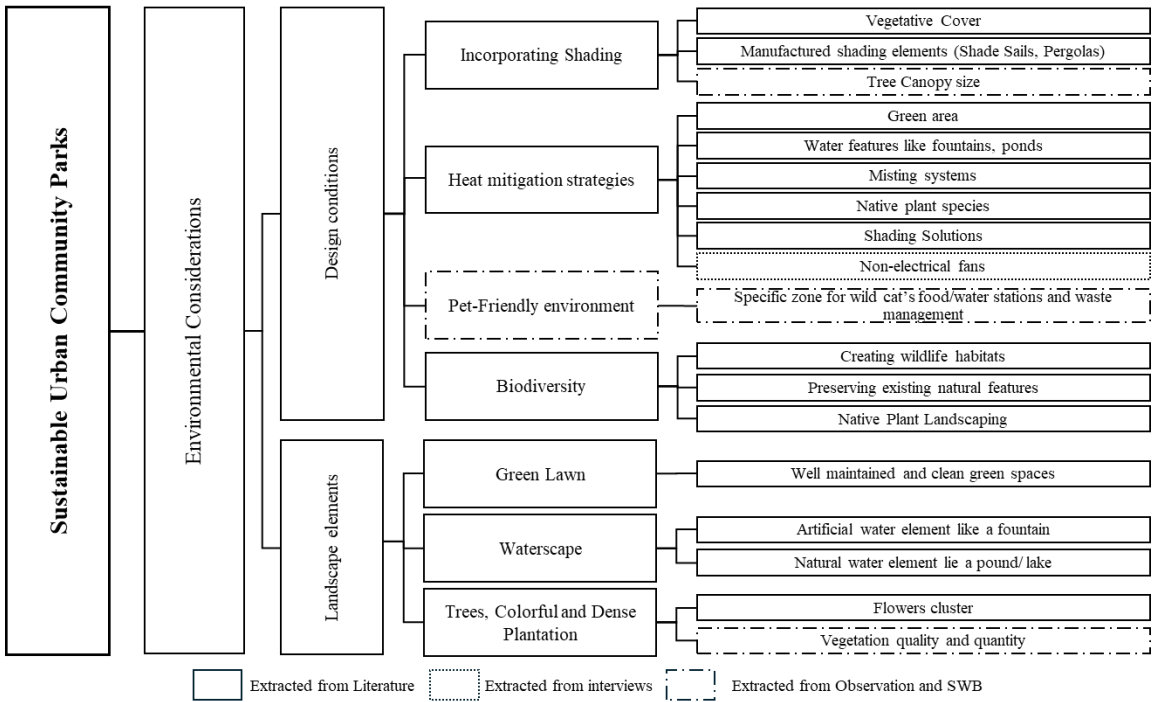


Figure 119. Environmental Considerations Criteria and Sub-Criteria.

Sustainable Economic Considerations:

Under the design conditions dimension in the environmental considerations of the framework, as illustrated in **Figure 120**, the addition of specific sub-criteria were derived from interviews with experts and observation. The criterion "Adequate Funding and Resources" includes the following sub-criteria: "Long-term Financial Planning," "Governmental Grants and Funds," and "Proposals Development." These sub-criteria reflect a comprehensive approach ensuring the effectiveness of sustainability within urban community parks. They are essential for addressing the financial challenges that often impede successful implementation and maintenance.

"Long-term financial planning" is critical to ensuring that funding is available not only for initial park development but also for ongoing maintenance and improvements. This approach enables the anticipation of future needs and the allocation of resources accordingly. As recommended by experts, establishing a long-term financial plan allows planners to create realistic budgets that account for maintenance, upgrades, and unforeseen expenses, thereby ensuring that parks remain safe and inviting overtime.

In the context of "Governmental Grants and Funds," grant programs often encourage innovative and sustainable practices, prompting park planners to explore modern technologies and methods that can enhance park functionality and environmental impact. "Proposal development" encourages a thorough assessment of the park's needs and the formulation of clear, actionable objectives. This strategic approach helps align funding opportunities with specific environmental and community goals.

The inclusion of a "Balanced landscape" sub-criterion under the "Appropriate landscape" criterion was derived from naturalistic observation, as the landscape in two sites were found to be unbalanced. This criterion is crucial for designing a sustainable community park. Incorporating a mix of (fine, coarse, and medium) landscape elements can enhance the park's visual appeal and create a more engaging and enjoyable experience for visitors. Different textures provide contrast, visual interest, and sensory stimulation, contributing to the overall attractiveness of the park.

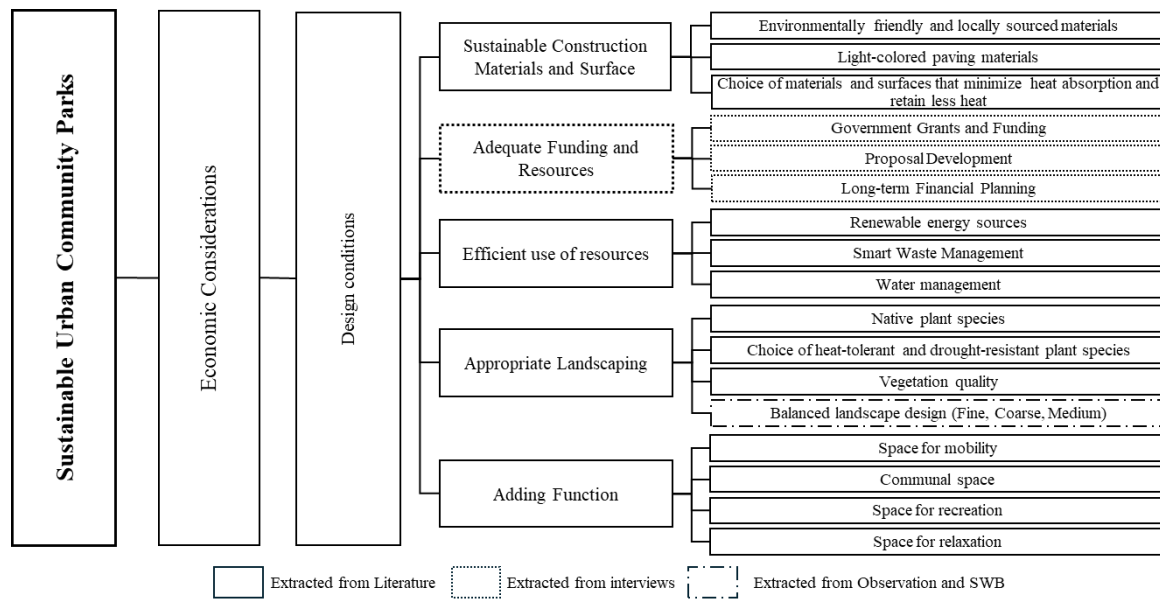


Figure 120. Economic Considerations Criteria and Sub-Criteria under Design Conditions Domain.

