Ain Shams University
Faculty of Engineering
Urban Planning

Biophilic Urbanism: Urban Water-Ways from Segregation to Integration Case Study of the Nile River in Egypt

A Thesis submitted in partial fulfilment of the requirements of the degree of
Master of Science in Architectural Engineering
(Urban Planning)

By
Sarah Eid Huneidak Muhammed Ali
Bachelor of Science In Architectural Engineering(Urban Planning)
Faculty of Engineering, Ain Shams University, 2012

Supervised By
Prof. Dr. Marwa A. Khalifa
Prof. of Urban Planning & Design,
Faculty of Engineering
Department of Urban Planning & Design,
Ain Shams University

Prof. Dr. Ahmed Sami Abd Elrahman
Prof. of Urban Planning & Design,
Faculty of Engineering
Department of Urban Planning & Design,
Ain Shams University

Cairo
2021

Ain Shams University
Faculty of Engineering
Urban Planning

Biophilic Urbanism: Urban Water-Ways from Segregation to Integration
Case Study of the Nile River in Egypt

A Thesis submitted in partial fulfilment of the requirements of the degree of
Master of Science in Architectural Engineering
(Urban Planning)

By
Sarah Eid Huneidak Muhammed Ali
Bachelor of Science in Architectural Engineering
(Urban Planning)
Faculty of Engineering, Ain Shams University, 2012

Examiners' Committee

Name and Affiliation	**Signature**
Prof. Ayman Hassan Ahmed Architecture , Cairo University	…….
Prof. Marwa A. Khalifa Urban Planning, Ain Shams University	…….
Prof. Abeer El Shater Urban Planning, Ain Shams University	…….
Prof. Ahmed Sami Abd Elrahman Urban Planning, Ain Shams University	…….

11 March 2021

Statement

This thesis is submitted as a partial fulfilment of Master of Science in Architectural Engineering, Faculty of Engineering, Ain Shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

Student name

Sarah Eid Huneidak Muhammed

Signature

……...…….

11 March 2021

Researcher Data

Name	: Sarah Eid Huneidak Muhammed
Date of birth	: 08-10-1989
Place of birth	: Cairo, Egypt
Last academic degree	: Bachelor of Science
Field of specialization	: Urban Planning and Design
University issued the degree	: Ain-Shams University
Date of issued degree	: 2012
Current job	: Senior Architect at Land Consultants

Acknowledgments

First and foremost, I thank God for all the blessings He bestowed upon me and for giving me the strength and patience to finish this work.

I would like to extend my deepest gratitude and appreciation to my supervisors, Prof, Marwa Khalifa and Prof. Ahmed Sami for their guidance and support.

This work is dedicated to my beloved late father whom I am forever grateful for and whom I wish was here with me at this moment. I thank my family and friends for their endless support and their continuous encouragement for me over the past years.

Special thank you to my dear friend Rana Samak for her support, help and for always being there for me and for my friends Haidy Ehab and Basma Mohammed for all their support.

ABSTRACT

With most of the world's population living in cities and urban areas, cities are seeking new ways to bring Nature into their urban fabric with goals of improving urban quality of life and improving human well-being. Natural areas include terrestrial urban parks, green spaces, and riparian and coastal areas. Riparian areas within the built urban environment include urban water-ways and their immediate adjacent urban areas.

Historically, urban water-ways have played a significant role in the establishment and evolution of human settlements, they were initially used for spiritual purposes, food, water supply and for transportation of goods and people, and later as a source of leisure and recreation. However, with increased urbanization, people's perceptions of water-ways have changed throughout history.

In recent years, a lot of cities around the world started recognizing the breadth of benefits that proximity to water environments within these ecologically and culturally sensitive spaces can provide as places of high restoration levels, unique cultural identity and high economic value. However, a lot of cities still fail to recognize these potentials.

For the past decades, water-ways and their adjacent urban areas have been subjects of heavy development. However, they are rarely designed to reflect the innate human need for contact with Nature, commonly known with the term "Biophilia" as coined and popularized by E.O Wilson to describe people's inherent affiliation to all forms of living organisms. The application of Biophilia, which is referred to with "Biophilic Urbanism", is increasingly emerging as a planning and design approach to guide urban development mechanisms and policies to foster positive Human-Nature connections in urban areas and address multiple global pressures including increased urban population, climate change and finite resources.

Under the guidelines of the approach “Biophilic Urbanism” the main objective of this study is to identify Biophilic indicators in the Nile waterfront in the selected study area, explore valuations of Nature within the study area, assess the degree of integration of the Nile waterfront within the urban fabric of the city, and investigate future potential opportunities of the utilization of the Nile in central Cairo as a catalyst for improving human well-being and quality of urban life as urban Nature.

The research follows an analytical case study approach. Methods of data collection included an extensive literature review, field survey and on-site observations, concurrent with semi-structured interviews when possible, and an online survey. An in-depth analysis of data was then carried out to assess the degree of integration of the Nile waterfront within the urban fabric of the city, identify biophilic indicators, and identify typologies of Nature valuations in the waterfront and to investigate potential opportunities and challenges of applying “Biophilic Urbanism” in future development plans along the Nile waterfront.

Results demonstrate that users of the Nile waterfront are rarely allowed physical access to the water. Visual access is mostly provided, with minor exceptions. Other cross-cutting findings indicate a lack of longitudinal and lateral social connectivity to the waterfront, lack of continuous appropriate pedestrian trails, and a general lack of green spaces and public amenities.

Key words:

Biophilia; Biophilic Urbanism; Human-Nature Connections; Natural Environments; Human well-being; Urban Water-ways; Urban Waterfronts.

Table of Contents

List of Figures

List of Tables

CHAPTER 1: Introduction

Introduction

As the world is becoming more urban, people became more disconnected and separated from Nature. The relationship people shared with Nature over most of evolutionary human history has gradually diminished and in some areas, disappeared (Irvine & Fuller, 2010; Kothencz & Blaschke, 2017). A part of this separation is the perception of Nature as something "Over there", that, in most cases, people have to "go and visit Nature", that cities and Nature cannot coexist (Feng & Tan, 2017). With most of the urban population living in cities, they are on the front lines to shift the way people perceive Nature as an inseparable part of urban areas (Beatley, 2011).

In cities founded on river banks or major water-bodies, the most obvious places to find explicit Nature are the waterfronts. Historically, those natural water-edges played a significant role in the evolution of cities, where significant cultural events took place along the river course, specifically for their location. This is explained in great part by the fact that both agricultural and industrial activities were, up until very recently, heavily dependent on a close water source. Trading also relied on water-ways in both Western and Eastern civilizations and so remained throughout most periods in history, only to lose part of this importance after the Industrial Revolution (Kostof, 1992).

However, the problem is that there are still many cities around the world that did not recognize the breadth of benefits and values that proximity to water environments can provide, where Nature exists and settles in the heart of urban areas and immediate contact with Nature can be significant. (Beatley, 2011). Urban waterfronts have been sites of heavy development and often are sites of pollution, exploitation and exclusive access, representing a dilemma for city planners, designers, and architects as it reinforces the need to change the way humans perceive these sensitive water edges and their role in the development process of the surrounding urban areas, raising the question of how to unlock their potential benefits for everyone without having the ecological vs. social vs. economic trade-offs (Chester & Grant, 2015).

The Nile River in Egypt, as is the case with major urban rivers, has been a source of life for human beings since the time of the Great Egyptian Civilization, used in shipping, trading, food security, and transportation as well as being the main water resource. The Nile river, once considered as a

refuge of sort or a retreat for those in need of fresh air and some leisure time, is increasingly becoming more separated from the urban environment, reflected in the pollution of its water, degradation of the ecological Nature of the river, lack of recreational activities along its waterfronts and exclusive access to it, physically and visually (Kondolf et al., 2011). Thus, the need for a shift in the management approaches of the River as more than just a mere water resource and the need to harness the potential benefits of this waterway as a permanent and powerful natural element that exists and settles in the very structure of the urban fabric of most Egyptian cities.

1.1 Research Justification and validity

With over two-thirds of the world's population living in cities and megacities, this concentration of people in the urban environment is putting an increasing strain on Ecosystems, used as primary sources of basic needs (food, water), while at risks of exploitation, misuse, and human-waste (UN-HABITAT, 2015). This is also true for marine and coastal ecosystems, as identified by global studies to be subjected to biodiversity loss and environmental degradation more than any other ecosystems (Bagan & Yamagata, 2014; Britton et al., 2020).

Many urban centres have developed around water-ways because the resources that they provide, including food, water supply, power, and fertile land for agriculture and transportation. Urban development has rarely been sympathetic with its environment and has often overlooked the value of aquatic ecosystems. Consequently, urbanization is considered to be one of the most dramatic alterations of ecosystems (Everard & Moggridge, 2012).

Urban water-ways have been significantly affected by rapid urbanization, a situation common to all areas subjected to urbanization (Morley & Karr, 2002). Nowadays, it's very difficult to find an urban waterway in its natural state, one of the many effects of urbanization that resulted in alterations of the ecological Nature of urban water-ways. These alterations are wide-ranging and multi-faceted from channelization, fragmentation of river-systems and floodplains, alterations of sediments

regime and hydrology, and embankment to water pollution (Everard & Moggridge, 2012).

Urban Water-ways can be safely perceived as entanglements of both "Nature and Culture" (Edgeworth, 2011). Yet, they have been a subject of social segregation, exclusive access and urban segregation from the built environment, consequently solidifying the perception of "Cities vs. Nature" and further widening the gap between people and explicit Nature in their communities (Silva et al., 2006).

Within this Context, the approach of "Biophlic urbanism" is appearing in the design and retrofit of urban areas around the world. Based on the well-established "Theory of Biophilia", popularized by E.O.Wilson in 1984 and in which Wilson argued for our innate need for Nature as well as the evident relationship between Nature, human health and well-being. The term has been recently defined as an emerging design principle for buildings and urban areas, featuring a suite of natural design elements that address multiple pressures related to climate change, increasing urban population, and human inherent need for contact with Nature (Beatley, 2011; Newman et al., 2017).

1.2 Research problem

Throughout its long history, Egypt has been centred around the Nile since the great ancient Egyptian civilization, dependent on the river for navigation, communication and upon the river's periodic floods for agriculture. However, recently, the river has been subjected to increasing segregation from the urban fabric of the built environment and excessive degradation in it`s ecological nature as a result of rapid urbanization, exploitation, misuse, and informality.

