An Ecocentric Approach to Defining a Public Park System

Abstract

Purpose: This research aims at examining public parks as a complex interrelated system in which a public park's natural and man-made systems can work together within an ecocentric approach. It will create a framework that can support the design and management of public parks,

Design/Methodology/Approach: The article first introduces previous research and justifies the need for a new approach. It then uses conceptual analysis to examine the concepts that construct a park's system through previous theoretical research. Finally, the public park system is constructed by synthesising its components and showing the interrelations between them. These components are defined based on previous theoretical and empirical research.

Findings: A public park system is defined as consisting of a natural system and a man-made system with multiple components that interact to offer the overall experience in a park. The defined system can be a useful tool for decision-makers, managers and designers in the analysis and evaluation of existing and potential projects to achieve multifunctional parks that are better utilised and have a wider influence.

Originality: The research offers an alternative approach for framing public parks that does not deal with their components in isolation from each other. This view of public parks brings together perspectives from different literature into one coherent framework that emphasises mutual dependencies and interactions in one integrated whole.

Keywords

Urban Landscape – Public Space – Green Space – Systems thinking – Socio-ecological System

1. Introduction

The wide benefits of green spaces are currently more recognised, especially if compared to previous views that considered landscapes as mainly visual amenities (Bolliger and Kienast, 2010; de Groot *et al.*, 2010; Haq, 2011; Lee *et al.*, 2015). Landscapes are multidimensional, include both human and nature-related aspects and can be considered as complex systems (Matsuoka and Kaplan, 2008; Opdam *et al.*, 2018; Steiss, 1974a, 1974b). Fields of ecology, landscape ecology, environmental psychology, urban design and landscape architecture discussed these multidimensional aspects and linked them to their effects on humans and

their preference in using them. Despite covering a variety of aspects, their discussions often remained limited in showing mutual dependencies and relationships important for presenting complex systems (Murphy and Hedfors, 2011; Steiss, 1974a, 1974b).

Accordingly, a new approach is to be proposed in this article to create a more elaborate understanding of public parks as a complex system. Creating the public park system is a part of ongoing research about public parks management in Cairo, Egypt. It will be used in that research to develop a tool to evaluate existing public parks in Cairo through observations. Using the tool in the research will uncover its practicality and any required modifications. Experts' consultation will also determine its usefulness in practice and any necessary changes to make it comprehensive. The public park system will then be part of a proposed management framework for Cairo's public parks.

The article starts by discussing previous approaches in defining public and green spaces to highlight the advantages of proposing a new approach. Secondly, conceptual analysis is used to clarify how the proposed change in the new approach will be expressed in the use of modified and new terminologies. Finally, components of the public park system are synthesised and the interrelations between them are discussed. The research depended on previous theoretical and empirical studies to define the components of the system. The conceptual analysis and the components of the system are also built upon concepts from fields of systems thinking, sustainability, evaluation and assessment, ecology, landscape ecology, environmental psychology, urban design and landscape architecture.

2. Why is a New Approach Needed?

Examples of research discussing public spaces include Project for Public Spaces (PPS) (2009), Francis (1988) and Carr *et al.* (2007) who determined different qualities for successful public spaces. Carr *et al.* (2007) made some referrals to the effects these qualities have on one another and how they are linked to human needs, while PPS (2009) and Francis (1988) discussed them with less referral to the connections between them and how they influence one another and affect humans.

Matsuoka and Kaplan (2008) focused more on green spaces. They did an extensive literature review to determine needs in urban landscapes and summarised them into six needs under two main themes, nature-related and human-related needs. Haq (2011) also discussed the benefits of green spaces under three main categories: 1) "environmental benefits", 2) "economic and aesthetic benefits", and 3) "social and psychological benefits". He showed links between each of these benefits and the natural processes that contribute to providing

them. Matsuoka and Kaplan (2008) stated that the categorisation into the six needs does not mean that they are in isolation from each other. They claimed that further research is required to examine the relationships between them. Similarly, relationships in Haq's (2011) work require to be further elaborated.

Furthermore, Aly *et al.* (2018) attempted to define these relationships by establishing a framework that relates designed landscapes to human needs. Max-Neef's matrix of fundamental human needs (Costanza *et al.*, 2007; Max-Neef, 1991) was used to conceptualise this relationship. This matrix of needs and needs' satisfiers was redefined to include landscape related satisfiers. The matrix structure was also influenced by the ecosystem services (ES) perspective. Despite including multiple aspects and making connections that were not shown in previous lists of qualities, it does not show interrelations and dependencies between its entities (Aly *et al.*, 2018). It also inherited the simple linear format of Max.Neef's matrix and ES perspective.

The ES perspective represents linearly the relationship between different natural processes and the benefits they provide for humans (de Groot *et al.*, 2010). ES are linked to decision making, management and planning in the form of a cycle (Hermann *et al.*, 2011). Similarly, Costanza *et al.* (2007) depended mainly on Max-Neef's matrix to define quality of life and provided a circular representation that links quality of life to the opportunities that can meet human needs (Costanza *et al.*, 2007, p. 269, Fig.1). However, both Costanza *et al.* (2007) and de Groot *et al.* (2010) didn't show the internal dynamics of relationships and dependencies between the entities they defined.

ES has also the issue of having an anthropocentric perspective. "Anthropocentrism" is a worldview of natural systems as service providers for humans. It puts more focus on nature's "instrumental value" - ES, over any "intrinsic value". Humans, in this view, are the mere driver of "value", justifying in some cases the exploitation of resources. Natural elements are viewed as resources and their "value" is defined according to their degree of utility (Hunter Jr. *et al.*, 2014). Accordingly, Kopnina et al. (2018) claim that anthropocentrism fails to account for "legitimate concern" for non-humans. Therefore, protecting nature within this view will not help to achieve sustainability (Kopnina *et al.*, 2018).

A counter view is "ecocentrism" that considers any living organism as valuable as human-beings (Hunter Jr. *et al.*, 2014; Kopnina *et al.*, 2018). Natural elements are not "means to some other end" but they are ends in themselves. As humans, we should have a "moral responsibility" to care for such systems as "an end in itself" (O'Neill, 1992; Worster, 1980).

Consequently, “such care for the natural world is constitutive of a flourishing human life” (O’Neill, 1992, p. 133).

