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Sustainable Park Landscaping as an Approach for the Development of the Built Environment: Review and Employment

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Abstract

Implementing sustainable principles when landscaping parks is vital for the development of the built environment, and should take into account environmental, social, economic, and cultural aspects, in order to eliminate conflict between developmental requirements, and the need to preserve cultural and natural resources. This paper reviews the guidelines that should be considered for current and future sustainable parks in regions with a moderate climate, in order to ensure that they incorporate ecotourism, cost effective operation and maintenance, a clean environment, the promotion of renewable energy, and resource preservation. A number of parks, located in moderate climate zones, are studied in terms of aspects such as their location, topography, operation, and landscaping characteristics, to demonstrate the prevailing normative values that can be applied to sustainable park design. Prince Meshari Park, in Al-Baha city, Saudi Arabia, is employed as a case study for applying all of the guidelines proposed in this investigation, and to highlight some of their merits and limitations in terms of the current situation of the park.

Keywords

sustainable parks; cost-effective parks; environmental balance; landscaping; resource preservation; ecotourism

1. Introduction

In recent decades, the importance of the built environment and its resources has emerged as an issue, especially in countries with a moderate climate that wish to establish parks with limited conditions and resources (Ceballos-Lascurain, 1996). Parks should not be considered isolated structures, since they interact spatially, and are functional components of landscape ecosystems (Noss, 1987). Moreover, parks can be a source of many wider benefits, including purifying the air; providing water; improving urban micro-climates (Chiesura, 2004); minimizing stress, and enhancing meditation, thereby revitalizing city inhabitants; promoting a sense of peace and tranquility (Ulrich, 1981); extending the lifespan of elderly people (Takano, Nakamura, & Watanabe, 2002); encouraging the use of outdoor space; increasing social integration and interaction among neighbours (Coley, Kuo, & Sullivan, 1997); mitigating the cost of pollution abatement; preventing and reducing the incidence of disease; attracting visitors and promoting a city as a tourist destination; and generating revenue and employment (Chiesura, 2004). As such, and for example, (Parés-Franzi, Saurí-Pujol, & Domene, 2006) examined how the urban parks in Mediterranean cities are distributed, and assessed the ways in which their design and management follow criteria adapted to Mediterranean environmental conditions. The authors found that incorporating certain sustainable practices can

significantly improve the environmental performance of these public spaces, under the conditions of a Mediterranean climate. Moreover, (Ayeghi and Ujang, 2017) explored the impact of the physical features of an urban park on their users' attachment to the park, with reference to KLCC Park in Kuala Lumpur. They found that the physical features influenced the users' functional attachment, and active features, such as water features, had a stronger effect on user attachment than passive features. Urban managers and urban designers are now able to create pleasing open spaces that attract increased numbers of visitors, due to their sustainable physical features. According to (Jim, 2000), there are two crucial aspects of sustainable landscape planning: providing high quality planting, and guarding against subsequent degradation and intrusion. In addition, (Tian, Jim, Tao and Shi, 2011) assessed the green space fragmentation in Hong Kong, and found that the fragmentation index took almost all of the characteristics of the landscape pattern into account, in terms of the size, shape, proximity, connectivity, heterogeneity, and interspersion. Meanwhile, (Maruani and Amit-Cohen, 2007) reviewed and compared a number of planning approaches and methods applied to open spaces, and illustrated the differences between these models, claiming that securing a satisfactory and dynamic design for open spaces cannot rely on planning alone, as it also requires a thorough understanding and control of local engineering bodies and stipulations that should be adhered to.

The Saudi environment possesses certain climatic challenges, since it is harsh and dry, and can be classified as BWh climate, with an average temperature above 18°C (Weatheronline, 2019). The climate and culture are similar in Arabian countries, such as Saudi Arabia and Egypt, with the latter characterized by a hot, arid zone with variable day and night temperatures (Fathy, 1973). In addition, the challenge of water scarcity means that there is a reliance on non-renewable groundwater supplies to cope up with growing demand (Swain, 1998). Due to the increasing demand for water in the Gulf Coast Countries (GCC), where water resources are limited, alternative water sources are now sought, such as wastewater reclamation, and desalination (Al-Rashed & Sherif, 2000). According to Sutton, Anderson, Elvidge, Tuttle, and Ghosh (2009), Saudi Arabia accounts for 4.6 hectares of ecological footprint per person, which ranks the country among the most environmentally challenged countries in the world.