These impacts are conspicuous in severe environmental deterioration as the banks of the river became a prime location for trash, litter and debris, its lively bridges occupied by informal usages and as alternative sidewalks for pedestrian and it's waterfront, a manifestation of exclusive access and social segregation. For Cairo, the Nile waterfront is part of the identity of the city, and this identity has been compromised.

1.3 Research Questions

1. The main question addressed in this research is: "**What** are the opportunities and challenges of adopting the approach of Biophilic Urbanism in urban development plans along the Nile waterfront in Central Cairo?"
2. **What** are the implications of the process of urbanization and the human-Nature connections**, How** can the human-Nature relationship be explained?
3. **Why** is the approach of "Biophilic Urbanism" considered more convenient and comprehensive as an innovative approach for urban development than other contemporary approaches?
4. **How** can “Biophilic Urbanism” be applied in urban water-ways and waterfronts development projects to improve human health and well-being?
5. **What** are the current conditions of the Nile`s Waterfront in Cairo? **How** do people perceive the River and its waterfront and what do they value in the waterfront?

1.4 Research Objectives:

1- The main aim of the research is **To Assess** the degree of integration of the Nile waterfront within the selected study area in Central Cairo and investigate the potential opportunities and challenges of applying “Biophilic Urbanism” in future urban developement along the Nile Waterfront.

2- **To explore** the theoretical debate on the relationship between Nature, Urban Eco-systems, biodiversity and human health and wellbeing.

3- **To demonstrate** the importance of utilization of urban water-ways as factors of urban integration rather than factors of urban (dis)integration.

4- **To investigate** the current global approaches of integration of urban water-ways as a natural element into the planning process of urban development as a natural tool to improve the built urban environment.

5- **To identify** biophilic indicators in the River Nile waterfront in the selected study area in Central Cairo and investigate typologies of Nature valuations of the river and its waterfront.

1.5 Research Scope, Limitations and Delimitations

Research Scope:

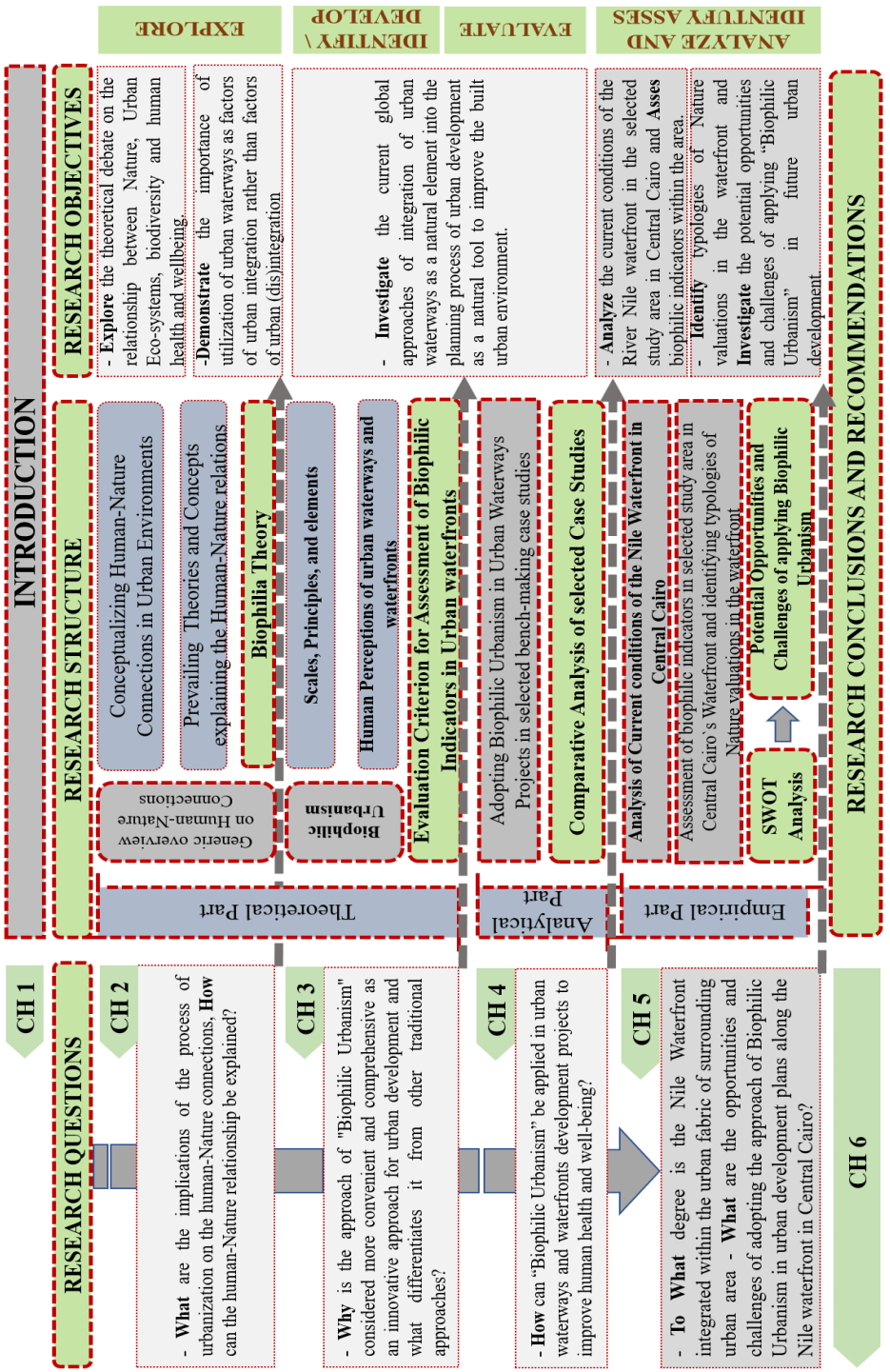
As the main goal of this research is to investigate the potential opportunities and challenges of adopting the approach of "Biophilic Urbanism" in future development along the Nile River, the Research will focus mainly on the Social and Environmental aspects of this approach and the potential benefits that could be derived from its application.

Research Limitations:

Limitations and delimitations to the study conducted in the research include the ongoing political conflict about the expected effects of the construction of "Renaissance Dam" in Ethiopia. Other delimitations will include the selected global best practices in the application of "Biophilic Urbanism" approach in urban development along urban water-ways, as the selected criteria for these case studies may vary in scale and the key drivers for adopting such approach in urban development along the course of their respective water bodies.

Another important limitation is the elimination of the irrigation and drainage canals of the Nile River in urban contexts. This was based on the fact that many of these canals are settled in "Informal settlements" and thus including them will widen the scope of the research within the set time-frame and can lead to conflicting results as "Informal settlements" represent an issue that needs to be tackled separately.

1.6 Research Structure / Research Design



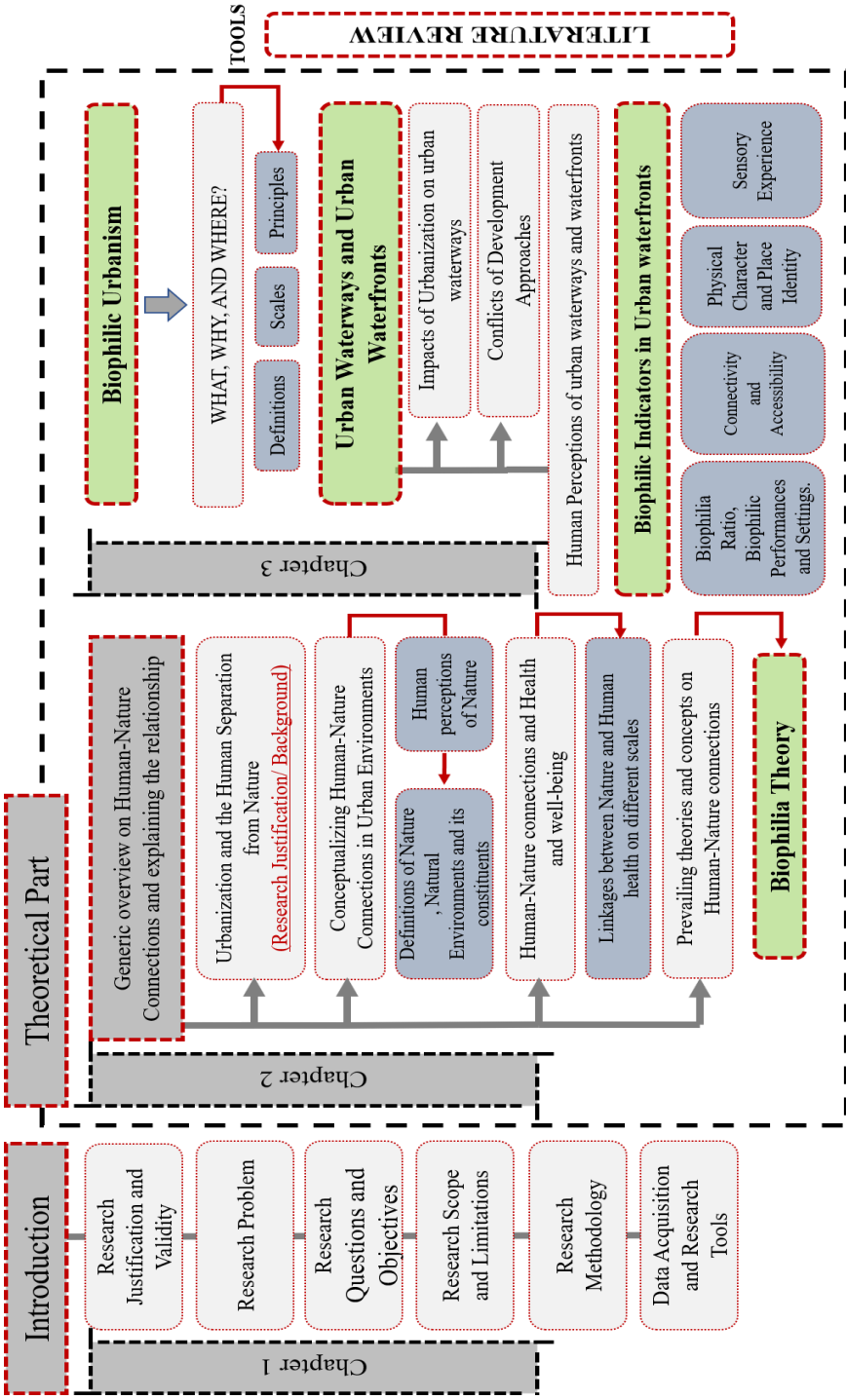
1.7 Research Methodology

The research is split into three parts within 5 Chapters plus the Conclusions and recommendations Chapter. The first part will focus mainly on the Theoretical debate on the relationship between Nature and human health and wellbeing, prevailing theories on the benefits of Nature in literature as well as theoretical perceptions of urban water-ways and the current challenges of integrating them in the built urban environment. This part will also explore the approach of "Biophilic urbanism", its definitions, scales, and applications in urban development field.