ES is also strongly tied with “economic valuation” which can lead to the over-exploitation and commodification of nature. However, some see that ES is not a counter view for ecocentrism. Instead, ES add the human side of the relation, bring together different viewpoints and concerns, and advocate to protect ecosystems and use them sustainably. Moreover, they can include both the intrinsic and instrumental values of nature as they have non-material services in the category of cultural services (Schröter *et al.*, 2014).

It is important to note that “interdependence” is a vital concept to be considered here and that destroying nature causes harm to humans (Worster, 1980). The United Nations Sustainable Development Goals (UN SDGs) urge the sustainable use of resources to protect the natural environment. The SDGs also include goals to remedy the effect of human developments that caused climate change.

To sum up, previous representations of public and green spaces show some common problems that this research is trying to overcome. Firstly, the linear structure and defining a variety of components without focusing on their interrelationships. To overcome this problem, this research will propose a structure for the components of public parks that adapts the systems approach. Secondly, it will not use the ES perspective to avoid the anthropocentric focus and its related ethical issues. Finally, some changes will be introduced to the use of terminologies, especially the use of the two terms function and service, and how the nature-human relationship is defined to achieve a relationship that is more considerate and respecting.

Systems thinking is important in guiding analysis and design in landscape ecology. It can combine both natural and human aspects of landscapes which this research intends to do (Opdam *et al.*, 2018). “The concept of social-ecological systems can be a good starting point because it connects ecological and social systems by two feedbacks: the perception within the community of benefits from landscapes and, secondly, the interventions in the landscape that are taken to ensure better value out of these benefits” (Opdam *et al.*, 2018, p. 4). A public park system is to be defined reflecting the benefits side of these two feedbacks. Moreover, a framework for managing this system will tackle the follow-up and interventions to sustain its value which will be developed in a following research.

Furthermore, Tress and Tress (2001) also emphasised the importance of including both natural and human aspects in landscape research. They defined a model that shows the

interactions and influences between the two systems. However, the model is not detailed and serves as a basis for further detailed analysis of various landscape types. Finally, Gu, Deal and Larsen (2018) developed another framework for landscape architecture (Gu *et al.*, 2018). Their framework is also general and its developers recognise that it has "theoretical gaps" and further details are required to operationalise it which "is difficult because it involves complex systems and dynamic processes" (Gu *et al.*, 2018, p. 17). This research is tackling this gap by providing a more detailed structure for public parks that tries to grasp their complexities.

The proposed framework incorporates different concepts about public and green spaces into one defined system. It considers a park as two complementary nature and man-made systems that influence human life. The goal is to realise this value for humans without undermining the natural system intrinsic value. A systems perspective will allow a detailed and comprehensive presentation of a public park that shows its internal relationships and mutual influences within an integrated whole (Murphy and Hedfors, 2011)

3. Research Terminologies related to Public Parks

This section discusses the terminologies that will be used to outline the public park system. It justifies the shift from common terminologies that are strongly associated with anthropocentrism. In the end, a final classification for the used terminologies is given and the importance of differentiating them in the proposed sets of categories is explained. This will help to lay the foundation for the following section where the exact components of each category will be explained.

To begin with, functions and services have several interpretations in different fields. These interpretations determine to a great extent which of the two worldviews are being followed as they categorise natural elements, the processes they perform and define their relationship to humans. Using these two terms to describe any natural elements is particularly problematic. Function is "the natural purpose (of something) or the duty (of a person)" (Cambridge Dictionary, 2020). It can be used to describe an ecological "process" (Jax, 2005) or a biological "activity" (Wouters, 2005). In the field of Ecology, it can also be used to refer to "services" (Jax, 2005).

Selman (2009) views functions/multifunctionality as ecocentric, while services hold the anthropocentric view. Both concepts are strongly related as functions "yields cultural benefits" and services "rely on underlying functionality" (Selman, 2009). Selman (2009) also explained that the anthropocentric view of services is not necessarily "utilitarian". According to the Millennium Ecosystem Assessment, direct short-term economic benefits could be

sacrificed for preserving natural systems to achieve long-term well-being (Selman, 2009). However, function, as shown in its basic definition, is tied to purpose and service, and implies that the purpose of natural elements is serving humans. Whether they are used interchangeably or being differentiated, their use always leans more towards the anthropocentric view.

In the field of landscape ecology, attempts to separate the side of natural elements and humans are common; in differentiating between function and purpose or between function and service. In this case, function describes a process an element performs or the dynamics of a system, while service explains how the functionality benefits human beings (Aly *et al.*, 2018; Bolliger and Kienast, 2010; de Groot *et al.*, 2010; Hermann *et al.*, 2011; Selman, 2009). Forman and Gordon's (1968) provide also a definition for function which is processes-oriented, descriptive and does not include any human-related elements by not using terms as capacity or services (Forman and Godron, 1968 in Brandt and Vejre, 2003). However, Brandt and Vejre (2003) claim that this descriptive notion is not enough to explain the complexity of landscape functions, and that "purpose" and "ability to work" required to be included too. They also differentiated between natural and human-related functions that introduce changes to the environment - land use functions (Brandt and Vejre, 2003).

On the other hand, using the term function does not raise the same issues when describing man-made systems and artefacts. These are different from natural elements in how they are intentionally made to serve human purposes. Humans design them to perform certain functions and they cannot exist outside humans' innovation and their use (Katz, 1993). However, a man-made system cannot be isolated from the natural resources required for its development. Humans should accordingly develop such systems responsibly and carefully consider their effects on the environment.

Function is classified in architecture into several categories to cover technical and non-technical aspects of the built environment. One of these categories is the "utilitarian function": "the accommodation of a specific use or activity" (Roth, 1994, p. 11), and the "contextual utility or immediate purpose" (N th, 1997, p. 436). Architecture functions also include "symbolic" and "psychological" functions which are more about what the built environment communicates to its users and their experience and satisfaction in using it (Roth, 1994).

Table 1 summarises the use of terminologies in this research. As the definition of *function* is closely related to purpose and requires deliberate human intention, therefore, it will only be

used when describing the physical elements of a park. On the other hand, natural elements exist away from any human purposes and intentions which makes using function in describing them less suitable (Katz, 1993). Jax's (2005) classification of functions in ecology and Wouters's (2005) in biology included functions as processes and activities. This descriptive sense of functions will be applied in discussing natural elements, but *processes* will be used instead. Accordingly, intentional functions introduced by humans and the natural processes occurring regardless of human purposes will be clearly distinguished. Functions of physical elements will describe only the technical functionality of the elements and will not include any intangible effects on humans.