The Kingdom of Saudi Arabia (KSA) has therefore established national parks to motivate tourism, under the supervision of city councils, that are sustainably operated and maintained, employing renewable energy applications, and resource preservation measures. For example, Al-Baha city possesses a wide selection of green spaces. It is located in the region of Al-Baha, on the western coast of the KSA, and is affected by the Indian Ocean monsoons, with an average rainfall of 300 millimeters occurring between October and March, which constitutes approximately 60% of the annual precipitation (Weatheronline, 2019). Therefore, serious consideration was given to the development of the forests in the region (Tourism, 2004), in order to create guidelines and regulations to be implemented for their landscaping and sustainable long-term operation.

The present study reviews the planning and design considerations of national parks that are applied at the landscaping stage, and the coordination of these aspects, which together seek to achieve desirable optimum solutions that satisfy sustainable development principles. Sustainable parks depend on their design to attract tourists, therefore the design must promote the most effective bioclimatic level in which cost effective maintenance, and a visually pleasing appearance, can be achieved. In this context, it is necessary to consider several aspects: the conservation of limited resources; operational cost; waste reduction; prevention of air, water, and soil pollution; organic fertilizing; the life cycle of the grass; organic pest control measures; the selection of suitable plants and trees that can adapt to the climate and location; and the efficiency of irrigation through the use of renewable energy technologies.

This study focuses on the sustainable elements of park planning, and discusses their roles, seeking to conclude a vision and standards for park landscaping that promotes sustainable built environment development, taking into account the majority of the sustainable principles, and applying them to the current design of Prince Meshari Park, Al-Baha city, Saudi Arabia, clarify their potential outcomes according to the current situation of the park.

2. Methodology

This study assessed certain principles of sustainable design for park planning that contribute to the development of the built environment, and motivate ecotourism, by assessing those employed in projects, such as the Internationale Bauausstellung Emscher Park (IBA Emscher Park); the Internationale Architecture Exhibition Emscher Park in the German Ruhr region; KLCC Park in Kuala Lumpur, Malaysia; Horsetopia – Run Fast Live Slow, in South Korea; and Upcycle Park, in Hong Kong. The study also proposed a new design for the case study of Prince Meshari Park, in the KSA, applying sustainable concepts, and discussing the anticipated outcomes resulting from the new design.

3. Sustainable park design and ecotourism

Ecotourism is a form of tourism that is committed to enjoying the natural environment in a way that does not violate the ecosystem, or have a negative impact on the biodiversity. The ecotourist enjoys observing ecosystems, and their constituent animals and plants within their habitat, and also enjoys the historical, cultural, and heritage features that characterize the location. Compared with other forms of tourism, ecotourism tends to be more cultural, and less harmful to the environment, since it is green, responsible, and sustainable. As part of this, ecotourism is concerned with the landscaping of parks that contributes to the promotion of ecological balance, and has an interest in maintaining an environment free from pollution, and in improving the environment in general, including preserving the wildlife (Newman & Jennings, 2012). It should be emphasized that the importance of parks, both for tourism, and as a strategic reserve for natural resources and genetic banks, requires the support of governmental initiatives to provide the necessary scientific research and equipment to ensure the preservation of their resources. Ecotourism can contribute to the economy of the built environment if these parks are carefully designed (Al-Sawaf, 1992). As well as the benefits of their natural environment, parks offer many other attractive opportunities, including the ability to demonstrate the customs and traditions of local communities, and to produce publications, souvenirs, and television and radio programes, for example regarding the forest in the park and varieties of trees it includes. The integration of ecotourism into the Sustainable Parks Management Plan will contribute to generating a sustainable national income, and to raising awareness of the importance of preserving biodiversity and natural resources.

3.1. Park design layouts

There are range of potential designs for parks, including the incorporation of geometric shapes, such linear or oval forms, or any other geometric shape that is proportional to the parameters of the location's topography, whereby symmetry can be achieved. A layout can also involve binary and multiplication symmetry for the flower beds at the side of the main axes of the park, or a design employing circular or radial symmetry, in which the segments of the park are all repeated within a circle. A layout can also be adopted that simulates nature, and avoids the use of geometric shapes, instead using local materials, or the design can involve a dual layout that combines both natural and geometric forms, or a free layout, which releases geometric lines from their forms (Motloch, 2000). Some of these designs are illustrated in Figure 1.