The second part will be a combination of both Theoretical and Analytical approaches to explore the global current approaches to urban development along urban water-ways with emphasis on what are the current mediating methods to integrate these water bodies into the built urban environment as a tool to improve the built environment through an analysis of selected best practice case studies. While the Third part will focus mainly on the case of the Nile River in selected study area in Cairo. Finally, the Results and Discussion section interprets and describes the significant findings of the study. Lastly, the Conclusions chapter synthesizes the main points and findings of the research and ends with recommendations for policymakers, architects, urban planners, and finally researchers.

1.7.1 Adopted Approach

The research will follow a **Mixed Methods Approach** combining both qualitative and quantitative methods to obtain answers for the research questions. The research will follow a **Descriptive Approach** in the theoretical part of the research by exploring the theoretical debate on the relationship between urban water-ways and the surrounding built environment, focusing mainly on the environmental and social aspects of this relationship. Followed by an **Analytical approach** in the following parts by exploring the global urban development approaches of urban water-ways and integrating these water-ways in the built urban environment through an international benchmarking case study (or multiple case studies) and an empirical study of the case of the Nile River in Egypt.


Introduction
Research Justification and Validity
Research Problem
Research Questions and Objectives
Research Scope and Limitations
Research Methodology
Data Acquisition and Research Tools
Chapter 1
Theoretical Part
Generic overview on Human-Nature Connections and explaining the relationship
Urbanization and the Human Separation from Nature (Research Justification/ Background)
Conceptualizing Human-Nature Connections in Urban Environments
Definitions of Nature , Natural Environments and its constituents
Human perceptions of Nature
Human-Nature connections and Health and well-being
Linkages between Nature and Human health on different scales
Prevailing theories and concepts on Human-Nature connections
Biophilia Theory
Chapter 2
Biophilic Urbanism
WHAT, WHY, AND WHERE?
Definitions
Scales
Principles
Urban Waterways and Urban Waterfronts
Impacts of Urbanization on urban waterways
Conflicts of Development Approaches
Human Perceptions of urban waterways and waterfronts
Biophilic Indicators in Urban waterfronts
Biophilia Ratio, Biophilic Performances and Settings.
Connectivity and Accessibility
Physical Character and Place Identity
Sensory Experience
Chapter 3
TOOLS
LITERATURE REVIEW

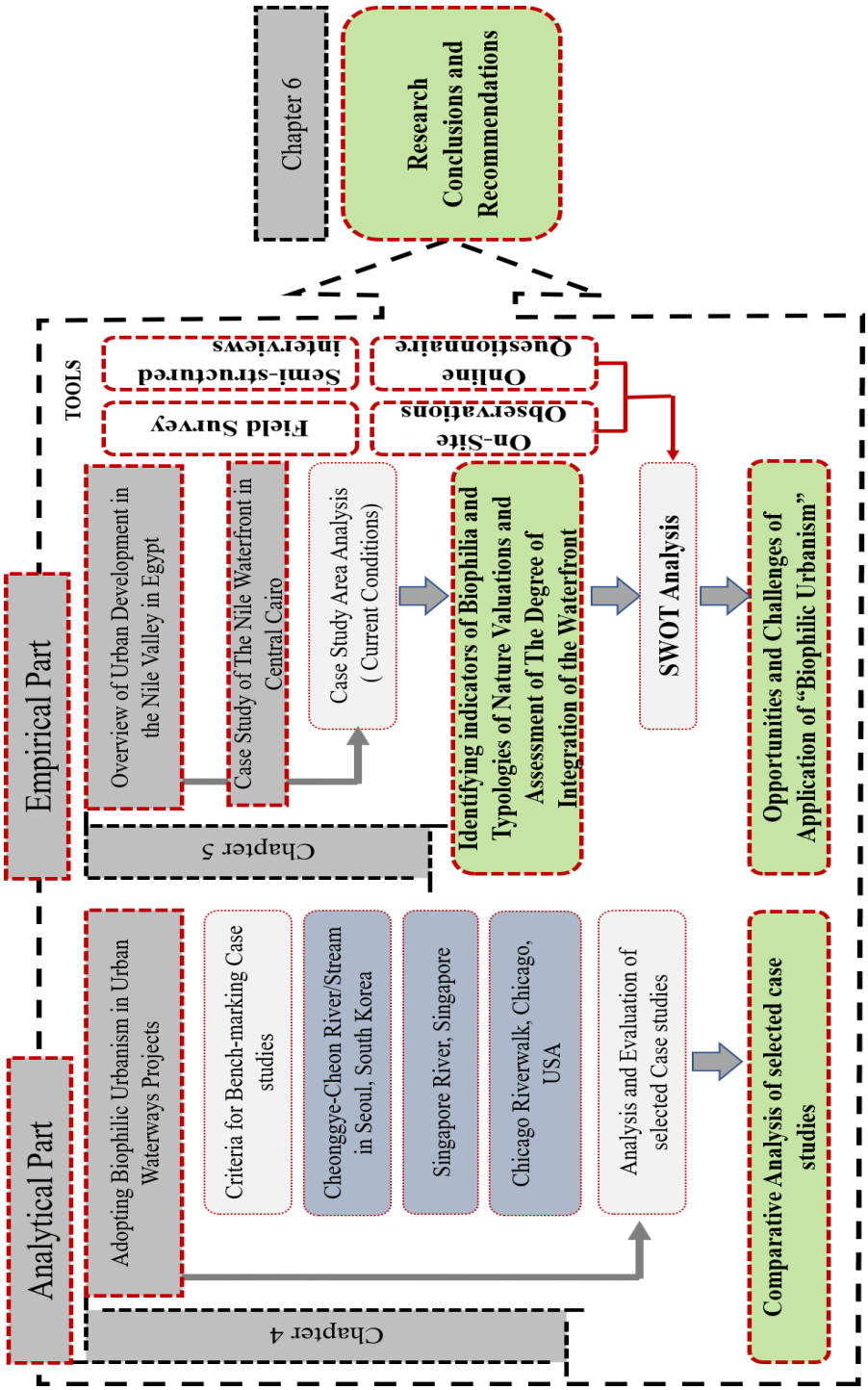


Figure 1: Research Design and Methodology. Source: Author.

1.7.2 Data Acquisition and Research Tools

Primary Data:

The primary data is collected and developed by the researcher and used later for analysis. **Mixed Methods Approach** will be used for collecting **(Qualitative and Quantitative)** data obtained through:

Field Survey, onsite observations, and structured / unstructured interviews with respondents of different educational backgrounds and age groups, including residents and dwellers of selected area.

The governmental authorities will include Egyptian Ministry of water resources and irrigation (MWRI) since they hold responsibly over The Nile River, General Organization for Physical Planning (GOPP) as they are responsible of planning existing urban areas to assess whether or not The River is, in any way, considered as an important potential natural element in these urban areas as well as the Egyptian Ministry of Environment (EEAA).

Questionnaires will be the second method of primary data collection; it will be used to gather information form a large number of people that can`t be concluded in interviews. They will be mainly users, dwellers or residents of urban areas settled on the edges of the Nile River to explore their perceptions of the river and its waterfront.

Secondary Data:

Secondary data is the data acquired through literature review, to analyse it and use it in the research to provide a theoretical support and base for the research argument.

The secondary data for this research is obtained through an extensive literature review and is divided into two parts; the first is a general view Nature, urban Nature, and urban water-ways as part of it. The second is an exploration of the approach of "Biophilic Urbanism", its definition, practice, and application in the field of urban development along the edges of urban water-ways as well as the current global approaches of urban development along the course of urban water-ways.

Other Resources will include conferences reports from international agencies such as The Nile Basin Initiative (NBI) and The United Nations Environment Program (UNEP) for data on The Nile River current conditions regarding aspects such as Water Quality and Ecological Nature.

1.8 Targeted Audience

The Research main objective is to guide concerned governmental authorities, decision makers, urban planners and designers as well as the general public to the importance of integrating The Nile River as a natural element in the process of planning and designing for future urban development along the river waterfront as well as introducing the approach of "Biophilic Urbanism" as an innovative approach for urban development. The Research's targeted audience will include:

Public Authorities such as The General organization of Physical Planning (GOPP), Egyptian Ministry of water resources and irrigation (MWRI), the Egyptian Ministry of Environment (EEAA) and The National Organization for Urban Harmony NOUH). Other organizations such as urban planners/urban designers, Educational and Academic Related institutions as well as Non-Profit organizations with related interests.

PART 1: THEORTICAL PART

CHAPTER 2: Human-Nature Connections: Explaining the Relationship

Introduction

Since the beginning of human history, human health and overall well-being have been markedly tied to the natural environment (Ewert et al., 2014; Song, 2011). Human health and well-being are influenced by Nature as much as human actions and behaviours affect the natural environment (Kellert, 2005; Wilson, 1984). However, with industrialization and the increased number of urban populations, people became disconnected and separate from Nature. A part of this separation is the perception of Nature as something to be observed or consumed but hardly as something inherently essential for human health and well-being (Beatley, 2011). Another part of this separation is the current urban form and city design that often ignores, rather than, embrace Nature and natural environments (Church, 2018).

Over the past few years, considerable attention has been paid to the debate on humanity's place in the natural world. Although there is a large existing body of scientific and scholarly research demonstrating the human-Nature relationship, contemporary societies still fail to recognize the potential benefits derived from the natural environment (Kellert, 2005). As of today, People spend about 90% of their time in artificially built environments and habitats, consequently resulting in a loss of appreciation of human reliance on the natural world (Soga & Gaston, 2016).

The overarching goal of this chapter is to explore the existing body of literature work demonstrating the theoretical debate on the relationship between Nature, human health, and well-being from a multi-interdisciplinary perspective, with an emphasis on the urban sociology perspective. This chapter will tackle the current predominant tendency of placing human beings outside the ecosystem, human perceptions of Nature and the subsequent human valuations of the natural world. A review of prevailing theories and concepts in the literature on Human-Nature connections will follow with an emphasis on the theory of "Biophilia" as the underpinning theoretical foundation for the approach of "Biophzilic Urbanism".