Table 1- Summary of Research Terminologies

Previous Use	Proposed Use	How the Term is Used	Reason for Modification
Function	Function	Describe the technical performance of man-made elements	To clearly distinguish between functionality introduced through human intentions (purpose) and processes that occur naturally
	Process	Describe natural activities	
Service	Quality	Characteristics of the park resulting directly from a specific function or benefit	To avoid implying intermediary actors
	Benefit	Direct advantage for humans resulting from a natural process or a park quality	To avoid the anthropocentric view
	Short-term Impact	Effects on direct users inside the park	
	Long-term Impact	Wider effects on users' and non-users' life	

However, as the focus here is on a man-made system that widely uses natural elements, this relationship requires to be defined too. As function will not describe natural processes to avoid the connection to purpose, similarly the use of services will be avoided too. Natural elements do not exist to serve humans and are not commodities to be sold, instead, they have benefits that humans can realise. Thus, *benefits and impacts* will describe these effects. The recognition of these effects does not undermine the natural elements' "intrinsic value". "Impact" is an evaluation and assessment terminology used to define "positive and negative, primary and secondary long-term effects produced by a development intervention, directly or indirectly, intended or unintended" (OECD, 2002, p. 24). "Outcome" is used to describe "the likely or achieved short-term and medium-term effects of an intervention's outputs" (OECD, 2002, p. 28). In this research, *impact* will be used to indicate both *short-term* and *long-term impacts* without using *outcomes*.

Wallace (2007) also avoided the use of function in linking ecosystem services with human-related values. He used processes and clearly distinguished them from services which are defined clearly as benefits for humans, but he kept the use of the word services. He emphasized the importance of the distinction between the three categories of processes, services and functions. However, his approach remained significantly anthropocentric as he viewed processes as "means to achieve ends (services) such as food production and potable water" (Wallace, 2007, p. 238). According to his view, these processes are not ends pursued for their own value but for providing services (Wallace, 2007).

Moreover, the effects that physical elements have on a park's users will not be categorised as services. Elements will be arranged in a park to provide *qualities* instead of services. The use of the word services is often linked with having an intermediary actor to do the serving which is, in many circumstances, not the case. Therefore, *quality* is more suitable, which will also have effects on users and the wider community. To sum up, six main terminologies describe the public park system and are differentiated into four categories (Table 1). *Elements* of a public park are in a separate category. *Functions* and *processes* represent the second category while *qualities* and *benefits* represent the third one. The fourth category entails *short* and *long-term impacts*.

Benefits and qualities can affect one another but they generally represent direct achievement from the performed functions or processes either tangible or intangible, while impact represents the short-term effects that these benefits and qualities have on users inside the park and also the long-term influence they can have on their life generally. Differentiating processes/functions, benefits and impacts follows the same logic in differentiating functions and services and differentiating utilitarian functions and other functions categories in architecture. Some of the defined services under the ES categories will also be included without referring to them as services.

This earlier separation gives each category a distinct character that will benefit the goals of this research. It will help in applying an important principle about the theory of function; the importance of the differentiation between "activities that are functions (such as the beating of the heart) and activities that are side-effects of functional organs (such as heart sounds and pulses)" (Hempel, 1959 in Wouters, 2005a, p. 133). The categorisation differentiates between what is an inherent process or a technical functionality and their effects - the benefits, qualities, and impacts. Functions and processes can also have unintended consequences, either positive or negative, which can also be categorised as side effects, not as primary

activities. Moreover, for both natural and physical elements, putting these elements in parks with their associated processes and functions does not automatically translate into the desired effect.

Differentiating functions and processes from benefits, qualities and impacts will also help in setting management-related functions required for sustaining each of them. For example, maintaining vegetation in a park so it can perform its primary processes will need the support of irrigation, but supporting a certain image that users may seek in a park will require additional processes. If a strict geometric vegetation structure defines the image of a certain park, excessive maintenance will be required which has nothing to do with the primary vegetation processes.

Moreover, a differentiation between functions and processes from elements can sometimes be redundant. However, this differentiation is seen to be specifically beneficial in elaborating opportunities in using different elements to provide the same park quality. For example, people will seek comfort in using a park, a related quality could be having shelter- a function would be allocating elements and designing structures to provide a canopy. An element that will perform such function can be a tree or a light structure. A decision between the two will determine specific maintenance requirements and certain consequences will emerge. This decision should be taken with these considerations in mind and be in line with the required goals in either establishing a new park or modifying an existing one. Setting priorities and balancing requirements when deciding how any quality or utility is being introduced in the park are essential to achieve sustainable management, and the differentiation between elements, functions, processes, qualities and impacts can help in setting a clearer framework for management.

4. The Public Park System

This section structures the public park system and synthesises its components. The structure is based on concepts of systems thinking and sustainability. The different components of the system including their influence on humans are gathered from previous theoretical and empirical studies. These studies cover a variety of fields like ecology, landscape ecology, environmental psychology, urban design and landscape architecture.

In social systems, anthropologists following functionalism theories, define small societies as “wholes”. They claim that interrelationships exist between elements of a society where they work together towards achieving individual and societal goals (Steiss, 1974b). The system is never in a static state and any change in one of its elements will affect other

elements and the overall system too (Bateson, 1936 in Steiss, 1974b; Pareto, 1935). This can be similarly applied to the interrelations and dependencies in a public park without losing viewing it as a whole. Parks are also complex places to manage, and for effective management, this complexity requires to be represented clearly. Systems thinking "reveals principles common to all complex phenomena and provides a basis for models to describe and manage them" (Murphy and Hedfors, 2011, p. 1). The park's complexity is divided into different levels, but without being in isolation from requirements or effects (Steiss, 1974a).

According to general system theory, "any system can be viewed as consisting of a conversion mechanism whereby certain inputs are transposed or converted into outputs" (Steiss, 1974a, p. 195, 1974b, p. 85). The components of the system interact together and with its surroundings and have mutual interdependencies that work towards achieving a common goal (Steiss, 1974a, 1974b). For example, a park can be dependent on external financial resources and its accessibility on the connectivity to public transportation lines. It can also have effects outside its direct boundaries on climate quality or in attracting economic activities.