As depicted in **Figure 121**, in the landscape elements of the economic considerations in the framework include the addition of "Air Quality Sensors" and "Interactive Learning/Entertainment Stations" as sub-criteria under the criterion of "Balance Smart Technology Integration." These sub-criteria would enhance the functionality and educational value of the sustainable community parks while promoting sustainability and public health. As recommended by experts, the inclusion of "Air quality sensors" would provide real-time data on pollutants such as particulate matter, carbon dioxide, and ozone levels. This information is crucial for assessing the environmental health of the park and surrounding areas, enabling timely responses to air quality issues. The continuous collection of air quality data would allow park management to identify trends and evaluate the effectiveness of green infrastructure initiatives, such as tree planting or vegetation management, in improving air quality.

Additionally, the "Interactive Learning/Entertainment Stations" would blend learning with entertainment. These stations can feature interactive displays that engage visitors of all

ages, making learning about the environment both fun and accessible. It is important to note that the aim of "Balanced Smart Technology Integration" in community parks is to leverage technology to maximize sustainability while ensuring visitors can relax and connect with nature. This approach seeks to create a harmonious relationship between technological advancements and the natural environment, ultimately enhancing the overall park experience.

Furthermore, the addition of the sub-criteria "Maintenance plan," "Regular monitoring and adaptation," "Ticketing system to safeguard communal spaces," and set of "Clear vision and goals" were derived from expert interviews. A structured maintenance plan helps allocate resources efficiently, schedule tasks effectively, and maintain the park's infrastructure and amenities in optimal condition. Including "Regular monitoring and adaptation" as a sub-criterion enables park managers to assess the effectiveness of maintenance efforts and make necessary adjustments. Regular monitoring allows for the early detection of issues, prompt responses to maintenance needs, and continuous improvement of maintenance practices based on feedback and observations.

Moreover, implementing a "Ticketing system to safeguard communal spaces" was added as a sub-criterion establishes guidelines and rules for park users to follow. By setting clear regulations regarding park usage, behavior, and responsibilities, the park can maintain order, safety, and cleanliness. Lastly, defining specific objectives through the "Clear Vision and Goals" sub-criterion helps align maintenance efforts with the overall vision for the park, ensuring that maintenance tasks contribute to achieving the park's long-term sustainability and fulfilling community needs.

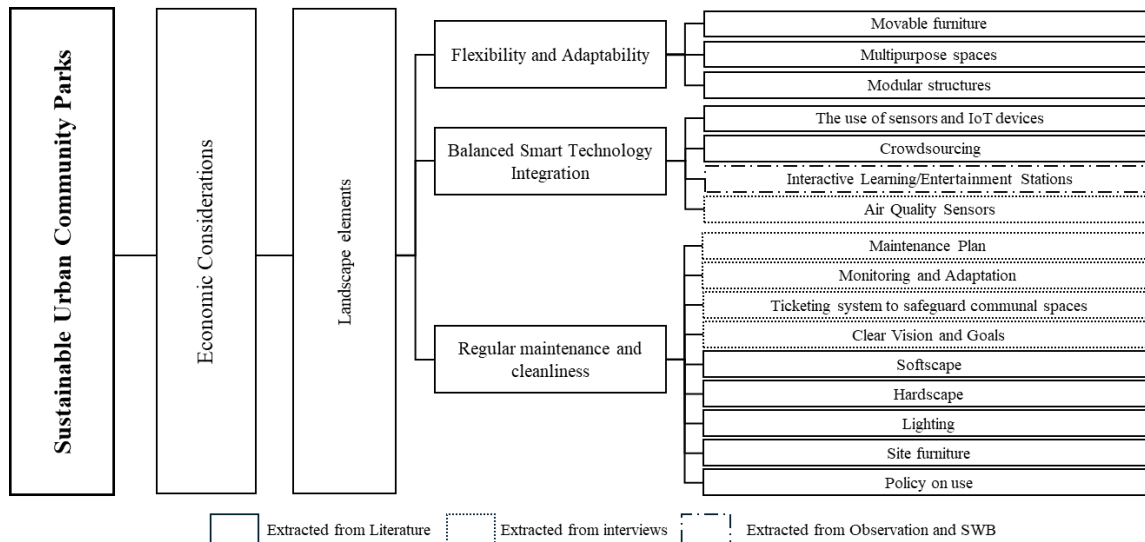


Figure 121. Economic Considerations Criteria and Sub-Criteria under the Landscape Elements Domain.

Socio-cultural Considerations:

The socio-cultural considerations layer of the framework, as depicted in **Figure 122**, has been significantly enhanced through the addition of various sub-criteria. These additions reflect an initiative-taking approach to creating community parks that are responsive to the needs and behaviors of the community.

Under the design conditions, in the "Prioritize people's need and behavior" criterion, four sub-criteria have been added: "Behavioral observation," "Community input", "Age-appropriate facilities," and "Facilities reflecting community interest."

Conducting behavioral observations allows park planners to identify how visitors interact with the space. This data-driven approach enables the design of facilities and amenities that align with actual user behavior, ultimately enhancing user satisfaction. Furthermore, actively seeking community input fosters a sense of ownership among residents. Engaging

the community in the planning process ensures that the park reflects their needs and preferences.

Additionally, providing facilities that cater to different age groups promotes intergenerational interaction. Age-appropriate playgrounds, exercise areas, and gathering spots ensure that everyone, from toddlers to elderly, can enjoy the park.

Furthermore, under the "Sustainability awareness" criterion, two sub-criteria have been added: "Educational signage" and "Recycling and waste management." Installing educational signage throughout the park informs visitors about local ecosystems, sustainability practices, and the importance of conservation, thereby enhancing their understanding and appreciation of the environment. Moreover, clearly marked recycling and waste management stations encourage proper disposal of materials, fostering a culture of sustainability among park users.

In the "Easy accessibility and universal design" criterion, three new sub-criteria have been added: "Safe and appropriate surfacing," "Universal restrooms," and "wide pathways." Their inclusion could ensure that all surfaces in the park are safe and accessible. For example, using soft materials in play areas reduces the risk of injuries. Providing universally designed restrooms ensures that all visitors, including individuals with disabilities and families with children, have access to essential facilities.