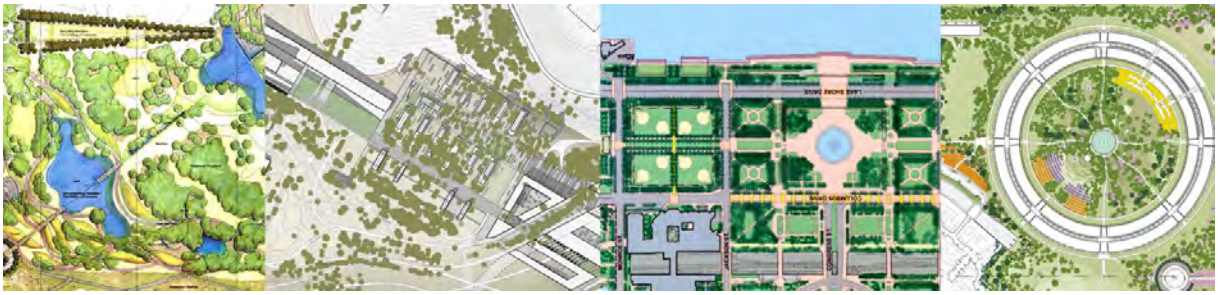

Figure 1. Park landscaping systems (Sources: Bureau, Partners, Site-Design, n.d.).

3.2. Sustainable planning principles for parks

The planning of parks is generally influenced by the climate, inhabitants, and economy of the place, or city, in which they are located, with every individual accounted for by a specific percentage of its green area (Wahid, 1988). In addition, when planning a park, the following set of principles should be observed:

- The areas allocated for parks must be commensurate with the density of the population that it will serve. For example, a park that will serve between 2,500 and 5,000 people requires an area of park between 2 and 10 m2 per inhabitant (Al-Musawi, 2010).
- The location of a park should be appropriate for its use, and should preferably be outside any anticipated expansion of the city's buildings, in order that it remains away from the city's congestion, and in a safe place away from any highways (Hansen, 2010).
- The topography of a park's location should be considered, and the park planned according its the contour lines (Al-Sawaf, 1992).
- The streets surrounding the park should be identified, together with those leading to its entries, taking into account the allocation of parking spaces (Motloch, 2001).
- If it is established inside, or near a city, the park should be isolated from the surrounding streets with high fences, or thick fences of trees and windbreaks, but if the park is located in a natural landscape, there is no requirement to isolate it (Bartholomew, 1975).
- A range of recreational elements, such as topiaries, bog gardens, paths and drives, boating lakes, conservatories, and lawns should be provided, in order to meet the needs of the local inhabitants, includes a diversity of vistas, using the cultivation of different types of trees (Northam, 1984; Piereall, 1979).
- The selection of plants is the main component that should be considered when designing a sustainable park, unless it includes imported plants. The plants should be chosen carefully, according to their growth and other properties, and should perform a role that is appropriate to the environment, as well as being postioned suitably, whether individually within green areas, or in groups as edging for the park, or as sensory pathways (Al-Ghitani, 1982).

3.3. Elements of sustainable park design and landscaping

According to Lidy (2006), the following are elements of sustainable park design and landscaping:

PLANT ELEMENTS: A number of aspects should be considered when selecting a plant, including its stages of growth; the suitability of the location in which it is to be planted; its eventual size; the purpose of the planting, whether for its aesthetic appearance, to block undesirable views, to divide a spaces, to providing shade, or to minimize air pollution or wind speed, as different plants are suited to different aspects, and might include climbers, grasses, or green spaces constituted of permanent areas of grass;

STRUCTURAL ELEMENTS: The structural elements of parks can be divided into the following: those that are required, such as parking lots; information centers; ticket offices; restrooms; cafeterias and restaurants; and souvenir stores, those that are possible, such as children's playgrounds, boating lakes, internal transport, and a space for concerts, exhibitions, or fairs, and the disputable, such as new monuments; new buildings, such as pavilions, gazeebos, and tea houses; modern art objects and installations; and sports courts.

3.4. Water resources

The conservation of water is a cornerstone of sustainable park design and landscaping, and approaches to it can include the harvesting of rainwater for use in irrigation and flushing, and the use of pure groundwater, such as

wells and springs. If there is an abundance of rainwater, rain catchment is the most appropriate choice for the water supply, provided the necessary treatment of the water is applied if it is to be used for drinking and irrigation. It is also possible to utilize rainwater using traditional methods, such as the stairs and terraces built on the slopes of agricultural mountains, as illustrated in Figure 2 (Lyle, 1996).

Figure 2. Traces and agricultural debris on the slopes of mountains irrigated with rain water (Source: Author).