2.1 Urbanization and the Human Separation from Nature

Humanity, in its essence, is a product of human beings coevolution with Nature and the ongoing interactions and experiences with the natural world. Human emotions, senses and even cultures developed in close association with the natural world. Even in today`s modern societies, people still rely on the natural environment for food supply, shelter, productivity, and medicine (Ewert et al., 2014). However, as the world became more urbanized, People have developed a sense of alienation from the natural environment, manifested in the increasing number of the world population living in cities and urban areas in comparison with the number of those living in rural or suburban areas. As a result, the implications of this perceived separation between humans and the natural world are strikingly alarming (Dustin et al., 2009; Kellert, 2005; Soga & Gaston, 2016).

This separation from Nature not only significantly jeopardizes human health and well-being but equally affects the integrity and functioning of natural ecosystems. This separation also plays a role in shaping societal morals for environmental concerns and affects actions towards global issues such as biodiversity loss, climate change and environmental degradation (Mcharg, 1969; Simaika & Samways, 2010; Soga & Gaston, 2016; Turner et al., 2004).

Much of the literature work interprets this separation from the lenses of three main integrated, but distinctive, perspectives; the Religious, the Economic, and the Humanistic (scientific and philosophic). However, the religious perspective is considered to be the most significant as it established a worldview that was, and to a certain degree still is, an integral part of western thoughts and a moral direction for development (Srinivasan, 2014).

Arguably, religion had a significant role in separating humans from their environment. Christianity, as the primary religious foundation, and the most anthropocentric, and its association with "the western" perception of human-Nature separation is the most striking. Similarly, Judaism, although it asserted the sacredness of Nature as God’s creation, laid the foundation for human’s superiority over the natural world (Mcharg, 1969; Srinivasan, 2014).

According to White (1967), Judaism and Christianity, specifically, established human dominance over all other beings when it adopted a striking story of creation in which God first created Heaven, Earth, all non-human physical beings, and then man and gave him power over all else. White claims this as the root of our present-day ecological crisis as it established the idea that the natural environment was created for the sole purpose of serving mankind and thus should be perceived as such.

On the other hand, in Islam, Nature, although a sacred creation of God, wasn't a principal concern of the religion as it thought of the human life on earth as a temporary journey for his eternal one in life after death and thus a person shouldn't be concerned with their material world (White, 1967). While Eastern religions such as Hinduism and Buddhism, among others, believed that humans are integral parts of the natural world. They thought of Nature and humans as one and thus negative human perceptions of Nature led to negative actions and consequences (Marten, 2001).

From another perspective, this ancient perception of human superiority over Nature influenced the scientific direction of thoughts. Vining et al., (2008) relates the human separation from Nature to "The Enlightenment" as people relied on reason, observation, and experience to inform their knowledge and understanding of the natural world, laying the notion of human dominance and superiority over the non-human world in the very core structure of science. This is explicitly emphasized in deliberations made by influential philosophical scholars during the Renaissance era asserting that humanity was based on the belief that the natural world, including non-human beings, were created to only sustain human life.

In the work of Olivier (2013), he references René Descartes, considered the "father" of modern philosophy, asserting that: *"we may find a practical philosophy by means of which, knowing the force and the action of fire, water, air, the stars, heavens and all the other bodies that environ us, as distinctly as we know the different crafts of our artisans, we can, in the same way, employ them in all those uses to which they are adapted, and thus render ourselves the masters and possessors of nature."*

Srinivasan (2014) makes a similar point when referencing another philosophical scholar, David Ehrenfeld, who claims that humanity was based

on *"The irrational faith in the limitless power of humans to dominate the world, the belief that the environment and other species can and should be manipulated and controlled to meet human needs."* The fact that this perception of human superiority over the natural world was adopted by influential groups with fundamentally different ideologies implies that the rationale of humans perceptions of Nature as inferior to humanity was evidently embedded in the fabric of modern science and therefore led the direction of development and progress resulting in the present day perceived separation between human beings and Nature (Srinivasan, 2014).

From an economic standpoint, Cronon (1995) suggests that industrialization and urbanization were the major forces that drove humans further apart from the natural environment. Maller et al. (2005) echoes this opinion when writing about the rapid increasing of world urban population as a side effect of the enormous shift from land-based economy in which agriculture was the main economic activity to the industrialized world in which cities are at the forefront of economic development. While arguments made by Kovel (2007) held "Capitalism" responsible for the present ecological crisis and its subsequence of human separation from the natural environment. He argued that capital is eco-destructive in its essence, asserting that under economic oriented regimes, Nature is constantly exploited and consumed in favour of achieving economic profits.

In contemporary societies, many came to believe that economic development and civilization equate to exploiting and subjugating the natural world. Unfortunately, these tendencies are supported by current paradigms of urban development. This is demonstrated in high levels of consumption of natural resources, conversion of natural habitats into more harmonious and culture eccentric landscapes, and generating vast amounts of waste and pollutants (Kellert, 2005). As such, the universality of human-Nature separation underpins much of the theoretical debate about how human perceptions of Nature can shape collective societal concerns and actions for environmental issues. The fact that despite the mounting evidence and rising global awareness of human actions implications, much of scientific discourses still separate between culture and Nature with ancient predominate tendencies to place humans outside their ecosystems (Beery et al., 2015).

2.2 Conceptualizing Human-Nature Connections

The question of how humans perceive themselves in relation to Nature and how this perception can influence human behaviours and actions towards the environment has been addressed within multiple wide-ranging and interdisciplinary studies (Frumkin et al., 2017; Proctor, 2004). In urban Ecology, Nature is referred to as the accumulative geological, evolutionary and biophysical processes that have occurred throughout time. Nature is also described as any element of the natural environment such as soil, plants, animals, water or air (Maller et al., 2005). Natural environments are described as the geophysical surroundings encompassing all living and non-living organisms that aren't influenced by man-kind (Ewert et al., 2014).

Wohlwill (1983) interprets Nature as the domain of organic and non-organic matters that aren't a product of human activities or interventions. However, most literary work asserts that a clear-cut simple definition of Nature and what constitutes the natural environment doesn't exist. A substantial body of literature and scientific research provides multiple conceptions of Nature. These conceptions are by no means distinct, and sometimes even contrasting, but most often conclude that the notion of Nature is highly linked to the individual and societal perceptions of Nature and its constituents (Kellert, 2005; Proctor, 2004; Schultz, 2000).

For the purpose of this research, Nature is defined as the physical and biological world that is not developed, manufactured or intervened in by humans while encompassing the human experience with the natural environment through deliberate human creation and construction including any direct, indirect or symbolic representation of the non-human natural world (Sandifer et al., 2015).

Tracing down evolutionary human perceptions of Nature and how natural ecosystems function, it's clear that human perceptions are driven by worldviews. Worldviews refer to a collective group of images or stories that people used to understand the surrounding environment. They are influenced by cultural and social interactions with the natural environment and dictate to a high degree how people view the natural world, what they value in it and how they relate to it (Marten, 2001).

These shared worldviews vary from a particular geographical area to another and tend to be dominant that they generally influence human actions and behaviours towards the environment (Figure 2). These actions could be environmentally responsible or irresponsible but they certainly affect the natural eco-systems (Marten, 2001).

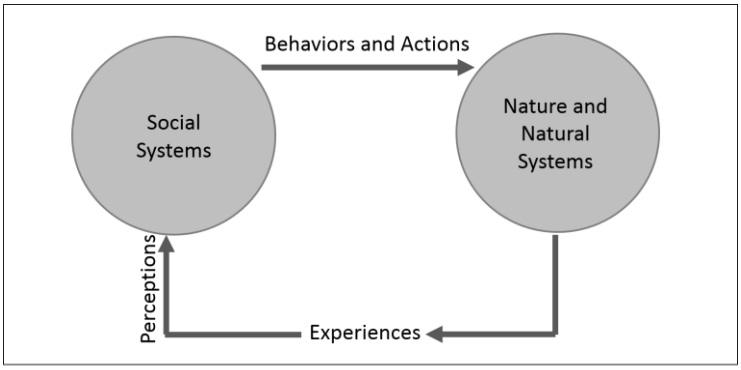


Figure 2: Perceptions of Nature and Human behaviour towards the Environemnt
Source (Marten, 2001).

Studies show that the types of attitudes or actions people exhibit towards the environment are closely associated to how they perceive themselves within the environment regardless of their evolutionary, biological or psychological connections with it (Ewert et al., 2014). Cronon (1995) believes that the notion of Nature is a social construct. Wohlwill (1983) Makes a similar point with the suggestion that the human conceptions of Nature is a product of culture.

A substantial research argues that human attitudes towards the environment are linked to the value they place upon themselves, others, plants, and animals. The basis for these values varies according to a person's personal prior experiences of Nature (Ewert et al., 2014). Therefore, since the physical environment is highly diverse and complex, it's to be expected that different values and concerns for the environment will be exhibited by different individuals, societies, and cultures. It is also reasonable that a group of people may share the same levels of general concern towards environmental issues for different reasons (Schultz, 2000; Strain et al., 2019; Wohlwill, 1983).

2.3 Human-Nature Connections and Health and Well-being in Urban Environments

Human Health and Human Well-being, on both individual and collective levels, is a significant issue of concern for most of the world population today as it has long been recognized that human health and well-being are markedly influenced by environmental conditions (Everard & Moggridge, 2012; Keniger et al., 2013; Maxwell & Lovell, 2017; Sandifer et al., 2015). Both are a complex and multi-dimensional concepts that require a profound understanding of variable human material (water, food, shelter) and nonmaterial needs (health, social cohesion, security) (Yocom et al., 2016).

On one hand, Human Health, for the general public and medical practitioners, is often thought of as just the absence of disease (Seymour, 2016). However, The World Health Organization (WHO) defines health as *"a state of complete physical, mental and social well-being and not merely the absence of diseases and infirmity."*

On the other hand, Human well-being (HWB) is defined by the Millennium Ecosystem Assessment working group of the United Nations as "*The basic material for a good life, freedom of choice and action, health, good social relations, and security"* (Hassan et al., 2005). Overall human well-being is encompassing benefits gained from both physical and psychological health as well as other aspects of well-being that include positive thoughts and emotions, self-sufficiency, proactivity and a positive perception of life (Diener et al., 1999).