Furthermore, the wide pathways accommodate various modes of movement, including wheelchairs, strollers, and bicycles, ensuring that the park is accessible to everyone. Inclusive activities, such as a universal playground, promote social cohesion and interaction among community members, enriching the park's role as a communal space.

Moreover, providing efficient car parking spaces addresses the local preferences in Saudi Arabia, where many park visitors, as observed, rely on private transportation.

Privacy aligns with cultural and social norms in Saudi Arabia, where family and gender-specific spaces are highly valued. It ensures that all visitors feel comfortable and respected. When people feel their privacy is respected, they are more likely to utilize and revisit the park, which can lead to a more vibrant community space. Strategically placing quiet zones away from play areas and using natural sound barriers enhances the user experience, supports mental health, preserves ecosystems, and promotes community engagement within a balanced park environment. Furthermore, providing visual privacy can make park users feel more secure and comfortable, encouraging them to relax and engage in activities without feeling exposed.

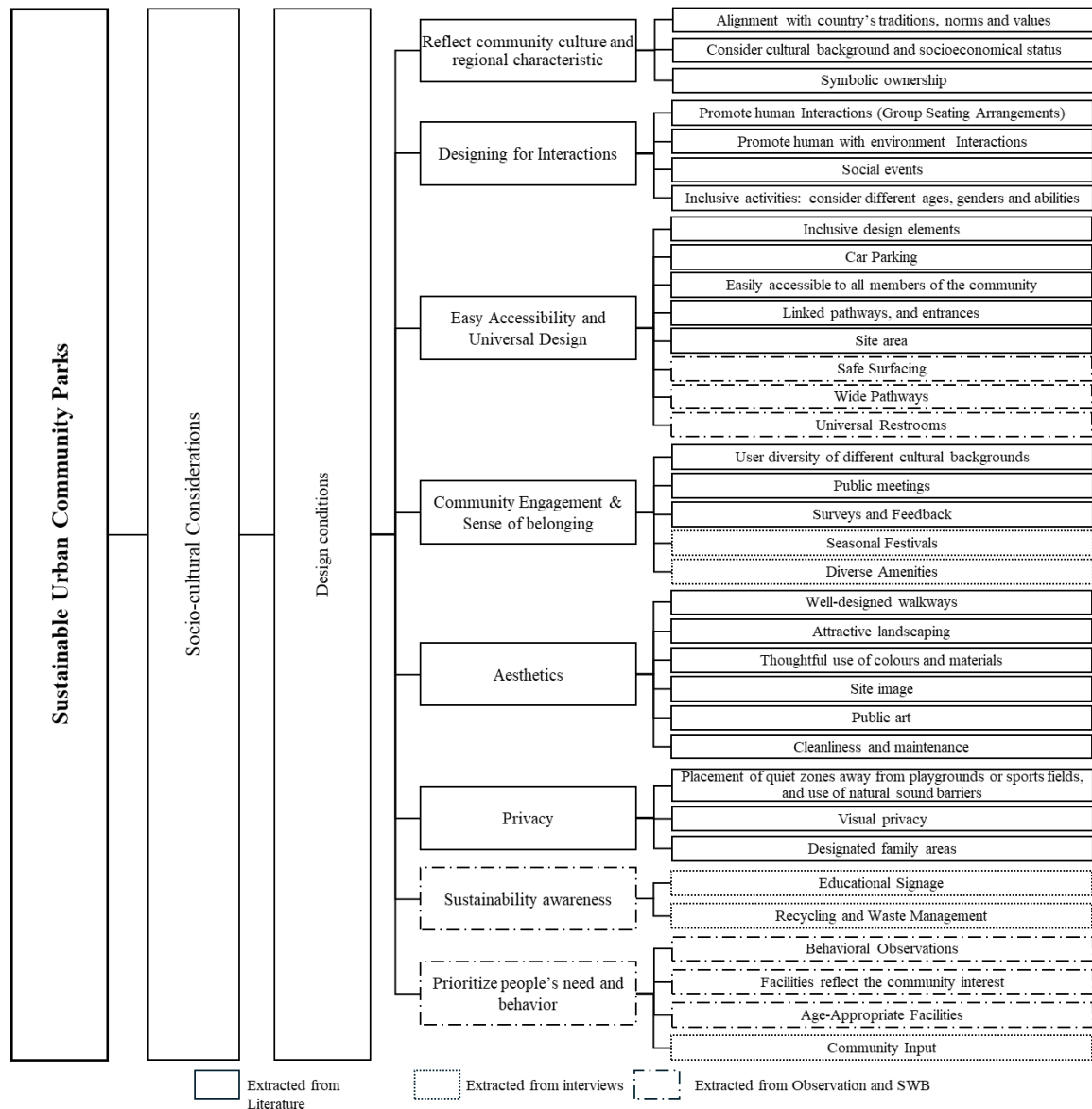


Figure 122. Socio-Cultural Criteria and Sub-Criteria under the Design Conditions Domain.

Moving to the landscape elements dimension, as illustrated in **Figure 123**, the "Wayfinding system" criterion has been enhanced with four sub-criteria: "Focal area," "Map Kiosk," "Universal symbols," and "Braille and Tactile Maps." These sub-criteria aim to improve the user experience, ensure inclusivity, and promote a sense of orientation within the park environment.

Establishing focal areas, such as unique structures, art installations, or natural features provide clear visual cues that help visitors orient themselves within the park. Focal areas can also function as community hubs where visitors gather for events, activities, or social interaction. Additionally, thoughtfully designed focal areas contribute to the park's aesthetic appeal, drawing visitors and encouraging exploration.

In the case of "Map kiosks," these serve as focal points of information in large-scale community parks, providing visitors with detailed maps of the park layout, amenities, and points of interest. Well-positioned map kiosks improve accessibility for all users, ensuring that information is readily available to everyone, including those with mobility challenges.

Furthermore, "Universal symbols" promote inclusivity by catering to diverse populations, including non-native speakers, children, and individuals with varying levels of literacy. Moreover, "Braille and tactile maps" provide essential information for individuals with visual impairment, ensuring they can navigate the park independently and confidently. This inclusivity aligns with universal design principles, which are a fundamental aspect of the framework.

As observed, under the "Urban furniture" criterion, six new sub-criteria have been added: "Flexible use," "Wise position," "Regular upkeep," "Weather-resistant materials," "Ergonomic design," and "Sufficient benches and seating." Providing comfortable seating options encourages park visitors to relax, socialize, enhancing the overall user experience.