In the park system (Figure 1), the "inputs" are the elements of the park. The "conversion mechanisms" are the functions and processes. The "outputs" translate into the park's qualities, the benefits offered to humans and their impact on their life. Finally, "Feedback" from the outputs informs about changes that the system might require for better functioning, which can help in evaluating the system and introduce any necessary adjustments (Steiss, 1974a). The public park system consists of two main subsystems: a natural system and a man-made system. Elements of the natural system perform natural processes, while humans design and arrange natural and physical elements to perform configuration functions. Processes and functions influence the park qualities and benefits which in return have short-term and long-term impacts that are linked to human needs. Figure 2, shows the two systems

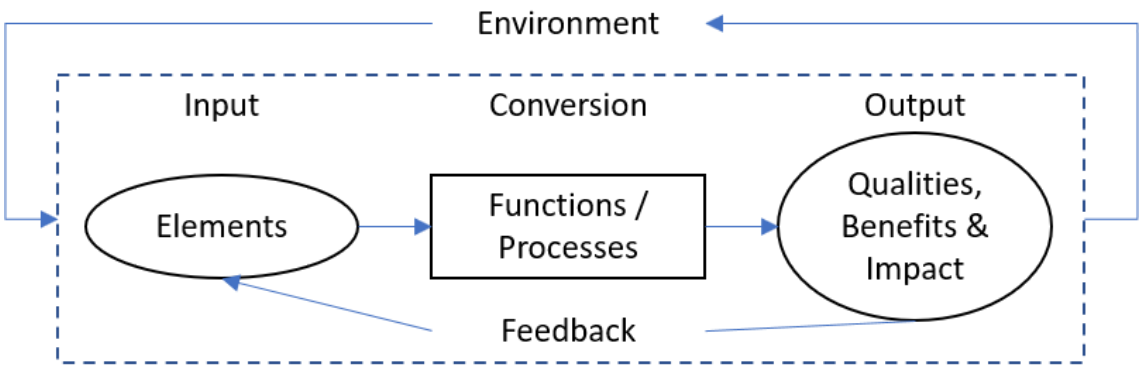


Figure 1 - Parks System, based on the General System Theory Model from (Steiss, 1974b)

and their effects on humans. It also illustrates that qualities, each category of benefits and impacts can have internal mutual effects on the same level, and that reverse relations exist too.

It is important to acknowledge that the park natural system is brought to cities through design and is rarely the original system where it is constructed. However, once established the system will have the same processes found in nature. Its performance will be slightly different from systems in their original state because of the disturbance of human activities. Designing the system to be as close to similar natural systems and minimise the negative effects of human activities can decrease the dependence on human interventions to keep the system running. The following three parts explain in more detail the park's natural and man-made systems and their impacts on humans.