In recent years, approaches conceptualizing human health and well-being have been broadly categorized into subjective and objective aspects. Subjective aspects of wellbeing refer to the perceived physical and emotional experience of an individual, while objective aspects of wellbeing refer to the external indicators used to measure individual experiences such as living conditions, education, occupational status (Seymour, 2016). Combined, these aspects together provide a more comprehensive approach of human health (Maller et al., 2005).

There is a large and growing body of literature that demonstrates that contact with Nature can have measurable psychological and physiological health benefits and other numerous positive effect (Table 1). Studies show that experiencing Nature can have positive effects on psychological/ mental health, healing process, attention and concentration, levels of stress, blood pressure, heart rate, behaviour, and other health factors. (Barton & Pretty, 2010; Coon et al., 2011; Sandifer et al., 2015).

Table 1: Examples of Reported Health Benefits of Interacting with Nature. Adopted from (Sandifer et al., 2015) with modifications from Author.

Benefits	Description	Examples
Physiological	Positive effects on physical health	- Increased physical activity. - Reduced blood pressure. - Reduced mortality from circulatory and respiratory diseases and reduced obesity and diabetes - Better recovery processes and better health near natural environments.
Psychological / Cognitive	Positive impacts on mental processes and behaviours and positive effects on cognitive functions	- Attention Restoration. - Reduced fatigue,depression, stress and negative emotions. - Improved productivity/ability to perform tasks and positive workplace attitude. - Improved performance and learning opportunities. - Increased creativity, happiness and calmness. - Improved emotional, social health of children. - Improved quality of life.
Disease regulation	Potential to reduce infectious diseases	- Reduction in spread of some infectious diseases
Social	Positive effect at individual community, or neighbourhood scale	- Enhances social cohesion and social support. - Facilitated social interaction.
Aesthetic, cultural, recreational, spiritual	Positive effect on cultural and spiritual well-being	- Increased recreational satisfaction. - Aesthetic appreciation. - Enhanced spiritual well-being.

Table 1: Continued

Benefits	Description	Examples
Tangible materials	Material goods and benefits	- Supply of food, raw materials, medicines, and other values. - Increased property value. - Economic value of recreation.
Increased Resiliency	Personal and community ability to withstand impacts and remain healthy	- Sustainability/pro-environment awareness and behaviour. - Supply of ecosystem services critical for human health and well-being

Various models underlying links between Nature and human health have been proposed to help explain the interdependency of human health and well-being and the natural environment. First is the concept of Ecosystem Services, which means that healthy ecosystems benefit humans by providing them with services and goods essential to sustain their life. Second is the Biophilia theory, which explores how people's instinctive affinity for the natural world drives them to directly interact with Nature. The third is a psychological phenomenon suggesting that people who live in familiar environments where they feel safe and secure are likely to derive the benefits provided by the natural world that improve their quality of life (Chen, 2017; Gillis & Gatersleben, 2015).

2.3.1 Ecosystem Services, Biodiversity, and Human Well-being

Ecosystem services are defined as the direct and indirect benefits derived from natural ecosystems to human well-being (Zari, 2019; Washington, 2013). Generally, ecosystems services refer to the processes and conditions through which natural ecosystems fulfil and sustain human life from maintaining biodiversity to the production of goods and providing intangible cultural and aesthetic benefits (Daily, 1997). While Biodiversity is defined as *"the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part"* as stated in (WHO & CBD, 2015).

At a global level, functioning ecosystems and biodiversity underline much of what sustains human well-being and health through a range of key linkages (Groot et al., 2002). The Ecosystem Millennium Assessment (Millennium Ecosystem Assessment, 2005) reveals that ecosystem services influence human well-being through many aspects in relation to disease regulation, raw materials, water quality, air quality, food and nutrition, pharmaceutical and traditional medicine and other cultural and psychological values (Figure 3).

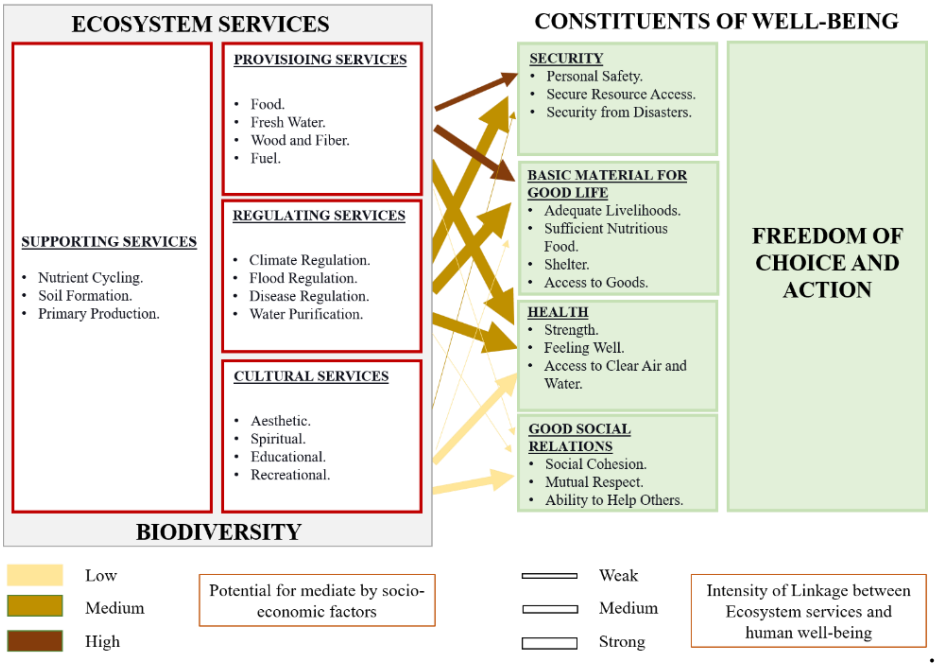


Figure 3: Linkages between Ecosystem Services and Human Health and Well-being, Adopted from (Millennium Ecosystem Assessment).

There are a myriad of functioning natural processes that occur within the built environment that connect humans to natural environments and are essential to human survival and well-being such as waste decomposition, soil formation, remediation of chemical and biological pollution, oxygen production, water supply and purification, products from animals and plants, pharmaceuticals, and food production (Kellert, 2005). However, most of these processes are often overlooked to the point where people don't consider the connection with Nature that these processes provide.(Hopkins, 2014)..

2.3.2 City Scale linkages between Natural Settings and Human Health

Cities are considered as interlinkages of ecological- social systems. At a city scale, within an increasingly and rapidly urbanized world, improving quality of life for city residents and dwellers depends on ensuring the delivery of ecosystems services produced locally by maintaining multifunctional, and accessible green and blue infrastructure into the urban fabric of cities (Andersson et al., 2015). An exponential literature work and scientific research linking natural environments with multiple direct and indirect health outcomes (Hartig et al., 2014; Maxwell & Lovell, 2017).

An established body of literature also suggests that the state of natural settings in urban areas may also have indirect effects on human welling for lower socioeconomic groups. Studies show evidence of positive association of certain types of natural environments such as urban green spaces, blue spaces, forests, and horticultural environments, taking into consideration the duration of exposure or contact with these environments and general health outcomes (Bowler et al., 2010).

2.3.3 Direct Human Health and Nature Linkages on Population and Individual level

Pathways through which contact with Nature may directly affect human health include air quality, physical activity, social cohesion, and stress reduction (mental health). Population-level studies have revealed that increased green spaces are associated with mortality, life-expectancy, and reduced cardiovascular diseases (Groenewegen et al., 2013; Hough, 2014; Keniger et al., 2013) while individual-level studies have shown close correlations between exposure to Nature on enhanced healing process and improved cognitive capacities. Other studies show positive associations between exposure to Nature and psychological health aspects including improved self-esteem, enhanced anger management, mental restoration, and attention recovery (Mitchell, 2013; Mitchell & Popham, 2008; Schultz et al., 2004). Interactions with Nature can also provide broader intangible benefits such as positive impacts on human behaviors and social skills (Keniger et al., 2013).

2.4 Relevant Theories and Concepts on Human-Nature Connections

Throughout most of pre-industrial history, human cognition was shaped in close contact with the natural physical environment. This first-hand state of knowledge of the natural world helped shape cultural beliefs and perceptions of Nature based on human experiences and adaptation to the natural world (Hartig et al., 2011). Multiple research fields examined the various direct and indirect ways in which Nature affects human health and well-being, including Evolutionary Biology, Social Economic, and Environment Psychology. A number of theories have been put forth to explain the human-Nature relationship (Hough, 2014; Keniger et al., 2013; Sandifer et al., 2015; Turner et al., 2004). Some of these theories believe that human need for contact with Nature is genetic, while others suggest that human affiliation to Nature is obtained through learning and ongoing experiences (Frumkin et al., 2017).

Most evolutionary based theories suggest that humans, generally, are attracted to natural environments simply due to the fact that their ancestors grew and developed within these environments. However, studies reveal that although people are born with an inclination towards natural environments, these tendencies often need to be nurtured to fully materialize (Hartig et al., 2011; Kellert, 2005). Theories of environmental preference assume a basis for human preferences for natural environments over others in adaptations to the environment over the evolutionary history of mankind (Kaplan, 1995; Kaplan & Kaplan, 1989; Lamb & Purcell, 1984). The following section provides a review of major relevant theories and concepts that discussed the Human-Nature connections.

2.4.1 Psycho-Evolutionary Theory (PET)

In the psycho-evolutionary theory, Ulrich (1983) emphasized human emotions or affections formed from contact or exposure to natural elements. These emotions, developed from the connection between early human beings and the natural environment, serve to reduce stress, which is often associated with artificially built environments. Ulrich argues that humans can experience

certain immediate reactions to natural environments before analyzing these sittings through cognitive processes.

The theory proposes that restoration from negative feelings occurs when people are exposed to natural sceneries or settings that elicit feelings of pleasantness, interest, and calmness. Ulrich (1999) continues to propose that, as part of the evolutionary process, humans have an innate biological capacity to acquire restorative responses from natural settings while having no such dispositions for modern built environments.

2.4.2 Attention Restoration theory (ART)

Restoration refers to the processes through which people can recover resources that have been diminished, often by humans themselves, in efforts to meet every-day demands in life. These include psychological resources and physiological ones. Psychological resources include the ability to focus individual attention on a certain task (Hartig et al., 2011). While the psycho-evolutionary theory emphasizes restoration from negative emotions such as stress, this theory, coined by (Kaplan & Kaplan, 1989) proposes restoration to improve functioning in every-day life activities through the recovery of attention fatigue, provided by natural settings that evoke feelings of fascination, compatibility, extent and a sense of being away from usual, often stressing, environments (Ewert et al., 2014).