"Urban furniture" can be designed for flexible use, such as movable chairs or modular seating arrangements, which allow for adaptable configurations to accommodate various activities and user preferences within the park. Including regular maintenance and upkeep

as a sub-criterion ensures that urban furniture remains in good condition, upholding the park's appearance, safety, and functionality over time.

Additionally, selecting durable, weather-resistant materials for park furniture enhances its longevity and ensures that it can withstand various weather conditions. Furthermore, the park's furniture, designed with ergonomic principles in mind, prioritizes user comfort, safety, and well-being, promoting proper posture, ease of use, and overall satisfaction for park visitors.

Moreover, the provision of proper waste management facilities helps maintain cleanliness in the park, promotes environmental sustainability through recycling initiatives, and ensures a hygienic and pleasant environment for all park users. Most importantly, the strategic placement of park furniture in optimal locations, considering factors such as views, accessibility, and user convenience, maximizes the functionality and aesthetic appeal of the park space.

The inclusion of two additional sub-criteria, "Food and beverage" and "Sports field based on community input," under the "Comfort and amenities" criterion was derived from observations and community feedback during the SWB analysis. Integrating food and beverage amenities within the park enhances the overall visitor experience by offering convenient access to refreshments and snacks. This addition addresses the needs of park users while encouraging longer visit durations and greater satisfaction.

Furthermore, "Designing sports fields based on community input" ensures that these facilities align with the specific preferences and requirements of local residents. Actively involving the community in the planning process enables the park to offer sports fields that

support popular activities, promote active lifestyles, and a sense of ownership and engagement among users.

Under the "Safety and security" criterion, two additional sub-criteria: "Park boundaries" and "Analysis of usage pattern" have been included. Observations and community feedback have highlighted the absence of defined boundaries in parks as a recurring issue in parks across Al-Khobar. Implementing physical barriers can enhance safety by preventing children from inadvertently leaving the park and being exposed to traffic or other external hazards. Moreover, analyzing usage patterns enables the anticipation and mitigation of safety concerns, such as overcrowding or the identification of secluded areas that may require increased attention and monitoring.

Under the "Sculpture and landform" criterion, three additional sub-criteria have been added: "Interactive installation," "Cultural representation," and "Functional landforms." The inclusion of interactive art pieces create memorable experiences, encourages exploration, and foster creativity among park users. Furthermore, sculptures and art that reflect cultural representation promote inclusivity, cultural awareness, and a sense of belonging among community members. Additionally, functional landforms, such as seating areas, walkways, water features, or natural amphitheaters, serve both aesthetic and functional/practical purposes. These features enhance the park's usability, spatial organization, and recreational opportunities to a more engaging and versatile environment for visitors.

The addition of three new sub-criteria "Public transit accessibility," " Multiple entrances," and "Safe crossing" within the "Circulation path and connectivity to surrounding" criterion

is essential for enhancing the park's functionality and accessibility. Including well-planned trails for cyclists and pedestrians promotes physical health and encourages a healthy lifestyle. As observed, ensuring accessibility to public transit facilities near the park improves connectivity for a wider range of visitors, including those who rely on public transportation. Furthermore, prioritizing safe crossing points within and around the park promotes walkability and pedestrian safety, mitigates traffic risks, and ensures a secure environment for park users accessing nearby destinations. Lastly, incorporating multiple entrances into the park design enhances connectivity and circulation by dispersing visitor entry points and improving accessibility from various directions. This approach provides convenient access to various park amenities, enhancing the overall user experience and catering to diverse user preferences.

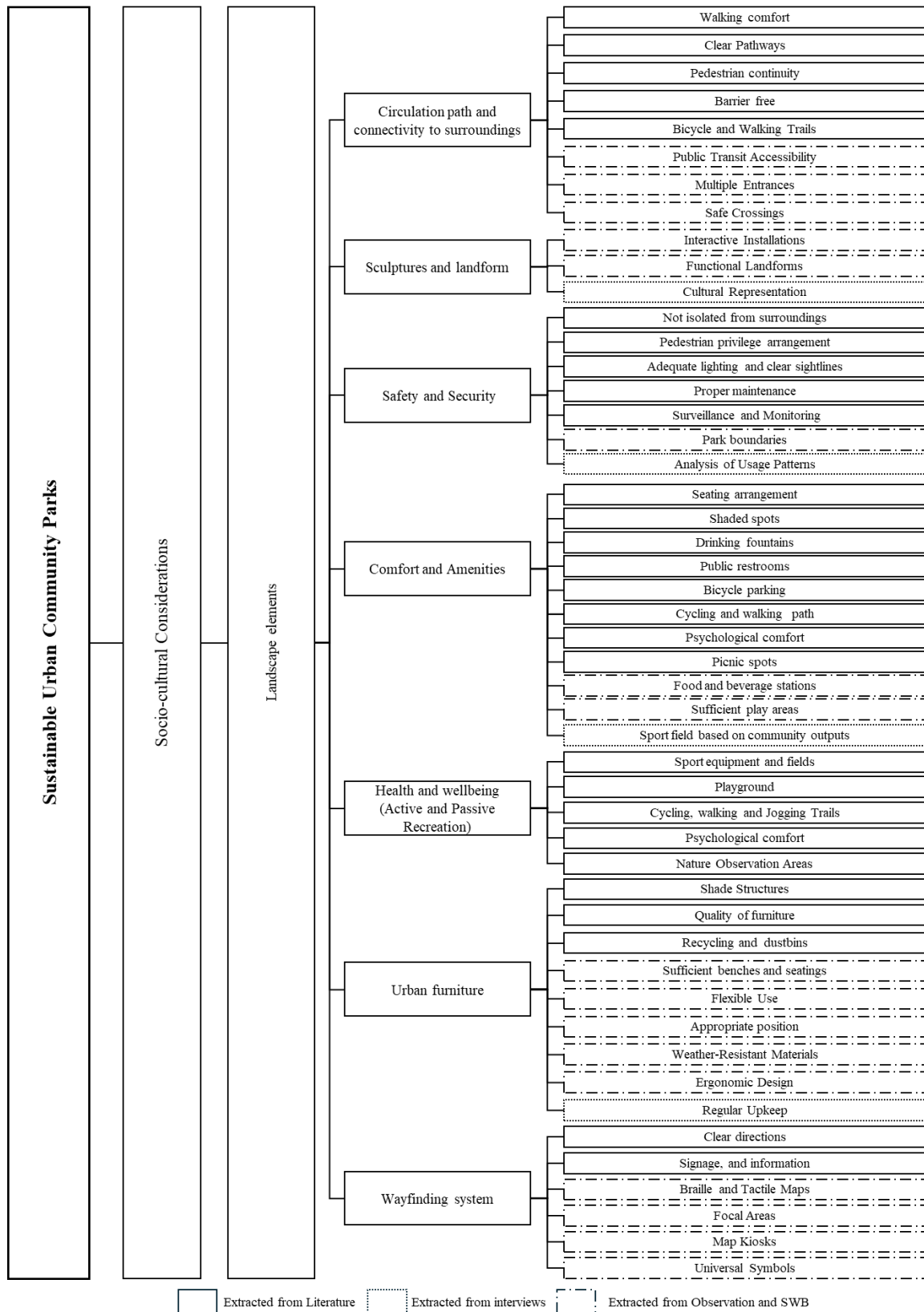


Figure 123. Socio-Cultural Considerations Criteria and Sub-Criteria of the Landscape Elements Domain.