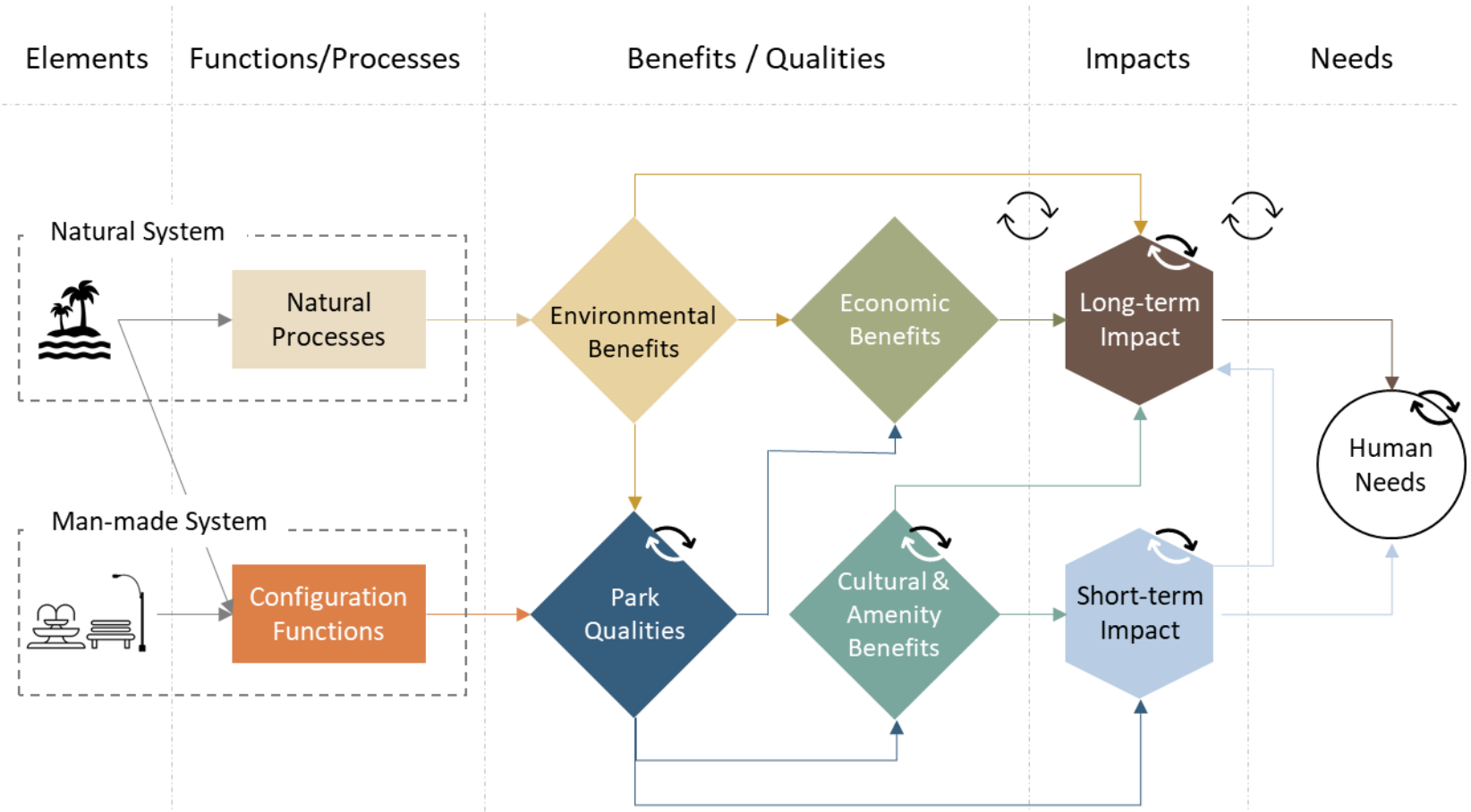


Figure 2 - The Two Main Systems in a Public Park

4.1. The Public Park Natural System

What distinguishes public parks from other public spaces is their characterising natural system (Table 2). People expect parks to have a flourishing green element that allows them a contact with nature (Haq, 2011; Jim, 2013; Lee *et al.*, 2015; Matsuoka and Kaplan, 2008). The main natural elements of this system are soil, water and vegetation. They perform natural processes as part of their composition which have benefits for humans. Natural elements enhance biodiversity by creating habitat and support reproduction (de Groot *et al.*, 2010; Haq, 2011; Lovell and Johnston, 2009a). Vegetation and water can also improve microclimate quality and reduce urban heat island effects (Buyadi *et al.*, 2013; de Groot *et al.*, 2010; Haq, 2011; Lafortezza *et al.*, 2009; Lovell and Johnston, 2009a). Moreover, vegetation can also give humans benefits related to the reduction of air, water and noise pollution, stabilising soil and reducing erosion, and mitigating the harmful effects of floods (Buyadi *et al.*, 2013; de Groot *et al.*, 2010; Haq, 2011; Lovell and Johnston, 2009a; Stokman, 2008; Urban Green Blue, 2015; Vannoppen *et al.*, 2016).

Environmental benefits can have other economic, cultural and amenity benefits, and affect qualities leading to short or long-term impacts. Productive vegetation is a source of food, work and financial resources (de Groot *et al.*, 2010; Haq, 2011; Lovell, 2010). Enhanced environmental qualities save resources, and reduce the energy and cost required for interventions to mitigate harmful effects on the environment or control natural phenomenon like flooding (Buyadi *et al.*, 2013; Haq, 2011; Lovell and Johnston, 2009a; Stokman, 2008). Workplaces close to green spaces have improved quality which impacts productivity (Haq, 2011). The natural system with its processes and environmental benefits are important in determining the ecological quality of a park which allows contact with nature (Costanza *et al.*, 2007; Francis, 1988; Matsuoka and Kaplan, 2008). Finally, if natural processes and their benefits are revealed in a park, they will provide access to information and education (de Groot *et al.*, 2010; Haq, 2011; Lovell and Johnston, 2009b).

Table 2 - The Natural System and its Associated Benefits and Qualities

Natural System

Natural Elements	Natural Processes	Environmental Benefits	Economic Benefits		Cultural and Amenity	Park Qualities	Benefits
Vegetation / Soil	Creating Habitat	Biodiversity	Food		Access to Information and Education	Ecological Quality	Contact with Nature
			Work				
Water	Reproduction Processes		Financial Resources				
	Evaporation and Transpiration	Microclimate Quality	Workplace Quality	Energy and Cost Savings			
	Absorbing heat and decreasing its transfer			Saving Resources			
Vegetation	Absorbing dust, smoke and harmful gases	Air Quality					
	Absorbing CO_2 and releasing O_2						
	Absorbing and deflecting sounds	Noise Reduction					
	Absorbing pollutants from water	Water Quality					
Soil	Stabilising soil	Flood Mitigation		Energy and Cost Savings			
	Absorbing water, decreasing runoff and increasing infiltration			Saving Resources			
	Slowing water flow						