The water treatment type depends on the water's source and quality. Groundwater to be used for drinking should be treated with simple processes using sodium hypochlorite and chlorine dioxide. Surface water can also be low turbidity water, and in this case, it should be filtered using sand filters, which should then be disinfected with bleach. The water treatment system itself should employ multi-stage filters that use filtering elements with narrow pores, such as ceramics and paper. If the surface water is of a high turbidity, the treatment must include the addition of industrial chemicals, such as alum and urine. The drainage and distribution of the water might employ a system such as that at Raghadan Park, Al-Baha city, Saudi Arabia, which is a buried or descending system that has less impact on the site, but is subject to vandalism. Furthermore, local water systems, and traditional irrigation systems should be utilized, such as those constructed on agricultural terraces in valleys, and on the slopes of mountains (Loutfy & El-Juhany, 2008).

3.5. Waste management

The management of parks should ensure the prevention of waste, in order to raise the awareness of their visitors and users of this issue, and to train their workers in how to prevent the generation of waste. The systems that can be employed include reusing mixed or digested anaerobic, biodegradable organic waste as soil fertilizer, using methane as an energy source, and adopting other techniques that reuse waste, such as dry toilets, and working without water (Beck, 2013).

3.6. Control of energy use

Renewable energy applications can play a central role in sustainable parks, and can have a lower impact on the built environment than traditional alternatives. When planning a park, it is necessary to consider the energy applications that can be adopted to help in reducing energy consumption, such as minimizing vehicle movements within the park, the precise allocation of buildings and services to meet the visitors' demands, and strategies for using thermal energy and night lighting. Solar energy systems can also be used for water pumping irrigation, as illustrated in Figure 3 (Lindberg & Hawkins, 1993).

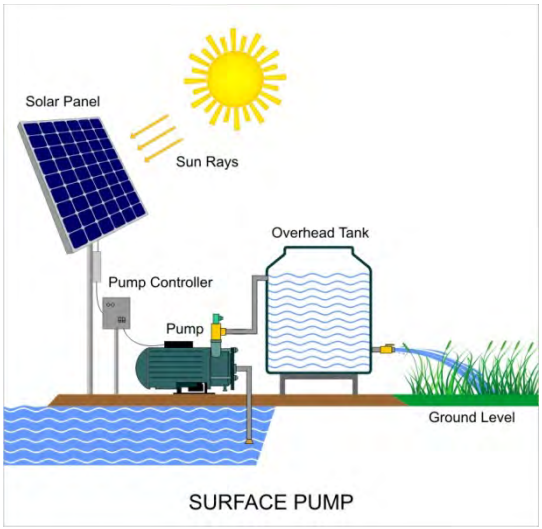

Figure 3. Solar power water pump (Source: Nicholls, 2006).

4. Examples of sustainable parks

The Internationale Bauausstellung Emscher Park, Emscher Region, illustrated in Figure 4, Germany: This park was created in the 1980s as part of an initiative to promote urban development, and socio-cultural ecological measures as the basis for economic change in an old industrial region (IBA, 1999). As a principal contribution of the park initiative, its sustainable landscaping was critical for offering a new perspective on approaches to regeneration. The initiative was based within a framework that ensured the enhancement of biological requirements, and the well being of the local population, thereby eliminating the predominance of economic interests. However, the environmental improvement was also deemed by the park's planners to be a prerequisite for economic renewal, since business was becoming increasingly connected with environmental aspects. The approach applied to the park's design was appropriate to the principles of sustainability depicted in Figure 5, in which each factor contributes to the overall sustainability, as the environment should contribute to human welfare, the economy should be maintained at a suitable wealth level, and social choices and institutions should be sustained. The design concept of the park was embraced, as it employed brownfield, rather than greenfield sites to accommodate structural change, without requiring spatial growth; secondly, it embraced maintenance, modernization, re-use, and better building techniques to lengthen the life of the buildings and production facilities; and finally, it transformed the production structure in favour of environmentally sound products and manufacturing methods (Ganser, 1996).

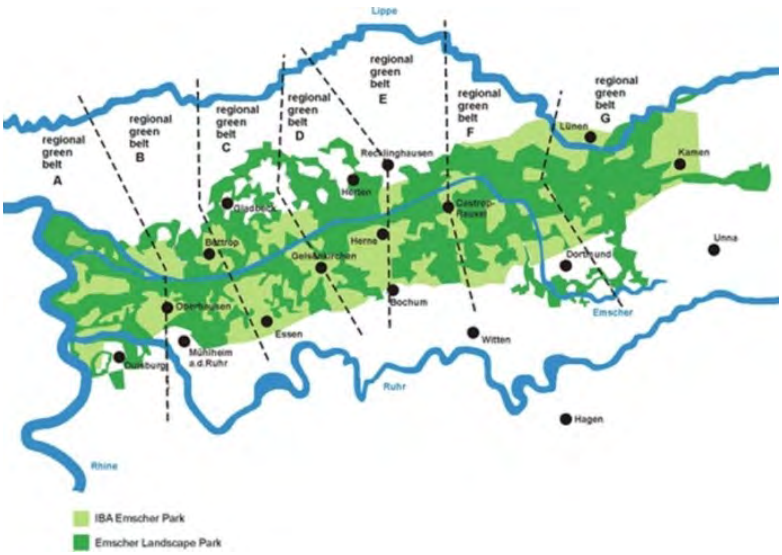

Figure 4. The master plan of the International Bauausstellung Emscher Park (Source: Gruehn, 2017).