After synthesizing data from a diverse range of sources including literature reviews, case studies, naturalistic observations, user satisfaction surveys, subjective well-being assessments, and expert interviews, a comprehensive framework has been developed, as illustrated in **Figure 124**.

This framework serves as a comprehensive guide for designing sustainable urban community parks in hot and arid environments, with a particular focus on Al-Khobar City. Additionally, it can be utilized as a tool for assessing the quality of existing parks, ensuring they meet sustainability standards and effectively address the needs of their communities.

This framework incorporates 39 criteria and 135 sub-criteria (including 17 design conditions, 13 landscape elements, and 9 smart enablers) for designing sustainable urban community parks. It serves as a practical guideline, integrating multidisciplinary insights and best practices to address the unique challenges posed by the region's hot arid climate. By emphasizing sustainability, community engagement, and environmental resilience, the framework aims to create parks that enhance the QoL for residents while fostering ecological balance and social cohesion.

Furthermore, the framework aligns closely with Saudi Vision 2030, promoting environmental sustainability, enhancing QoL, and fostering community engagement. Establishing sustainable urban community parks contributes to the development of more livable, resilient urban environments, supporting Vision's objectives of creating vibrant, thriving communities and a sustainable future.

Sustainable Urban Community Parks						
	Environmental Considerations					
	Design conditions	Landscape elements				
	Design conditions		Incorporating Shading	Vegetative Cover Manufactured shading elements (Shade Sails, Pergolas) Tree Canopy size		
			Heat mitigation strategies	Green area Water features like fountains, ponds Misting systems Native plant species Shading Solutions Non-electrical fans		
			Pet-Friendly environment	Specific zone for wild cat's food/water stations and waste management		
			Biodiversity	Creating wildlife habitats Preserving existing natural features Native Plant Landscaping		
	Landscape elements		Green Lawn	Well maintained and clean green spaces		
			Waterscape	Artificial water element like a fountain Natural water element like a pond/ lake		
			Trees, Colorful and Dense Plantation	Flowers cluster Vegetation quality and quantity		
	Design conditions		Sustainable Construction Materials and Surface	Environmentally friendly and locally sourced materials Light-colored paving materials Choice of materials and surfaces that minimize heat absorption and retain less heat		
			Adequate Funding and Resources	Government Grants and Funding Proposal Development Long-term Financial Planning		
			Efficient use of resources	Renewable energy sources Smart Waste Management Water management		
			Appropriate Landscaping	Native plant species Choice of heat-tolerant and drought-resistant plant species Vegetation quality Balanced landscape design (Fine, Coarse, Medium)		
			Adding Function	Space for mobility Communal space Space for recreation Space for relaxation		
			Landscape elements		Flexibility and Adaptability	Movable furniture Multipurpose spaces Modular structures
					Balanced Smart Technology Integration	The use of sensors and IoT devices Crowdsourcing Interactive Learning/Entertainment Stations Air Quality Sensors
					Regular maintenance and cleanliness	Maintenance Plan Monitoring and Adaptation Ticketing system to safeguard communal spaces Clear Vision and Goals Softscape Hardscape Lighting Site furniture Policy on use
			Design conditions		Reflect community culture and regional characteristic	Alignment with country's traditions, norms and values Consider cultural background and socioeconomic status Symbolic ownership
					Designing for Interactions	Promote human interactions (Group Seating Arrangements) Promote human with environment Interactions Social events Inclusive activities: consider different ages, genders and abilities
	Easy Accessibility and Universal Design	Inclusive design elements Car Parking Easily accessible to all members of the community Linked pathways, and entrances Site area Safe Surfacing Wide Pathways Universal Restrooms				
Community Engagement & Sense of belonging	User diversity of different cultural backgrounds Public meetings Surveys and Feedback Seasonal Festivals Diverse Amenities					
Aesthetics	Well-designed walkways Attractive Landscaping Thoughtful use of colours and materials Site image Public art Cleanliness and maintenance					
Privacy	Placement of quiet zones away from playgrounds or sports fields, and use of natural sound barriers Visual privacy Designated family areas					
Sustainability awareness	Educational Signage Recycling and Waste Management					
Prioritize people's need and behavior	Behavioral Observations Facilities reflect the community interest Age-Appropriate Facilities Community Input					