A substantial amount of research has demonstrated the efficiency of the attention restoration construct. For example, studies by (Taylor et al., 2001) show results of better performance at attention-demanding tasks after exposure to natural settings. Studies reveal that people living near natural environments report improved effective functioning and positive emotions, like feeling at peace and improved self-control (Bossen, 2010).

2.4.3 Savannah Theory

The savannah theory was originally founded on the mounting evidence from research indicating that throughout human history people preferred savannah-like landscapes over other landscapes on the basis that these terrains

offered a suitable site for human habitats for providing protection from predators and availability of resources (Orians, 1986).

As a result, people developed an emotional connection with this kind of landscape due to the long-standing relationship between humans and these kinds of landscapes which, in turn, evoked positive health outcomes. Later works provided further elaborations on such theoretical claims, addressing the human preference for scenes of tropical savannah over other kinds of more familiar natural scenes (Falk & Balling, 2010; Heerwagen & Orians, 1992). However, other literature work cast doubts on the idea that the savannah-like landscapes should be considered as the optimal setting for human habitats (Han, 2007).

2.4.4 Prospect-Refuge Theory

Another evolutionary based theory articulated by Appleton (1975) drawing on habitat suitability to explain the human preference for natural landscapes and in which he believes that humans are attracted to certain habitats either for concealment, shelter, accessibility or ease of travel. Appleton also suggests that these types of the landscape are still attractive to humans in contemporary societies. He also emphasizes that differences in cultural, social and historical backgrounds are without doubt important but certainly not the main driving force as they developed over the course of human evolutionary history out of an innate need for survival (Hartig et al., 2011).

2.4.5 Naturalistic Intelligence Theory

Gardner (2000) introduced "Naturalistic intelligence" as one of the nine intelligence categories introduced in his multiple intelligence theory. Naturalistic intelligence refers to the human affinity to be outdoors and in contact with nature, sensing distinct patterns in nature, and recognizing the subtle changes in outdoor environments.

Gardner assumed that not all individuals are gifted with the ability to recognize natural patterns and thus not all individuals are genetically naturalists. Humans developing naturalistic intelligence through genetics is logical considering that human survival depended on being in tune with nature since early humanity (Ewert et al., 2014).

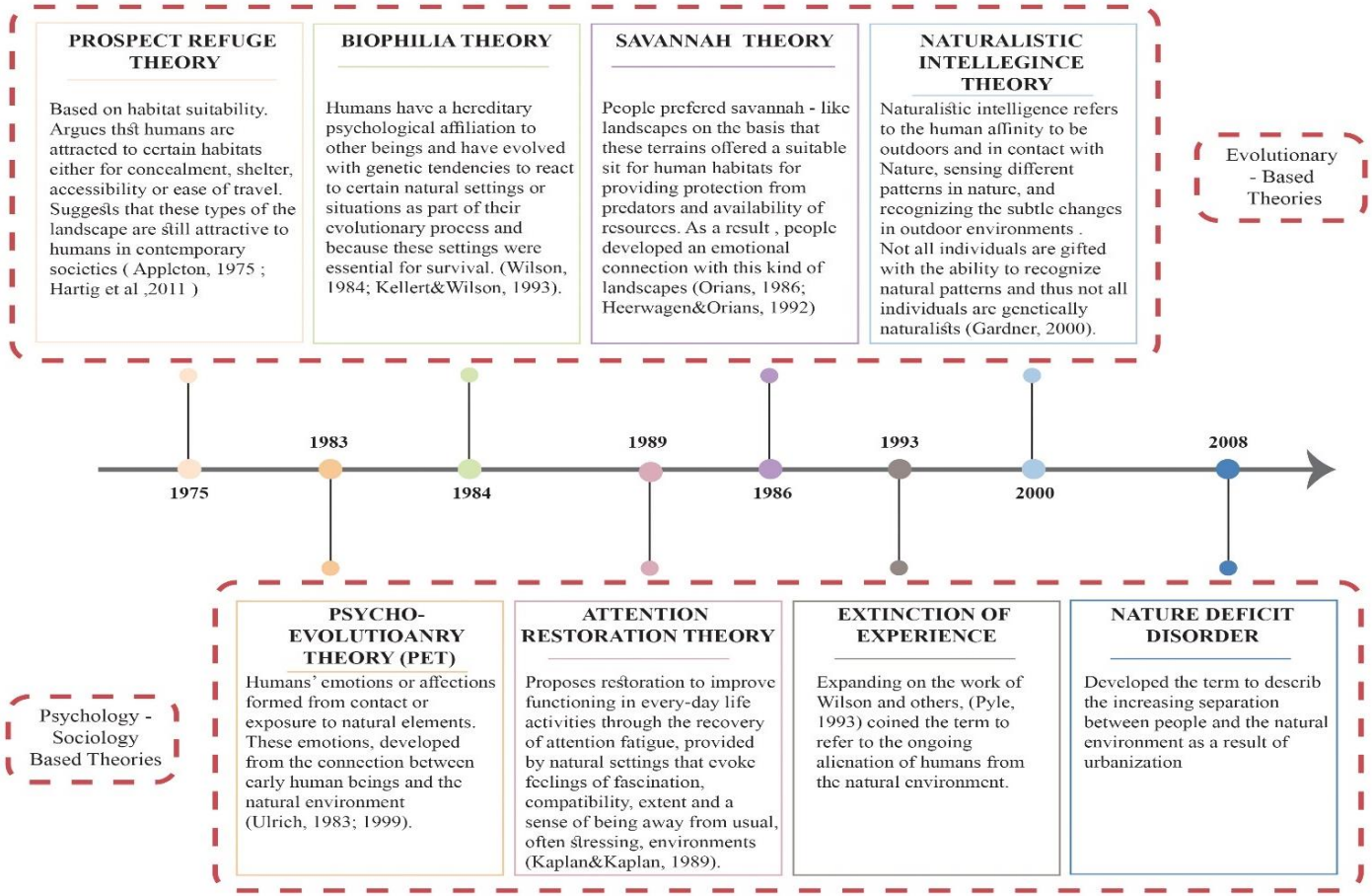


Figure 4: An estimated timeline of relevant theories in relation to Human-Nature connections. Source: Author.

2.5 Theory of Biophilia

In the 1970s, the term "Biophilia" was first coined by the German social psychologist Eric Fromm to describe a human psychological attraction to all forms of life and other beings. Bio means "life or living beings" and Philia means "Love or Attraction". It was later adopted and popularized by E.O.Wilson in his book, "***Biophilia"***, in which he argued for the innate human affiliation to other forms of life and which is explained through the process of human survival and evolution (Heerwagen et al., 2008; Kellert & Wilson, 1993; Wilson, 1984).

In his work, Wilson claimed that humans have a hereditary psychological affiliation to other beings and have evolved with genetic tendencies to react to certain natural settings or situations as part of their evolutionary process and because these settings were essential for survival. Wilson suggested that the continued expression of these tendencies is essential to human well-being (Wilson, 1984). However, others believe these tendencies might result from a "gene-culture coevolution process", in which someone may respond with a certain behaviour, positive or negative, to a given stimulus (Beery et al., 2015; Kahn, 1997).

Recent scientific research drawn on the "Biophilia" hypothesis has found that these human tendencies still apply to modern day societies. People tend to exhibit positive feelings and emotions towards domestic animals, being near natural environments or settings such as running water, green sceneries, and flowers. By contrast, people exhibit negative emotions towards undesired habitats, objects or activities that they think of as potentially risky or hazardous (Dustin et al., 2009; Gullone, 2000; Reeve, 2014).

Further elaborations on the essence of these tendencies were made by Stephen Kellert, another pioneer, and advocate of the "Biophilia hypothesis", where he suggests that these tendencies are "weak" and in need of sufficient exercising and cultural support to be functional. He argues that, over evolutionary history, humans have come to carry pre dis-positioned values to certain elements of their landscapes that helped sustain human life and are detrimental to human physical and emotional health and overall well-being (Heerwagen et al., 2008; Kellert & Wilson, 1993).

These biophilic values (Table 2), evolved over time and, when adequately expressed, confer a range of benefits for human physical, mental and intellectual health. Some of these values are not discrete and some types of values frequently occur together (Jones et al., 2016). However, lacking contact and experience of Nature results in physical and emotional deficiencies due to the un-development of these values (Gullone, 2000; Kellert, 2005; Reeve, 2014; Totaforti, 2020).

Expanding on the work of Wilson and others, Pyle (1993) coined the term "Extinction of Experience" to refer to the ongoing alienation of humans from the natural environment. More recently, Louv (2008) developed the term "Nature-deficit disorder" to describe the increasing separation between people and the natural environment as a result or a side effect of urbanization, supporting the claim that humans are losing touch with their biological and evolutionary ties in ways that are critical to their health and overall well-being.

Table 2: Typologies of Nature Valuations. Adopted from (Kellert, 2005)

Value	Description/ Function
Utilitarian	• Practical and material benefits people derive from exploitation of nature either out of need or personal satisfaction. • Nature as a source of material or physical benefits including food production, medicine and shelter and other intellectual and cultural gains. • Physical sustenance, self-sufficiency and security.
Dominionistic	• The desire to control and manipulate the natural world. • Mastery, subduing and dominance of nature. • Excising a sense of independence, physical prowess and the ability to preserve in the face of adversity and unknown.
Symbolic	• The tendency to use nature for metaphorical expressions or to communicate thoughts to aid informing knowledge and exchange of understanding through imagery , speech or communication in both explicit or obscure ways. • Communication, psychological development and development of children linguistic abilities and taxonomic capacities.
Naturalistic	• The satisfaction humans obtain from direct/ indirect experience or contact with nature. • The perception of nature as source of stimulation and diversity . • Heighten awareness, inventiveness the willingness to discover and enhance creativity and imagination.
Moralistic	• Fostering a feeling of affinity and reverence for nature, often associated with indigenous people spiritual connection with the natural world. • Ethical and moral concerns of conserving nature developed from a sense of spirituality. • A sentiment that supports individual spiritual and sometimes religious beliefs.
Humanistic	• The human experience of emotional attachment and affection to nature and other beings as a form of kinship and bonding with other creations. • Often recognized in the bonding between people and domesticated animals for a sense of companionship. • An emotional response that can derive physical and psychological benefits including therapeutic benefits of healing natural environments such as gardens, seashores and other healing landscapes.
Aesthetic	• Physical preference to natural settings more than human-made environments • An aesthetic value of nature is largely universal and happens a cross cultures and social statues, it differs from an individual to another but its occurrence and impact is certain to a high degree.
Negativistic	• The inclination to avoid or fear certain typologies of nature such as the fear of spiders, snakes or wild animals as well as barren and hard landscapes that provoke fear and anxiety. • This value represent a stark contrast to “biophilia” which literally translates to “love of life and all form of it”, however, the inclination to affiliate with nature is a tendency to include negative emotions and responses as much as positive ones.
Scientific	• Systematic , practical study and observation of nature and biological processes. • Describes the motivation to analyze and observe nature to obtain knowledge and understanding of the structure, patterns and functions of natural process.