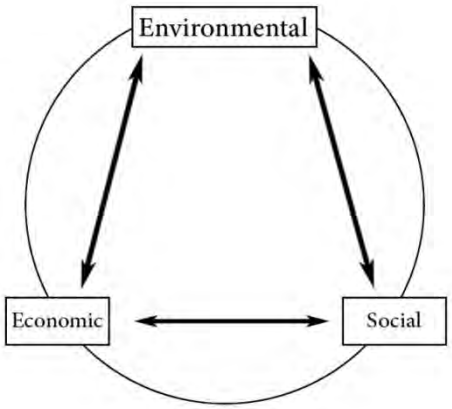

Figure 5. The attributes of sustainability (Source: Author).

KLCC Park Kuala Lumpur, Malaysia: The KLCC Park in Kuala Lumpur, Malaysia, was designed to illustrate the continuity of the country's green, tropical heritage through the integration of human creativity. The design of the park is that of beauty and harmony in the bustling city centre, as illustrated in Figure 6. It was created in an area of 20 hectares, and designed by the late Brazilian landscape architect, Roberto Burle Marx, who employed assemblages of trees, shrubs, cement structures, natural stones, traditional Malaysian wood, and multi-static water, blending their shapes and textures with the topography to produce an attractive, state-of-the-art design. The lake was aesthetically designed to be the focus of the park, and to include a musical fountain. There is also a playground for children in an area of 2 hectares. In general terms, the park design provides three basic elements: geometrical formations created by the bodies and channels of water, with a bridge spanning the lake; aesthetic features, such as a dolphin statue made from chrome-clad steel; and planting that includes a range of trees in variety of colours that creates a natural consistency with the surrounding pillars, edging, and terraces (Elsayed, 2012).

Horsetopia – Run Fast Live Slow, South Korea: Horsetopia is a horse park in Yeongcheon, South Korea. Fifty percent of the 1,474,883 site is devoted to horse racing, while the rest hosts horse-related activities. The park adheres to sustainable principles, within its profit-based operation, and its design includes 100% path lighting powered by on-site wind turbines; 95% of the earth excavated reused on site; 450,000 tons of the carbon dioxide produced stored on site within the architecture; five layers of terraced bioswale to remove water pollutants; 45% of the total area reserved for landscaping, in the form of open parkland, to reduce the heat island effect; innovative lighting solutions to reduce light pollution; food grown on-site, and food waste processed on-site; and souvenirs made using food waste and horse waste. The project seeks to elevate the status of horse racing over the next 10 years. In addition, all of the architecture was designed as extension of the landscape, with the contours of the landscape exploited to create zones, and to define boundary-free green spaces. The racing track was designed as the focal point, with various features circling outward from the fast track to create 'slow' zones.

Upcycle Park, Hong Kong: **S**ince it is located on the site of the old Kai Tak Airport, and its design includes the reuse of parts of old aeroplanes, Upcycle Park in Hong Kong seeks to play a role in entertainment, the economy, and ecotourism. Its contextual form was inspired by the master plan of Kowloon City airport, and it was designed to create an ecological environment suitable for various native species, with the design also respecting the airport's history. Hence, the airport's existing platforms serve as a bridge, a pool, and a stair above a canal, and simultaneously connect the surrounding structures into a holistic design. The park employs a multi-layered filtration system as a sustainable approach to watering, and several layers of terracing, incorporating a range of different plants, were built on both sides of the canal to filter the water runoff from the local neighborhood, purifying the water before returning it to the river. Some of the water is then exploited for recreational purposes in a pool. Repurposing the old structures constitutes an alternative approach to sustainable design, and includes reusing an old aeroplane as a canopy, bridge, tunnel, and outlook tower (Architects, 2019).

Figure 6. The master plan of KLCC Park Kuala Lumpur (Source: Magazine, 2005).

Figure 7. The master plan of Horsetopia Park (Source: (Architects, 2019).