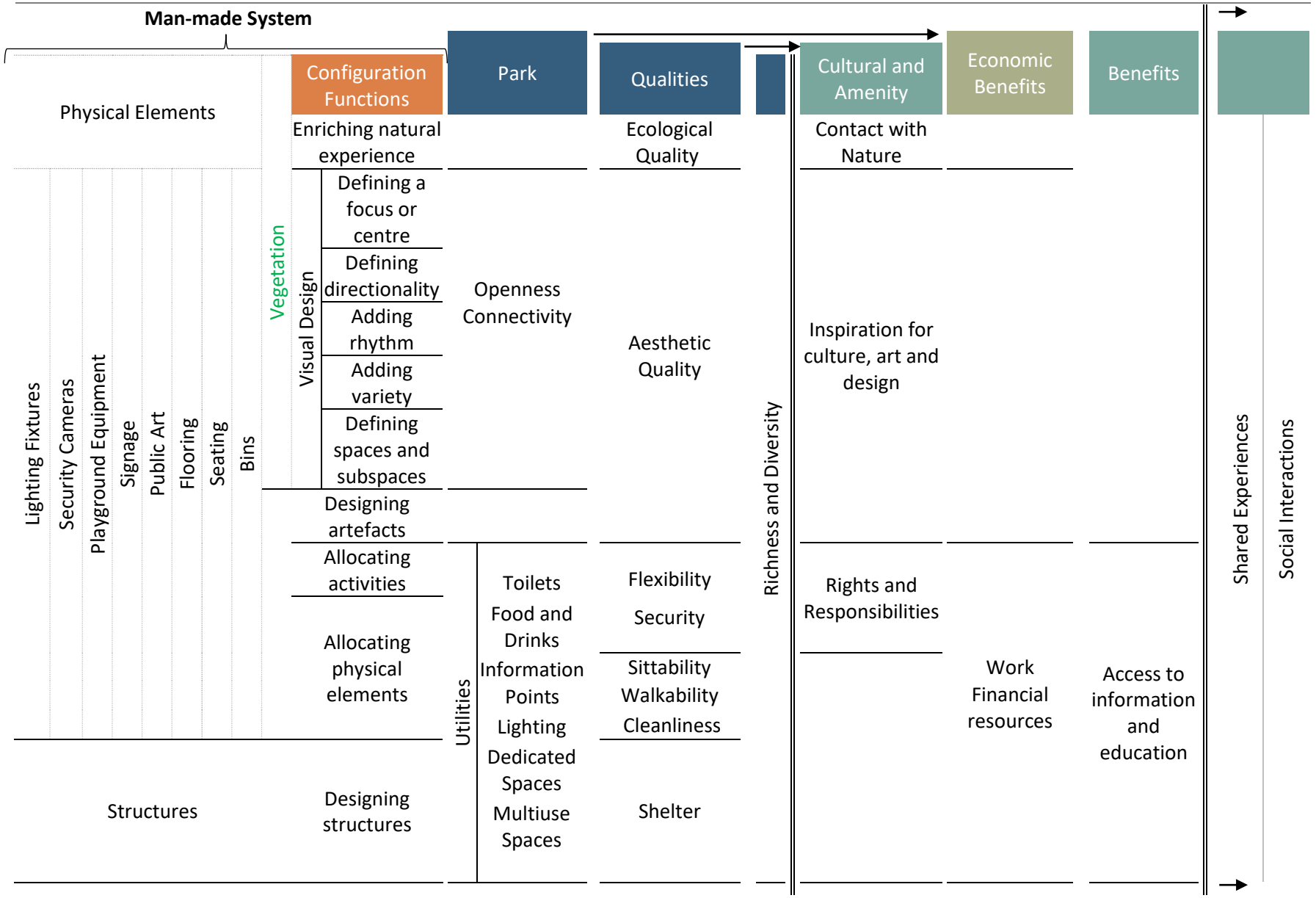
4.2. The Public Park Man-made System

Designers use natural and artificial elements to create public parks by assigning them several configuration functions that consequently determine the park qualities and provide benefits (Table 3). By applying visual design rules, vegetation is used to enrich the park natural experience, other artefacts are designed, and their location is selected (Carmona *et al.*, 2010; Francis, 1988; Kaplan, 1979; Matsuoka and Kaplan, 2008; Robinson, 2016). Consequently, different spaces are established, and activities are allocated within them. Designed structures also accommodate utilities or provide shelter (Carr *et al.*, 2007; Francis, 1988). Having different utilities, like dedicated and multiuse spaces, food and beverages, information points and sufficient lighting, is also an important quality that provides activities, attracts users and supports their use (Carr *et al.*, 2007; Francis, 1988; Matsuoka and Kaplan, 2008; PPS, 2009). Utilities also create financial resources and work opportunities. Moreover, green spaces can increase surrounding property values, attract economic activities, and support recreation and tourism (Haq, 2011; Lovell and Johnston, 2009a; Matsuoka and Kaplan, 2008). By providing information points, and spaces for various educational and awareness activities, parks can also support access to information and education (Carr *et al.*, 2007; Francis, 1988).

Among other qualities that support the use of the park are sittability, walkability and cleanliness (Carmona *et al.*, 2010; Carr *et al.*, 2007; Francis, 1988; Matsuoka and Kaplan, 2008; Paydar and Fard, 2021; PPS, 2009). Parks should also be secure, flexible and diverse to accommodate the use of various groups and allow them equal rights to access parks. Spaces and elements in a park should not hinder the use by any group and allow a degree of flexibility for users to decide on specific arrangements that support their use (Francis, 1988; Haq, 2011; Kaplan, 1973).

Visual design and artefacts design determine the park's aesthetic quality which influences inspiration for culture, art and design (Carmona *et al.*, 2010; de Groot *et al.*, 2010; Lovell and Johnston, 2009a; Robinson, 2016). Elements should also be arranged to provide openness and connectivity (Francis, 1988; Kaplan, 1973, 1979; PPS, 2009). The previously mentioned components combine to give the park richness and diversity (Carr *et al.*, 2007; Francis, 1988). Finally, public parks, with all its components, offer places for shared experiences and opportunities for social interactions (Carr *et al.*, 2007; Francis, 1988; Haq, 2011; Lee *et al.*, 2015; Matsuoka and Kaplan, 2008; Paydar and Fard, 2021; PPS, 2009; Salih *et al.*, 2020).

Table 3 - The Man-made System and its Associated Benefits and Qualities



4.3. Short-term and Long-term Impacts in Public Parks

Qualities and benefits in public parks have further short and long-term impacts on humans (Table 4). The first group of short-term impacts is coherence and legibility resulting from the openness of the space and the logical connection between its elements. Coherence and legibility are important in allowing users to make sense of their surroundings, facilitate orientation and wayfinding and achieve understanding (Kaplan, 1973, 1979; Paydar and Fard, 2021). They are also important for the quality of walkability (Figure 3). Secondly, achieving richness and diversity in a park impacts its complexity and mystery. They prevent a park from being dull to encourage further exploration into the space and support imagination, curiosity and artistic expression leading to the satisfaction of creation need (Carr *et al.*, 2007; Costanza *et al.*, 2007; Kaplan, 1973, 1979; Max-Neef, 1991). People prefer environments that they can recognise, but also those that are novel and can provide them opportunities for further discovery (Carr *et al.*, 2007; Francis, 1988; Kaplan, 1973, 1979; Tuan, 1974).

Thirdly, feeling discomfort in a park may discourage its use. Accordingly, achieving psychological, environmental and physical comfort are important for any further interaction with the space (Carmona *et al.*, 2010; Carr *et al.*, 2007; Lafortezza *et al.*, 2009; PPS, 2009; Salih *et al.*, 2020). The last group of short-term impacts are related to the passive or active engagement of the park users. Both are offered in the park through shared experiences, social interactions and contact with nature (Carmona *et al.*, 2010; Carr *et al.*, 2007; Francis, 1988; Matsuoka and Kaplan, 2008; PPS, 2009; Salih *et al.*, 2020). Engagement can satisfy human needs for leisure and spirituality by providing the long-term impacts of recreation, relaxation and tranquillity (Carr *et al.*, 2007; Costanza *et al.*, 2007; Haq, 2011; Lee *et al.*, 2015; Matsuoka and Kaplan, 2008). Engaging with nature and other people affect respect, receptiveness and passion, and give a sense of belonging, all reflected in affection, participation and identity needs (Costanza *et al.*, 2007; Matsuoka and Kaplan, 2008; Max-Neef, 1991; Salih *et al.*, 2020; Yu, 2021).