Conclusion

Human reliance on Nature is evident throughout the evolutionary history of humanity. This chapter provided an explanation of the relationship between human and Nature in many disciplines to define current human views and perceptions of Nature and its constituents. Some of these theories assumed an innate connection between humans and the natural environment that stemmed from the pure instinct for survival, while others considered that connection a mechanism for adaptation in the environment that led to developing an emotional connection between humans and the natural physical environment. While there are areas of overlap between some of these theories, most of them asserted the connection between humans and Nature, supported by scientific research. The mounting evidence from the existing body of literature work and scientific evidence explaining the Nature of this connection is indicative of its diverse, complex and multi-faceted Nature. However, it seems that much of the studies appear to be scattered throughout an inter-disciplinary academic literature with multiple interpretations of this connection.

This chapter laid the theoretical foundation for upcoming chapters in relation to human-nature connections, human valuations and perceptions of Nature and the natural environment and explained “The Biophilia Theory” as the main premise of this study. The next chapter builds on this work to explore the practice of "Biophilia" in city design and planning and introduces the approach of "Biophilic Urbanism" as a planning and design approach. It also seeks to identify biophilic indicators in urban water-ways and waterfronts by exploring human perceptions of these environments and identifying key factors that affect human perceptions of them.

CHAPTER 3: Biophilic Perceptions of Urban Water-ways and Waterfronts

Introduction

Cities are the epicentres of urbanization, they concentrate economic progress, provide cultural amenities, and influence social change (Ewert et al., 2014). Around 54 percent of the world population lives in cities and mega-cities within artificial urban environments dominated by man-made stimuli, a proportion that is expected to increase to 66 percent by 2050 (United Nations, 2017). This is consequently putting increasing pressure on cities and their systems, including increasing urban population due to rural-urban migration, resources shortages, and climate change. Moreover, the scale of change and time available to respond to such challenges is unprecedented (UN-Habitat, 2016). While cities are seeking new ways to address such pressures, scientific evidence is increasingly highlighting the importance of balancing the heavily artificially built urban environment with Nature to provide a range of health and wellbeing benefits for urban residents and dwellers and mitigate their environmental impacts (Reeve et al., 2013).

In light of such trends, "Biophilic Urbanism" is increasingly emerging as a design principle for buildings and urban areas around the world. It features the utilization of a range of natural and biophilic elements as a response mechanism to growing global pressures (Beatley, 2011, 2017; Kellert, 2005; Reeve, 2014).

This chapter discusses the historical spatial expressions of Nature/city relations and examines the different conceptions of Nature in modern cities through different phases of urbanization. The chapter then displays the practice of "Biophilia" in city design and planning, introduces the approach of "Biophilic Urbanism" as a planning and design approach demonstrating the integration of urban Nature in cities and urban areas with emphasis on urban water-ways and waterfronts. This chapter will also discuss impacts of urbanization on these natural resources and provide a review of current approaches for water-ways development and management in relation to urban development, with an emphasis on aspects of human well-being and Human-Nature connections. The chapter represents the main theoretical foundation for both Analytical and Empirical parts and from which stems the checklist of evaluation criterion used in the upcoming analysis.

3.1 Conceptions of Urban Nature in Cities

Nature confronts humans not directly through the relations between human beings and the rest of natural physical environment, but rather indirectly through the relations between human beings' perceptions of Nature and their use of it (Marx, 1988). In modern cities, Nature materializes into various spatial forms such as parks, open spaces, green zones and water-ways, each designated for a specific land use where a particular value of Nature is identified by the way it is interpreted, recognized, and appropriated by diverse political, cultural, and social actors (Cho, 2010).

Historically, Conceptions of the modern city have often been shaped in relation to degrees of deviation from the natural mode of living where Nature was pushed back, degraded and exploited and humanity's progress was strongly associated with its independence from Nature (Birkeland, 2016). Yet, cities were perceived as urban ecosystems with urban patterns derived from economic, political, and cultural functions and ecological processes occurring across multiple scales (Golubiewski, 2012; Grimm & Schindler, 2018). Cities were formed out of natural resources through socially mediated natural processes. Yet, by contrast, they were also conceived as separate from their respective bio-regions and placed outside of Nature or the natural order (Benton-short & Short, 2013; Douglas, 2011; Heynen et al., 2006).

Nature and the environment have been at the centre of focus of urban change since the birth of urban planning as an independent field. Attempts to harmonize urban development with Nature and integrate the dynamics of urbanization with natural systems have been a strand of urbanization since the industrial revolution. However, addressing the human need for contact with Nature and the science of how cities interact with their natural systems started gaining attention in ecological circles only recently (Benton-short & Short, 2013; Douglas, 2011; Heynen et al., 2006).

With each phase of urbanization came a refashioning of societal relations with Nature, where cities and Nature were constantly repositioned against each other. This perception led the process of the urbanization of Nature, a transformation of the early conceptions of first Nature that predominated in the past into the current conceptions of metropolitan Nature (Keil & Graham, 2005).

Interest in the role of urban Nature in the city has had a steady history since the industrial revolution. First with the rise of the "sanitary city" concept in the 19th century in an attempt to alleviate the horrid environmental conditions of the industrial city and later with the emergence of Ebenezer Howard's *Garden Cities* and Fredrick Law Olmsted's arguments for the role of urban parks to counter pollution (Ebrahimpour et al., 2017; Kaika, 2005).

At the turn of the early twentieth century, the debate on city/ Nature relations was central to the modern metropolis. In Le-Corbusier's Contemporary City and Frank Lloyd Wright's Broadacre city plan, Nature was introduced as a means of restoring a healthy vitality to modern urban society. This was evident in the explicit inclusion of produced forms of Nature within the heart of the city through a myriad of designed natural features such as public parks, botanical gardens, and tree-lined boulevards (Brand & Thomas, 2005; Gandy, 2006; Keil & Graham, 2005). However, by the end of the 20th century, cities were put at the forefront of a new cultural perception of Nature as a source of leisure rather than a material necessity (Castree & Braun, 2005; Gandy, 2004).

With increasing environmental consciousness following the environmental movement and the contemporary strive to create a "sustainable city", modern cities started seeking new ways not just to green the city but to bring Nature into the relations that structure the process of urbanization with goals such as improving urban quality of life, liveability, and human well-being (Kaika, 2005; Keil & Graham, 2005). Within this context, the role of urban Nature in regulating the urban environment has been considered from a wide range of perspectives to address global challenges such as population pressures, climate change, finite resources, and improving quality of life (Beatley, 2017). However, despite the recognition of the importance of Nature in holistic human health and well-being embedded in literature work supported by mounting scientific research, there remain barriers of applying this knowledge in development processes in relation to land use competitions, lack of experience in sustaining urban Nature in dense built-up areas, and complexities associated with financial constraints (Desha et al., 2015).

3.2 Urban Nature and Restorative Environments

In the last few years, recognition of the modern built environment's impact on the natural environment prompted the emergence of alternative design and development approaches as a response to growing global environmental concerns in relation to rapid urbanization, climate change, and major biodiversity loss as a result of a fundamental design flaw rather than a by-product of the modern-society, urban life (Mendler et al., 2006).

Approaches such as "Green Urbanism", "Eco-Urbanism" and "Sustainable Design" emerged as remedies in an attempt to halt and reverse the increasing depletion of the natural environment. (Cho, 2010; Heerwagen et al., 2008; Reed, 2007). However, much of these design and development paradigms focus mainly on minimizing or mitigating the human impact on natural systems and rarely address the human need for contact with Nature as an essential aspect of human well-being (Cleveland, 2014; Dias, 2015).

While the focus on minimizing the human impact on natural ecosystems is essential and necessary, it`s ultimately insufficient as it results in little benefit to human health and well-being (Panagopoulos, 2019). Pioneers of the "Biophilic Urbanism" approach argue that this the missing link in the sustainability discourse where the focus on low environmental impact design ignore the importance of restoring a positive relationship between Nature and humans in the built environment (Heerwagen et al., 2008; Kellert, 2005).

According to Berry (1972), long-term sustainability will never be achieved without maintaining a positive human experience of Nature, because to achieve this, a shift in how people value Nature to be inclined to act as stewards for the environment, is in order. Recent research emphasizes that designing with environmental consciousness without considering aspects of promoting human well-being and place-attachment might lead to a lack of motivation needed to maintain sustainable built environments (Heerwagen et al., 2008; Reed, 2007).

Research has also found a link between people's interaction and engagement with natural environments and their interest in, and knowledge of, its ecological worth (Wessells & Lejano, 2017). Similarly, fostering human attachments and caring for a place calls for planning and designing

urban spaces and settings imbued with positive emotional experiences such as enjoyment, pleasure, interest, fascination, and wonder (Unema et al., 2015).

Within this context, restorative environmental design, from which stem the approach of Biophilic Design and Biophilic Urbanism, includes both implementing low environmental impact strategies that minimize the adverse impacts on natural environments as well as a positive environmental impact that fosters a beneficial human-Nature contact in the built environment (Dias, 2015; Dizdaroglu, 2020; Heerwagen et al., 2008). As the main focus of this research is investigating potentials for fostering a sense of "Biophilia" on an urban scale, there need to be a comprehensive understanding of its components and constituents in urban built environments, which will be discussed in the following part.

As mentioned in previous parts, humans experience contact with Nature through three strategies; Direct Experience with Nature, Indirect Experience with Nature and the Experience of Space and Place (Heerwagen et al., 2008; Kellert, 2005; Wilson, 1984). First, direct experience of Nature which involves actual contact with Nature in the built environment, that includes contact with natural elements such as light, air, plants, animals, and water. Second, the indirect experience of Nature which involves the representation of Nature and an array of natural patterns, forms and processes that can be achieved through pictures and artwork with depictions of Nature, natural materials, ornaments inspired by natural shapes and forms or environmental processes. The third is the experience of space and place. This involves environmental features of particular relevance to human evolution such as prospect and refuge, navigation and way-finding, and ecological and cultural connections to place (Heerwagen et al., 2008).