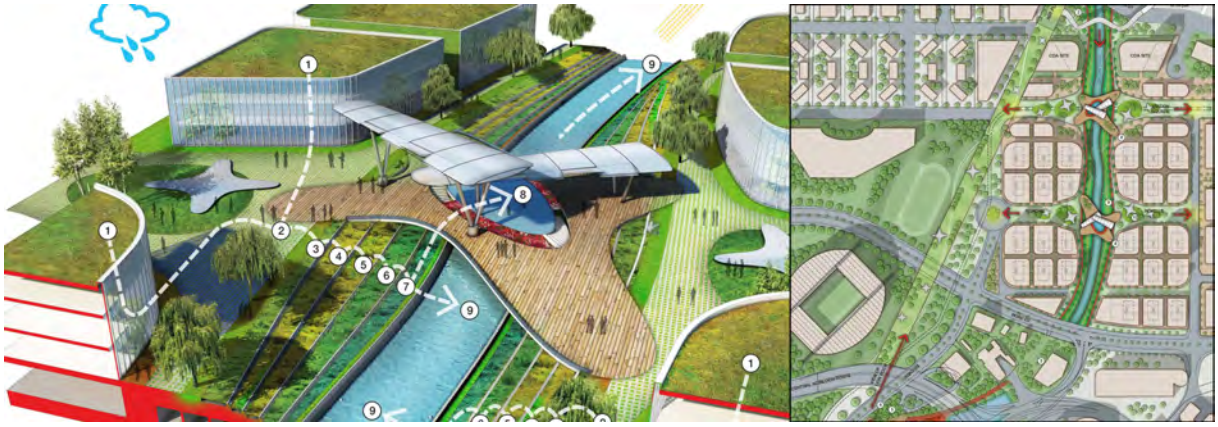

Figure 8. A perspective view and master plan of Upcycle Park, Hong Kong (Source: Architects, 2019).

5. Case study: Prince Meshari Park, KSA

Prince Meshari Park, or 'Al-Zaraieb Forest', is located in the southwest of the KSA, between the nearby cities of Al-Baha and Al-Mandaq. The climate is moderate during the summer, and rainy in the winter. The forest is characterized by a wide and abundant variety of vegetation, such as acacia, pines, figs, and juniper. It has been developed in successive periods, and includes children's play areas, family zones, lighting, internal vehicle tracks, and sports fields, as illustrated in Figure 9. However, the park currently requires an environmental management plan, in order to assess the current situation in detail, and provide recommendations to guide the future development of the forest. The plan requires the following elements:

- A vegetation survey of the forest. It has been observed that the vegetation has been significantly affected by the lack of rainfall in recent years, which has affected the growth and density of the forest. The project must determine whether this is due to water scarcity, development, and/or the increased use of the forest;
- A survey of the wildlife in the forest, and an analysis of historical records, if any exist, to determine the causes of population shrinkage, or extinction;
- An evaluation of the existing facilities, such as roads, utilities, gazebos, and street lighting;
- And evaluation of the location and use of the seasonal summer shopping festival, which was created by the municipality of the area, and other related matters, such as seasonal pollution.

In order to conduct these surveys and evaluations, a number of sites at the park were selected and evaluated, according to a set of systems that integrated planning and design principles, and therefore constituted a strategy for the development and sustainable coordination of parks.

The proposed sustainable design of the park allocates sites for different types of activities, such as festivals, sports, and aquatic playgrounds. It includes walkways for horses and bicycles, playgrounds for children, and seating zones, proposing that the park is divided into variety of different environments, including natural environments, a central garden environment, slope environments, and modern environments that can be employed for recreational structures. The landscaping considerations of these environments can be summarized as follows:

- Create irregular shaped open spaces with various functions and privacy, to facilitate their management within the park, and to allow a partial operation of the park to minimize operational costs;
- The central part of the park should be considered a central location for pedestrian movement to allow easy access to all other parts of the park, with an open festival space that can be surrounded by food trucks and pavilion structures;
- The eastern portion of the park should include outdoor waterfalls, with the water flowing into ponds that are surrounded by seating zones, which reflect the local and historical design of the nearby city, while maintaining the existing elements, such as rock formations and plants;
- The north side of the park should include a garden consisting of a circular pedestrian walkway surrounding an outdoor stage for local arts performances, and exhibitions of traditional tools;
- The park levels should be utilized for seating zones, while retaining the existing plants;
- In order to connect the different zones of the park, a number of main axes should be designed to link aspects such as the focal points of the park and its green spaces, and the main entrance and the park's traditional heritage gate with the park's centre, as well as an axis connecting the monument in the middle of the park with the eastern sector;
- The north-western sector of the park should be designated as a zoo area, to be designed in accordance with to the location's topography, and to permit the animals suitable freedom of movement;

– A network of secondary paths should connect the park's different levels.