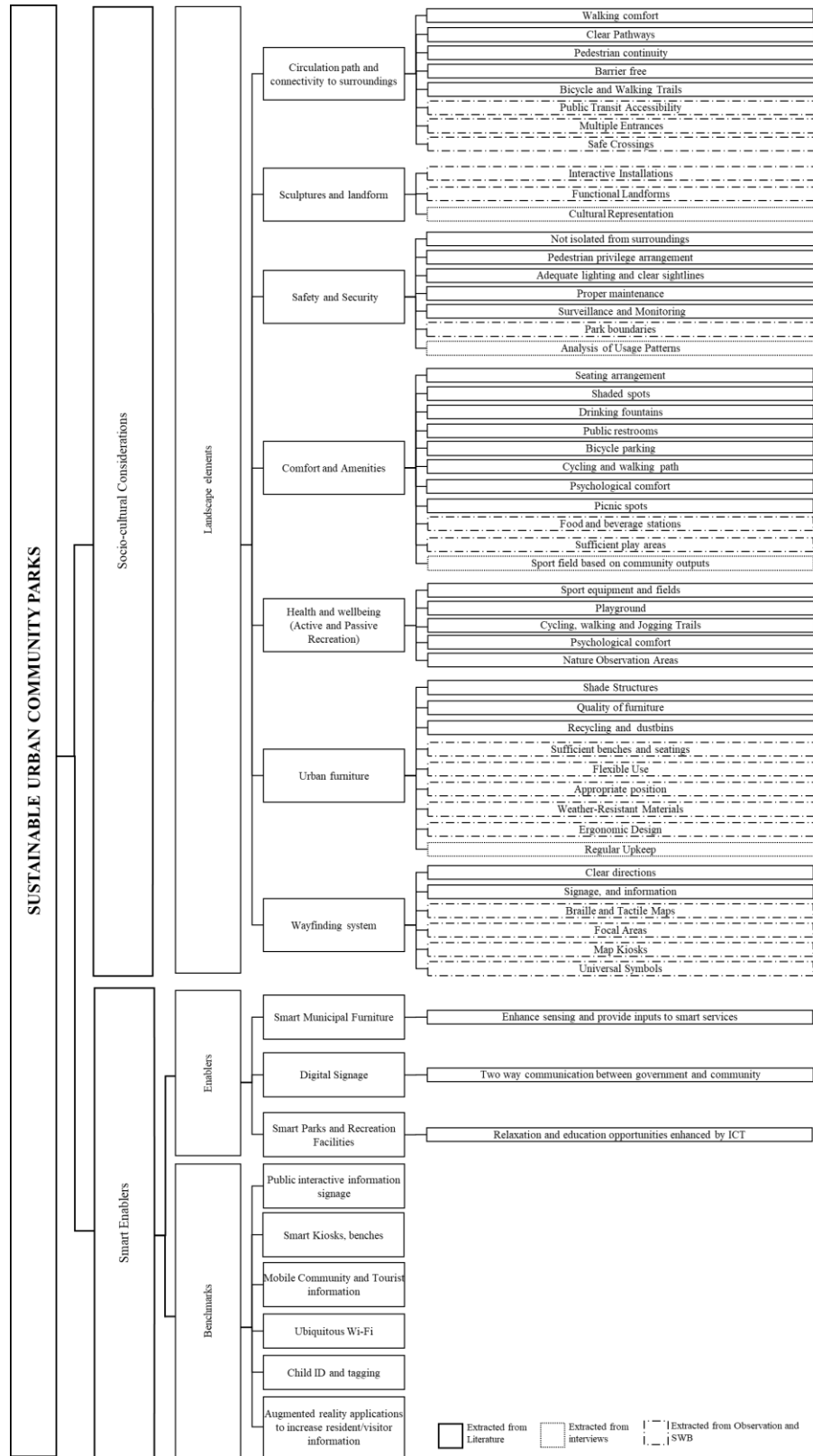


Figure 124. Finalized Framework Consist of Criteria and Sub-Criteria for Designing Sustainable Urban Community Park in the Context of Al-Khobar City.

CHAPTER 7

CONCLUSION AND RECOMMENDATIONS

Urban community parks are fundamental components of urban neighborhoods, offering a diverse range of benefits that significantly enhance residents' well-being. Research consistently demonstrates that these parks offer recreational opportunities, promote social interaction, enhance the environment, and support mental and physical health. As vital public spaces, community parks foster social engagement by bringing people together through their accessibility and proximity to amenities, cultivating a sense of community and connection among residents. The literature underscores the necessity of establishing a national framework for parks that reflects the unique environmental and social contexts of Saudi Arabia, emphasizing that such a framework would standardize park quality assessments and ultimately enhance user experience and satisfaction.

Few studies focus on community parks, and there is a significant absence of guidelines for creating sustainable urban parks. The investigation reveals that the lack of a systematic approach in Saudi Arabia arises from misconceptions within urban planning and landscape architecture, which often results in non-specialists overseeing these important spaces. Furthermore, the failure to integrate open space planning during the initial stages of city development, coupled with historical confusion over responsibilities due to a weak institutional framework, has exacerbated the issue. This gap presents significant challenges for professionals seeking to develop sustainable public open spaces in hot, arid regions.

Accordingly, this study aims to address these research gaps by proposing a comprehensive framework for designing sustainable urban parks in such environments and providing a tool for assessing their quality.

The study drew on existing literature to develop a conceptual framework for designing sustainable public open spaces. This framework was then applied to observe and evaluate selected parks (Dhahran Hills Park, Ithra Park, Shells Park, and Prince Ibn Jalawy Park), focusing on 13 landscape elements and 13 design conditions. The additions to the conceptual framework were informed by data collected through naturalistic observation, users' satisfaction and well-being surveys, and interviews with experts.

The observed community parks shared several common weaknesses that hindered their effectiveness. These parks suffered from a lack of shaded areas, and picnic areas, which should have offered respite, lacked sufficient shading. The parks also had limited strategies for heat mitigation, with sustainable materials seldom used. Community engagement was minimal, and the parks were not pet-friendly, missing an opportunity to cater to a broader range of visitors. Additionally, there was limited integration of renewable energy and smart technologies, while waste management practices remained inadequate. Essential services like restrooms and drinking fountains were absent and maintenance and cleanliness were irregular, undermining the overall visitor experience. Safety concerns, such as poorly defined park boundaries and insufficient nighttime lighting, also persisted. Moreover, there was a clear absence of sports equipment, and universal design principles had not been adequately considered, leaving the diverse needs and behaviors of park users largely unaddressed.

A significant number of park visitors reported low level of satisfaction, particularly in Sites 3 and 4. The primary reason for their dissatisfaction was that these parks were either the only available recreational spaces in their neighbourhood or the closest option to their homes. This limited availability forced visitors to use these parks despite their shortcomings, such as inadequate facilities, lack of maintenance, and other factors that failed to meet user expectations. This highlights the urgent need for improved park planning and design, ensuring that all neighbourhoods have access to high-quality, well-maintained parks that cater to the diverse needs of their communities.

The analysis of subjective well-being assessments (SWB) across the four case study parks (Hills Park, Ithra Park, Shells Park, and Ibn Jalawy Park) revealed several key insights into their impact on visitors' overall well-being. Hills Park and Ithra Park demonstrated positive visitor well-being, as evidenced by high scores in likelihood to revisit and recommend, indicating that these parks effectively meet user needs. Visitors across all parks primarily valued social interactions and physical activities, with many citing times spent with family and friends, as well as exercise, as their main motivations for visiting. In contrast, Shells Park exhibited moderate well-being levels, with visitors expressing concerns about cleanliness and safety, suggesting that improvements in maintenance could have enhanced their experience. Similarly, Ibn Jalawy Park showed moderate engagement and a balanced emotional experience but also faced notable issues related to cleanliness and safety. Hills Park and Ithra Park consistently scored higher in terms of overall happiness and connection to nature, suggesting that visitor experiences at Shells Park and Ibn Jalawy Park were less fulfilling and indicating areas for potential development.