Further long-term impacts are connected directly to benefits. Equal rights to use the park and its flexibility have a long-term impact on the freedom need through providing equal accessibility to shared public spaces (Francis, 1988; Haq, 2011; Kaplan, 1973). People can also find aesthetic enjoyment in parks as a part of their leisure and spiritual experience (Costanza *et al.*, 2007; de Groot *et al.*, 2010; Lovell and Johnston, 2009a; Max-Neef, 1991). Moreover, green spaces, encourage people to do outdoor activities and meet with others which can improve health, reduce stress and increase productivity (Carr *et al.*, 2007; Francis,

1988; Haq, 2011; Lafortezza *et al.*, 2009; Lee *et al.*, 2015; Lovell and Johnston, 2009a; Matsuoka and Kaplan, 2008; Salih *et al.*, 2020; Yu, 2021). Environmental benefits also impact health by providing better air, water, and climate quality, reducing noise levels, and protection from natural hazards (de Groot *et al.*, 2010; Haq, 2011; Lovell and Johnston, 2009a; Vannoppen *et al.*, 2016). Finally, health, productivity, protection from natural hazards, and economic benefits are important for future subsistence (Costanza *et al.*, 2007). More details about the relationships and dependencies in the public park system are illustrated in Figure 3.

Table 4 – Short-term and Long-term Impacts in Parks

Short-term Impacts	Long-term	Impacts		Human	Needs
Coherence Legibility	Making Sense			Understanding	
Psychological Comfort Environmental Comfort Physical Comfort				Safety	
Passive Engagement Active Engagement	Recreation Relaxation Tranquillity	Respect Receptiveness Passion	Sense of Belonging	Leisure Spirituality	Affection Participation Identity
Complexity Mystery	Imagination Curiosity Artistic Expression Exploration			Creation	
	Aesthetic Enjoyment			Leisure Spirituality	
	Physical Health Mental Health Emotional Health	Productivity	Future Subsistence	Subsistence Safety	
	Protection from Natural Hazards				
	Accessibility			Freedom	

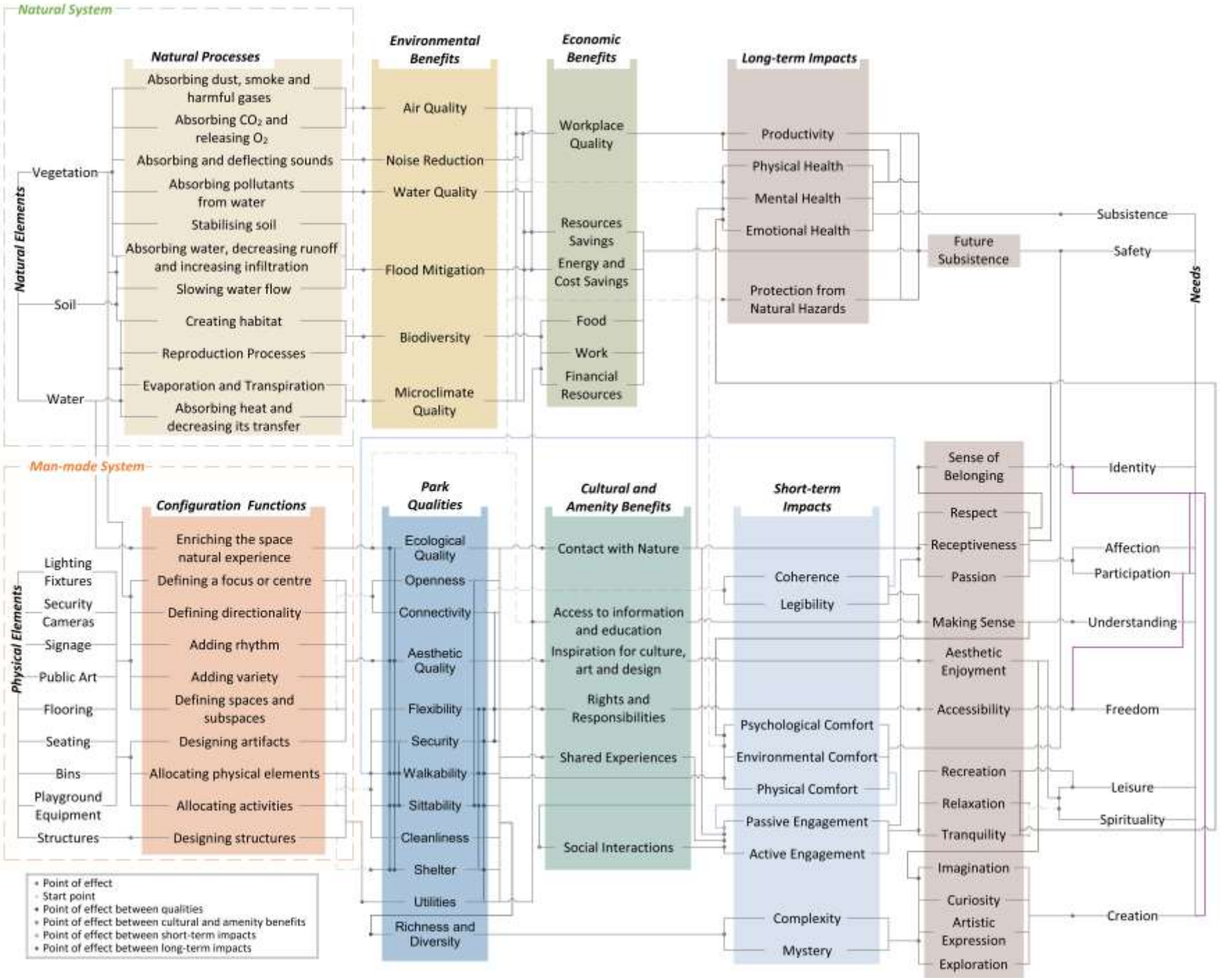


Figure 3 – The Public Park System

4.4. The Overall Structure of the Public Park System

The earlier tables provided lists of possible elements, processes, functions, qualities, benefits and impacts. They do not show all the dependencies and the relationships between them shown in Figure 3 and Figure 4. This part summarises the internal structure of the system and how its components relate to one another and provides some examples of how it could be applied in practice. In its general form, the public park system is constructed as follows:

- It has elements that have processes and assigned functions.
- A function or a process affects a quality or a benefit.
- The quality or the benefit has an impact on people, or it affects another quality or benefit. For example, the variety in park utilities influences the quality of flexibility and also gives economic benefits. Environmental benefits enhance ecological quality in parks and they can generally have an influence on economic benefits (Figure 3).
- An impact satisfies a human need or affects a quality, benefit or has another impact. Health, for example, affects another long-term impact - productivity. The degree of comfort in a park will also impact users' engagement in it. Coherence and legibility, short-term impacts, return to affect walkability, which at the same level of quality is affected by cleanliness, shelter, utilities, ecological quality and security (Figure 3).
- Needs are interrelated as well, for example, participation and understanding can influence freedom (Figure 3).