Figure 9. Master plan of thecurrent situation of Prince Meshari Park, and photographs of the park. (Source:Author).

5.1. Design concept

The new proposal for the design of Prince Meshari Park conserves the current natural situation, while also enhancing the park's context and function, and developing its potential for entertainment. The park should consider issues of sustainability for its structures, such as constructing a green hotel equipped with sustainable energy technologies, as there is currently a Saudi governmental initiative that seeks to raise awareness of sustainable development. In the proposed design, the park is divided into different open spaces, using natural and geometrical shapes that allow pedestrians to move within the different levels to explore the natural environment, the processes of which can be articulated through the design, which displays seasonal colours, textures, fragrances, and sound (see Figure 10).

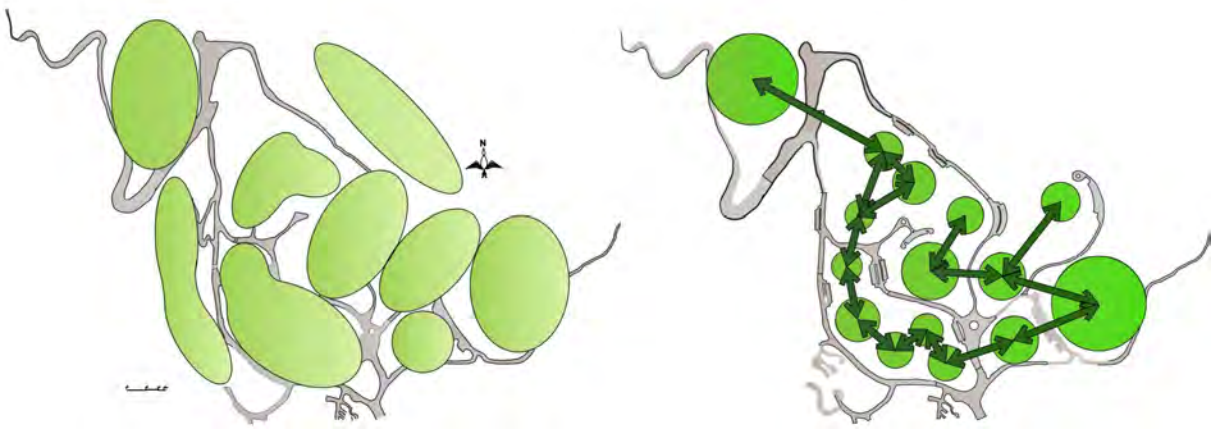

Figure 10. Park landscaping concept, dividing the area into different green spaces, on different levels (Source: Author).

5.2. Context

In the proposed design, the park is divided into a variety of green spaces in natural and geometrical shapes that provide the park with a range of separate spaces that can be easily managed, and which create privacy, and minimize the impression of vast areas, promoting a sense of harmony for the park's visitors. The central part of the park is designed as the park's focal point, and serves as an intersection of the park's movement axes, connecting all of the other areas. This central area contains an open space suitable for hosting local festivals, together with shops overlooking the terraces. Meanwhile, in the eastern sector of the park, the proposal includes a man-made waterfall, with water flowing into a group of water basins surrounded by a range of gazebos and souvenir shops. On the northern side, a garden consisting of a circular road surrounded by a square is designed to host the popular arts shows, and exhibitions of traditional tools. In the proposal, this space is surrounded by seating areas, and also includes an open-air theatre for seasonal events (see Figure 11).