Based on the analyzed data from observations and community feedback, the framework was reformulated and enhanced to include 17 criteria of design conditions, 13 landscape elements, and 9 smart enablers, each with a set of sub-criteria. The framework was then validated through interviews with experts. Using a five-point Likert scale, experts evaluated the importance of each criterion, calculating the weighted mean, importance rank and Relative Importance Index (RII).

The findings indicate a balanced approach to sustainability in park design in Saudi Arabia, with a slight emphasis on socio-cultural considerations, which received the highest weighted mean. This underscores the importance of aligning park designs with community traditions, values, and social inclusivity. Environmental and economic considerations were closely ranked, highlighting their interconnected role in achieving sustainability goals, particularly in addressing urban environmental challenges. Meanwhile, Smart Enablers received the lowest weighted means, suggesting that while digital infrastructure is acknowledged, it is a lower priority compared to other sustainability dimensions.

Key findings include a high importance placed on shading, with a mean score of (4.9), which is essential for thermal comfort in extreme heat. Socio-culturally, alignment with community traditions scored (4.8), emphasizing inclusivity. Accessibility features received a mean of (4.5), reinforcing the need for inclusive and accessible spaces. Heat mitigation strategies, including greenery and water features, ranked at (4.4). From an economic perspective, efficient resource management scored (3.8), indicating the importance of cost-effective practices for sustainability. Conversely, pet-friendly environment received the lowest importance, with a mean of (3.1).

The validated framework consists of two primary domains: sustainable and digital considerations (Environmental, Economic, and Socio-cultural, and the Smart Enablers). Within each sustainable considerations, two dimensions (landscape elements and design conditions) consist of criteria and sub-criteria. In total, the framework includes 39 criteria, 135 sub-criteria. The framework illustrated in **Figure 124** aims to enhance environmental sustainability, social inclusivity, economic viability, and cultural enrichment. The addition of smart enablers optimizes park management and maintenance. These components work together to ensure that parks are not only functional and accessible but also align with the community's values and needs.

The proposed framework serves as a practical guide, integrating various perspectives and strategies to address regional climate challenges. It emphasizes sustainability, community engagement, and environmental resilience to create parks that enhance residents' quality of life while promoting ecological balance and social cohesion. Aligned with Saudi Vision 2030, the framework supports environmental sustainability, improved quality of life, and community participation. The development of sustainable urban community parks could significantly contribute to creating more livable and resilient urban environments in line with Vision's objectives. This framework will also assist in assessing the park's quality, as well as user satisfaction.

It is important to note that while the integration of smart technologies in park management is a crucial consideration in today's urban landscape, the primary goal of a community park is to encourage interaction and provide opportunities for people to spend time in a real environment, not a virtual one. As evidenced by the ranking of the smart enablers dimension in the framework, it received the lowest level of importance compared to other

sustainable considerations. As discussed in previous sections, smart technologies can enhance the efficiency and effectiveness of park management, improve visitor experiences, and promote sustainability. However, it is essential to strike a balance between the benefits of smart technologies and the need for sustainable practices.

The integration of smart technologies can lead to a more efficient resource use, reduced energy consumption, and enhanced community engagement. Nevertheless, it remains crucial to prioritize the maintenance of these amenities to ensure their long-term functionality and effectiveness. Moreover, community engagement is a critical aspect of park design and management, and it is essential to prioritize the needs and preferences of community members.

When implementing the framework, it is essential to prioritize maintenance. Unmaintained amenities can negatively impact on visitors' experiences and the overall effectiveness of park management. Having amenities that are not properly maintained is worse than not having them at all. Therefore, it is crucial to allocate sufficient resources for maintenance and ensure that all design elements are integrated in a way that prioritizes sustainability and community engagement.

The implementation of the framework faces key challenges. Many urban parks operate under budget constraints, limiting their ability to implement sustainable practices and maintain existing facilities. Additionally, parks must adapt to changing climate conditions, including extreme weather events, which can impact plant health and user safety. Integrating sustainability into park design is complex, requiring specialized knowledge and collaboration among various stakeholders. The ongoing upkeep of sustainable features is

crucial; however, it is often neglected due to inadequate funding or staffing. Implementing modern technologies for water management and park maintenance can be resource-intensive and may require specialized training for staff. Furthermore, balancing park development with environmental preservation is essential yet presents significant challenges.

To address these challenges, expert recommendations include fostering interdisciplinary collaboration, ensuring community involvement, setting clear visions and goals, establishing maintenance plans, adopting monitoring and adaptation strategies, securing adequate funding and resources, promoting education and awareness, achieving balance in design, enforcing regulations to safeguard communal spaces, initiating pilot projects, utilizing climate-resilient plants, and incorporating sustainable and locally sourced materials. These strategies aim to overcome obstacles and create sustainable, functional, and community-focused urban parks.

To further explore sustainable urban community parks, future studies could focus on developing a spatial analysis using Geographical Information System (GIS) and regional surveys to evaluate the availability, distribution, and quality of community parks, as well as user's satisfaction in Al-Khobar city based on the proposed framework.

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Appendix A

Table 11. SWB Survey's Questions.

No	Questions
Multiple choice – Likert scale	
Q1	On a scale of 1 to 5, with 5 being the highest, how would you rate the following statements: 1.1. Your overall happiness during your visit to the park (<i>1 = Very Unhappy, 5 = Very Happy</i>) 1.2. How often did you encounter negative emotions, such as stress or anxiety, while in the park (<i>1 = Very Often, 5 = Never</i>) 1.3. How connected did you felt with nature during your time at the park (<i>1 = Not at All, 5 = Very Strongly</i>) 1.4. To what extent did being in the park positively affect your mood and emotional state (<i>1 = Not at All, 5 = Very Much</i>) 1.5. Did engaging in specific activities or interactions within the park have a positive impact on your emotions (<i>1 = Not at All, 5 = Very Much</i>) 1.6. Did the park contribute to your physical well-being through activities like walking or exercising? (<i>1 = Not at All, 5 = Very Much</i>) 1.7. How likely are you to recommend the park to others based on your experience? Likelihood to Recommend: How likely are you to recommend the park to others based on your experience? (<i>1 = Not Likely, 5 = Very Likely</i>) 1.8. How likely are you to revisit the park based on your experience (<i>1 = Not Likely, 5 = Very Likely</i>)
Multiple Choice	
Q2	How frequently do you typically visit the park?
Q3	How many hours did you spend in the park?
Q4	What is your primary motivation of visiting the park?
Open ended question	
Q5	For visits durations that are less than 2 hours and a visit frequency of every other week or longer, kindly provide specific details or a reason in your response.
Q6	Do you have any comments or recommendation?