Having the system defined in the general form (Figure 4) allows expressing the uniqueness of each park. Managers can define and track the detailed components of the system,

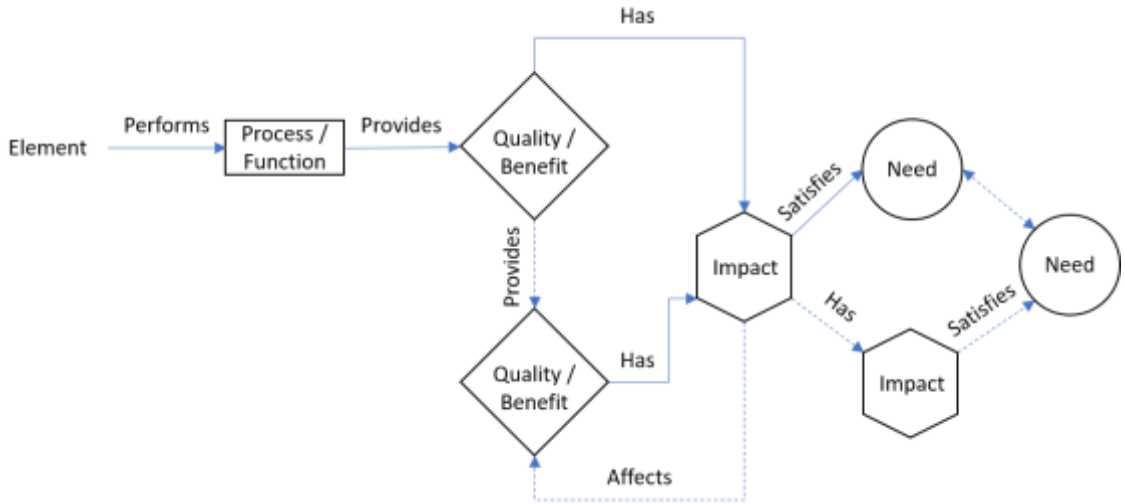


Figure 4 - The Internal Dynamics of the Public Park System

according to the characteristics of their park. The detailed description of these components illustrated in (Figure 3) includes the most common ones expected for a functioning park. However, not every park will include all of them and the model can incorporate other ones too. A degree of flexibility and adaptation is expected when dealing with the different characteristics of each park. The model can also provide a tool for managers to track the qualities missing in the parks they manage to be more successful. Decisions can be taken either to intervene and modify configuration functions or to fix a certain management related process. The interrelations defined in the system can allow a manager to understand all factors required for a certain quality and also the scale of effects any interventions can have. A manager can also plan to introduce a new quality, activity or target a certain impact by understanding their underlying structure.

For example, a space may have a certain utility like a playground, but visitors may not use it. Having the utility is necessary but not sufficient for the use. A manager can use the defined system to examine what other underlying issues might be the reason for the underuse. It could be a safety-related issue; parents do not feel the place safe enough to leave their children alone. When examining safety, the underlying impact is comfort which can be achieved through several qualities. It might be discovered that in this case, the space lacks shaded seating areas that can allow parents to sit and monitor their children while playing. Another example, a manager might observe that most visitors do not spend a long time in the park and that they are not actively engaged with each other. A direct reason for that might be that the space does not have enough benches for people to sit and socialize. An obvious intervention is to add more seating options which may or may not achieve the goal. But considering other factors can give a better opportunity for success. In addition to introducing more seating options, their location, physical comfort in being protected from weather conditions, psychological comfort regarding being placed in a safe well-connected place, its proximity to other utilities, etc, should be considered too.

As mentioned before, the public park system is part of an ongoing research on public parks management. A tool to evaluate public parks qualities through observations is developed based on this defined system. This evaluation tool took into consideration the interrelations between the qualities. They are all considered to be important and complementary, but their degree of influence varies. For example, utilities influence the qualities of shelter, walkability, sittability, flexibility and security, while connectivity has effects on security, flexibility and coherence and legibility that in return affects walkability

(Figure 3).

Existing parks in Cairo are to be evaluated using detailed criteria under each quality. Testing the use of the tool on Cairo's parks besides experts' consultation will determine its practicality and any missing evaluation criteria. This is meant to help as a management tool in pointing the problems and potentials in a certain park and supporting decision making. It can also help designers and planners in evaluating their proposals for new parks and consider the qualities from the early stages of any project. In addition, the public park system along with the evaluation tool will be one of the components of a management framework.

Conclusion

Green spaces and public parks consist of multiple components. These components are often discussed in literature separately with limited referral to their mutual dependencies. This research defines public parks as a system of interrelated components. It depended on previous theoretical and empirical research to define the system' elements, processes, functions, qualities, benefits, and impacts. They were derived by integrating knowledge from various fields and structured guided by systems thinking and sustainability principles.

The public park system consists of two complementary subsystems: a natural and a man-made system. Each system components interact and have mutual influences that result in the overall experience in a park. Public parks can enhance the quality of urban life and provide humans with several benefits. This research avoided defining the relationship between humans and the components of the park's natural system within an anthropocentric view. The benefits humans can gain from parks are highlighted without undermining the intrinsic value of the natural system.

The public park system was created as a first step in an ongoing research on public parks management. A set of criteria for each park quality in the system were developed to create an evaluation tool. Further research is currently undertaken to enhance this evaluation tool through application on observing existing parks in Cairo, in addition to experts' consultation. The public park system and the evaluation tool will then be a part of a framework for managing public parks. They can be a useful tool for managers and decision makers to evaluate the performance of existing parks and accordingly set management strategies, short and long-term goals, and operation plans. Planners and designers can also use the public park system to derive qualities and benefits they aspire to achieve with their projects and evaluate how their proposals will perform in terms of these qualities and benefits. The goal is to design and manage within a framework that realise the complexity of a park and how its

components work together and try to balance between a variety of goals and achieve multifunctionality.

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