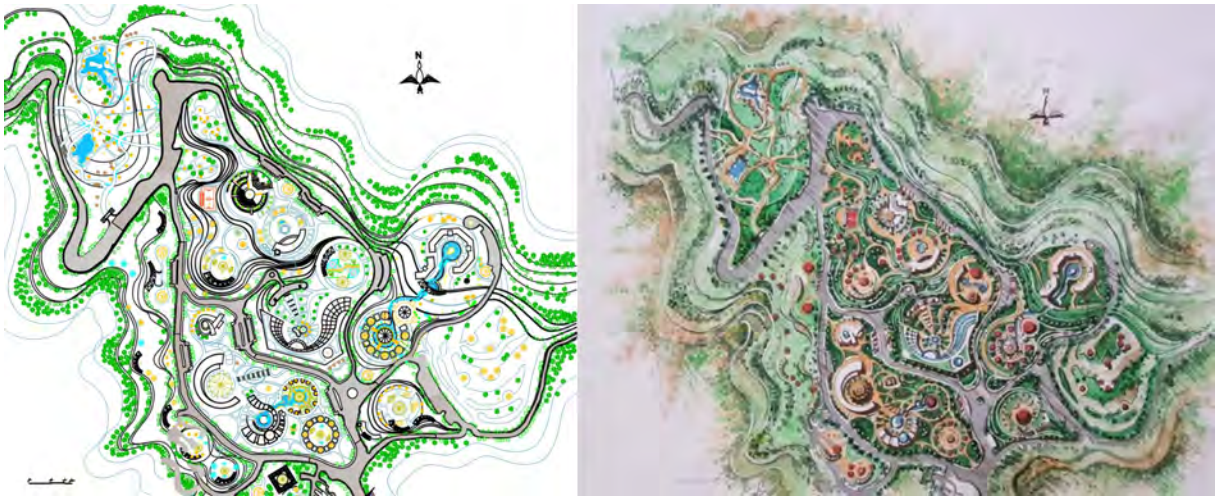

Figure 11. The master plan of the proposed park design(Source: Author).

5.3. Functions

When designing a park, careful consideration must be given to the architectural identity of its building facades, as an aspect of sustainable practice. In the proposed design, the architectural identity of the park's structures is influenced by the heritage buildings of the nearby city of Al Baha, and the design adopts various of its architectural elements into the park's buildings. The north-western region of the park is designed to serve as an open garden for animals, equipped with corridors that include all of the necessary elements, together with pedestrian paths facilitating movement around the sector, and creating distinctive zones that identify the progression of movement between the entry and the exit, and around the environments that are suitable for the wildlife they house. The landscaped layers increase the resilience of the design to heavy storms, while also creating natural habitats for different native plants, animals, and insects. A number of man-made ponds are located in various niches around the park, and a lake incorporated that is also proposed as an aspect of the animal park, fed by water from irregular channels. Meanwhile, the western sector of the park consists of levels throughout its mile-long extent, ranging from 1/2, that are intended to create a long path, incorporating spaces and seating areas at the sides.

Figure 12. Eastern and western perspective view of the proposed park design (Source: Author).

5.4. Entertaining

Since a successful park requires public engagement, the proposed plan for Prince Meshari Park provides multiple area for hosting arts and recreational events, such as the open-air theatre that is a safe and clean venue in which the public can enjoy seasonal events. At various locations around the park, the design includes platforms that can be used as basketball courts, fishing platforms, sites for art installation, or as a centre for traditional heritage arts. The design proposes that the entire park is illuminated at night using dynamic lighting that echoes that at the sport facilities, and the laser show in centre of Al-Baha city. The canals incorporated into the design allow visitors to interact with the water during both the day and the night, while also creating a new feature for nightlife that will promote the park as a hot spot for local residents and foreign visitors alike.

6. Conclusion

The concept of sustainable parks that the KSA has committed considerable effort to incorporating into new designs, planning, and landscaping must adhere to a variety of practices that respond to environmental issues in terms of their operational management and renewable energy applications. The design proposal for Prince Meshari Park represents a model of a sustainable park, and exemplifies the principles that must be considered when designing such spaces. These are as follows:

- Consider the local conditions, including the climate, topography, water availability, and soil quality.
- Satisfy sustainable park design principles, such as unity, interdependence, and repetition in terms of the shapes employed, whether geometrical, natural, or both, in order to achieve a functional fit in the distribution of the elements and activities within the park.
- Consider the selection of the plants, ensuring that only those that are suitable for the local environment, and can adapt to resist any local harmful insects are selected. This will affect cost-saving with regard to soil fertilization and modification, pest control, and irrigation.
- Design structural elements, such as pavilions, benches, and walkways that complement the environmental elements.
- Consider the necessary pest control measures.
- Use sustainably-harvested wood, and composite wood products for landscaping and other projects, together with the use of flexible wood.
- Use recycled products, such as glass, and rubber from tires, to create products for use in the paving stones and park furniture.
- Adopt soil control practices, including the fertilization, maintenance, and enhancement of soils that support diversity in the terrestrial environment.

Furthermore, the International Organization for Standardization (ISO) standards for SMEs, industrial, commercial, and residential facilities should be adopted, as energy auditing is a significant factor that can play a key role in achieving energy efficiency, and reducing power consumption, a goal that is included in the KSA's 2030 national vision. Once the new primary energy tariffs are imposed, sustainable parks should optimize their energy usage without affecting their operation and processes, thereby maintaining their overheads and profits, while increasing their energy efficiency and competitiveness. For this reason, energy auditing should become a core requirement, rather than simply a popular trend, therefore technologies such as solar powered trash bin compactors, rainwater harvesting for parks and open spaces, and solar PV systems for energy generation should be adopted.

7. Acknowledgments

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