Appendix B

Table 12. Profiles of Interview Participants

No	Name	Profession	Years of experience
01	Expert 'A'	Chief Development Officer at Public Investment Fund	20
02	Expert 'B'	Architect and Graduate student in M.Sc. Arch.	4
03	Expert 'C'	Assistant professor in Architecture and City design department	31
04	Expert 'D'	Assistant professor in Architecture and City design department	8
05	Expert 'E'	Urban Planner – PhD researcher	24
06	Expert 'F'	Landscape Architect	3
07	Expert 'G'	Professor in Facilities Management, Digital Technologies, Knowledge Management	26
08	Expert 'H'	Chancellor of Alasala University. B. Arch, M.Sc. from the University of Sydney- Ph. D from Illinois Institute of Technology, Chicago	12
09	Expert 'I'	Chairman and Assistant professor in Architecture and City design department	13
10	Expert 'J'	Architect and Graduate student in M.Sc. Arch.	3
11	Expert 'K'	Landscape architect and researcher	3
12	Expert 'L'	Urban planner	7
13	Expert 'M'	Architect and Graduate student in M.Sc. Arch.	5
14	Expert 'N'	Urban Planner in SDA	4
15	Expert 'O'	Landscape architect	6

Appendix C

Table 13. Interview Questions.

No	Sections and Questions
Section 1: Role of Sustainable Parks in Enhancing Quality of Life and Well-being – Short answers	
Q1	How do you perceive the role of sustainable parks in enhancing the quality of life and well-being of the community?
Q2	What strategies could be employed to create aesthetically pleasing park designs while maintaining sustainability objectives?
Q3	What specific features or amenities do you value the most in a park, considering the hot and arid environment?
Section 2: Validate the developed framework by ranking the importance of each factor of designing sustainable community park in Al-Khobar city – Likert scale	
Q4	On a scale of 1 to 5, with 5 being extremely important and 1 extremely unimportant, how would you rate the importance of the following Sustainable Community parks design conditions: 1. Incorporate shading 2. Efficient use of energy 3. Heat mitigation strategies 4. Biodiversity 5. Water management 6. Appropriate Landscaping 7. Adding Function 8. Designing for Interactions 9. Easy Accessibility and Universal Design 10. Community Engagement 11. Aesthetics 12. Pet-Friendly environment 13. Consider user's level of education 14. Sense of belonging 15. Sustainability awareness 16. Prioritize people's needs and behavior 17. Health and Well-being
Q5	On a scale of 1 to 5, with 5 being the highest, how would you rate the importance of the following Sustainable Community parks landscape design elements 1. Green Lawn 2. Trees, Colorful and Dense Plantation 3. Smart Waste Management 4. Sustainable Construction Materials and Surface 5. Waterscape 6. Flexibility and Adaptability 7. Smart Technology Integration 8. Circulation path and connectivity to surroundings 9. Sculptures and landform 10. Safety and Security 11. Comfort and Amenities 12. Active and Passive Recreation

	13. Urban furniture 14. Way-finding system 15. Regular maintenance and cleanliness
Q6	On a scale of 1 to 5, with 5 being the highest, how would you rate the importance of the following Smart Enablers in the Sustainable Community parks: 1. Smart Municipal Furniture: enhances sensing and provides input for Smart Services 2. Digital Signage: enables two-way communication between government 3. Smart Parks and Recreation Facilities: provide relaxation and education opportunities enhanced by ICT
Q7	On a scale of 1 to 5, with 5 being the highest, how would you rate the importance of the following Smart Enablers (Initiatives) in the Sustainable Community parks: 1. Public interactive information signage 2. Smart Kiosks, benches 3. Smart Street signs 4. Mobile Community and Tourist information 5. Interactive mobile applications for residents, tourists, and MICE 6. Ubiquitous Wi-Fi 7. RFID Ticketing 8. Smart Park Dynamic Applications for Public Discovery, Ticketing, Mapping 9. Child ID and tagging 10. Augmented reality applications to increase resident/visitor information
Section 3: Challenges in Implementing Sustainable Park Design Framework in Al-Khobar – Open ended questions	
Q8	In your opinion what are the main challenges you foresee in implementing the framework for sustainable park design in Al-Khobar?
Q9	What lessons have you learned from previous projects that can be applied to the development of a framework for designing sustainable urban community parks in Al-Khobar?
Q10	What design considerations do you consider ensuring the park's compatibility with Al-Khobar's climate and culture?
Q11	Does and how incorporating a smart layer into the framework would influence its efficiency?
Section 4: Expectations and Suggestions for the Successful Implementation of the Sustainable Park Framework	
Q12	What are your expectations and suggestions for the successful implementation of the sustainable park framework?

Vitae

Name : Sara Qwaider

Nationality : Jordanian

Date of Birth : October 06, 1998

Email : quwider_sara@yahoo.com

Address : Alanya, Antalya Province, 07460, Turkey

Academic Background : Architecture and City Design

ORCID : [0009-0000-6794-1575](https://orcid.org/0009-0000-6794-1575)

LinkedIn : <http://www.linkedin.com/in/saraqwaider>

Bibliographic details

Sara Qwaider is an architect, urban designer, and researcher with an academic and professional background in architecture and urban studies. She obtained her bachelor's degree in Architecture and Fine Art from Girne American University in North Cyprus and pursued a master's degree in Science of Architecture and City Design at King Fahad University of Petroleum and Minerals in Saudi Arabia. Her research interests encompass a wide range of topics, including Geographical Information Systems (GIS) and Remote Sensing (RS), vernacular architecture, Social Life Cycle Assessment (SLCA), Sustainable public open spaces, sustainable development goals (SDGs), Saudi Vision 2030, and the development of sustainable, smart, and cognitive cities.

In 2024, Sara presented a research paper “Developing Smart Sustainable Community Framework: The Case of Smart Education” at the Arab ICT Conference. Additionally, she has published in peer-reviewed journals, including: Qwaider, S., Al-Ramadan, B., Shafiullah, M., Islam, A., & Worku, M. Y. (2023). GIS-Based Progress Monitoring of SDGs towards Achieving Saudi Vision 2030. *Remote Sensing*, 15(24), 5770. <https://doi.org/10.3390/rs15245770>.