The realization of biophilia (Figure 5), is often related to the meaning or value of the experience of Nature, and in some cases to physicality (Tokhmehchian & Gharehbaglou, 2019). For achieving biophilia in modern-day built environments, understanding components of biophilic perceptions in urban environments is important. The following part provides an overview of components of biophilia and their meaning within the built environment.

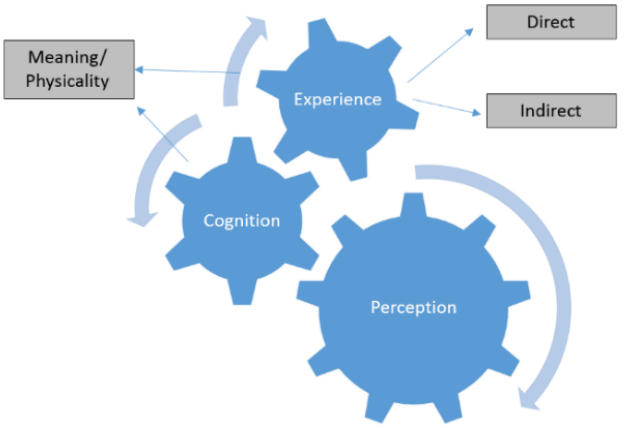


Figure 5: Components of Realizing Biophilia in Urban Environments.
Source: (Tokhmehchian & Gharehbaglou, 2019).

The first component is "Sense perception" which means the initial perception of the environment, Natural or urban because the impact of the environment on the senses is caused by stimuli that either draw users to a certain place or draw them away. Thus, designing places that evoke positive feelings is essential to realizing Biophilia. Sense perception is the result of physical senses; smell, sight, touch, hearing and taste (Berto et al., 2018; Chen, 2017; Tokhmehchian & Gharehbaglou, 2019).

Second is “Experiential reception”, which means the direct or indirect experience of being present in Nature. This, in turn, influence human behaviours and actions towards the environment (Tokhmehchian & Gharehbaglou, 2019). The third component, “Mental recognition”, refers to mental process to recognize and interpret surrounding environments. This analysis is affected by influence of personal experiences, personality factors and psychological factors which is influenced by personal values and meanings of places as well as cultural and societal perceptions of the environments. (Berto et al., 2018; Chen, 2017; Tokhmehchian & Gharehbaglou, 2019).

3.3 Biophilic Design and Biophilic Urbanism

Cities are fundamentally complex ecological systems dominated by human beings. They are ever changing and evolving patterns of both ecological and social processes. A city could be considered a dynamic intertwining of natural systems and man-made constructed built environments (Grimm & Schindler, 2018). In most cities, Nature can be found everywhere. However, it often goes unnoticed by urban residents and dwellers who are already detached and disconnected from the natural world. Lack of ways of engaging people with forms of urban Nature that exist in urban areas also decrease their sense of place and therefore the ways they connect with urban Nature and the benefits it provides (Beatley, 2011, 2017).

Biophilic urbanism expands to practice the concept of biophilia at the urban scale through the integration of natural elements throughout cities in the search for modalities of sustainable, resilient, and liveable cities (Kellert, 2016). The approach is based on the theory that humans have an inclination for Nature that needs to be expressed on a regular basis in their daily lives and argues for a holistic understanding of the potential benefits of integrating urban Nature in the urban realm (Reeve, 2014).

As a design principle, biophilic urbanism suggests that Nature must be incorporated in the urban fabric of cities and other urban areas, from aspects of daylighting at a building scale to integrating existing Nature at the neighbourhood and street scale and providing access to parks, waterfronts, and wilderness at the city scale (Littke, 2016). Biophilic urbanism can be applied at multiple scales in urban settings through a broad range of multi-functional features that address the global challenges of urban development and environmental protection (Desha et al., 2015).

In this regard, the main focus of biophilic urbanism is to provide experiences of Nature in urban areas that invoke positive physiological and psychological responses, which can be achieved through incorporating Nature into the built environment to maximize opportunities of human exposure to Nature through optimizing the design of natural elements and the physical built environment to capitalize on a range of direct and indirect benefits they can provide (Beatley, 2011; Kellert, 2016).

Moreover, (SBEnrc, 2012) define biophilic urbanism as *"An emerging design principle, in which Nature is intentionally and systematically integrated into the built environment in a way that provides for our inherent need of Nature, and harnesses the potential of Nature to regulate the urban environment to provide immediate economic, environmental and social benefits and concurrently build resilience to climate change, resource shortages, and population pressures".*

Within this context, biophilic urbanism expands beyond the physical conditions of utilizing natural elements in the urban fabric of cities to include how engaged and connected urban residents and dwellers are with Nature, In addition to measuring the number and size of natural elements in the city, biophilic urban also necessitates the consideration of how they are used by people and to what degree they provide opportunities for people to connect with Nature and appreciate it. Hence biophilic urbanism focus on physical settings in the urban realm as well as attitudes and experiences (Beatley, 2011; Littke, 2016; Reeve, 2014).

3.3.1 Principles, Scales, and Elements of Biophilic Urbanism

Humans experience contact with nature through three strategies that involve direct and indirect contact with nature and the experience of space and place in ways that elicit their inherit and evolved affinities to the natural environment. Direct experience of nature involves actual contact with nature in the built environment, while indirect experience of nature involves the representation of nature that can be achieved through depictions of nature or environmental processes. The experience of space and place involves environmental features of particular relevance to human evolution (Heerwagen et al., 2008; Kellert, 2016; Wilson, 1984).

Needless to say, not all aspects of integrating natural features within the built environment qualifies as biophilic urbanism such as isolated natural features in the urban built environment or within buildings, even if these features are of significant ecological value. Therefore, for the effective application of Biophilic urbanism as a design approach, (Kellert, 2016) developed a number of principles/ conditions that must be met to provide a positive experience of Nature for urban residents and dwellers. These are the following:

1. **Paying Attention to evolved human adaptations to the natural world that have advanced human health and well-being.**

Biophilic urbanism emphasizes human adaptation to the natural world that, over evolutionary time, has proven to be essential in advancing human health, well-being, and welfare. Thus, exposure to Nature that is irrelevant to human productivity and survival exerts little impact on human being and don't qualify as an effective instance of biophilic urbanism.

2. **Attachments to particular ecological, geographical, and cultural places and settings should result from the design.**

Biophilic urbanism promotes fostering emotional attachments to places and settings through satisfying human inherent need for contact with Nature. These emotional attachments motivate people to identify with and value the places they inhibit.

3. **The design should promote positive interactions between people and Nature.**

Biophilic urbanism fosters positive human- Nature interactions. Humans are a social species whose productivity depends on positive interactions within a spatial context. Effective biophilic design fosters connections between people and their environment, enhancing feelings of relationship, and a sense of belonging.

4. **The experience of Nature should be ongoing, repeated, and sustained.**

The experience of Nature should be repeated and sustained for the effective application of Biophilic design and biophilic urbanism, therefore, an isolated or occasional experience with Nature only exerts fleeting effects on people.

5. **Connected and integrated architectural solutions should be considered in the process.**

Effective application of biophilic design requires integrating design interventions that connect people to their physical settings. Exposure to Nature within disconnected spaces that aren't in harmony with their environments don't constitute as biophilic urbanism.

In today's heavily engineered and constructed urban built environment, achieving a beneficial experience of Nature requires deliberate planning and development decisions. Therefore, consistent with (SBEnrc, 2012) definition of biophilic urbanism, literature work provides a taxonomy of biophilic elements, or forms of urban Nature in cities, classified according to their scale or scope of application (Desha et al., 2015). These include three scales of elements; Building scale elements, Street/ Neighbourhood scale elements, and city scale elements. The three scales of natural elements, first developed by (Beatley, 2011), provide a functional guide to direct the development of programs and policies for utilization of biophilic elements across different scales of applications within cities (Table 3).

For the purpose of this research, the following review of elements of biophilic urbanism on both building and street scales is intended to provide only a summary of biophilic elements across scales without an in-depth review of these elements. Since a comprehensive review of all elements and scales of biophilic urbanism is beyond the scope of this thesis, therefore, the following section will discuss briefly the first two scales and focus on city scale elements, with emphasis on urban water-ways, as they are the main focus of this study.

3.3.1.1 Building Scale Elements

Building scale biophilic elements are commonly integrated into, onto, and around buildings. Identified elements include green roofs, green walls, vertical greenery, and indoor vegetation. Property types range from detached residential buildings to industrial and service facilities, including hospitals, schools, and universities (Beatley, 2011; Newman et al., 2017; Reeve, 2014).

There are a number of considerations of use for these types of elements, including the high potential for application of these features considering that most urban lands are dedicated to private and individual lots. Moreover, the use of these features is likely to be directed by property owners depending on the perceived value of these features (Reeve, 2014).

3.3.1.2 Street/ Neighbourhood Scale Elements

Street scale biophilic elements extend beyond the boundaries of individual property parcels at the street scale and generally lie within the jurisdiction of local governments. These include strips of land between property boundaries and roads, roads and streets, parking lots, small green spaces, and pocket parks (Reeve, 2014).

General considerations of use for street scale elements include ownership issues as roads and streets are typically publicly owned, in addition, these types of features need to be developed to allow for, and enhance other activities to occur in streets and reads such vehicle and pedestrian traffic, parking, access by services and emergency vehicles and, in some cases, property development. The potential of use of street scale elements is high, given the proportion of urban land allocated for roads and streets, and they have a high potential in accumulating a positive impact on urban areas and cities and have high potential of use (Desha et al., 2015; Reeve, 2014).

3.3.1.3 City Scale Elements

City-scale elements are typically larger than a suburban block or urban street. These features are generally few in number and accessible to all city residents, where public access is provided or allowed. These features can also traverse the boundaries of a city such as rivers, streams, canals and Green corridors and riparian areas along water-ways.

Considerations of use include number and size of features as it might be difficult to retrofit into already developed urban areas, particularly those with high density. Technical requirements for these types of features are low as they may be less connected to urban infrastructure. However, due to their size, potential benefits of these features include providing opportunities for recreation, experience with Nature, and biodiversity conservation that aren’t possible at the building or street scale (Reeve, 2014).

Table 3: Biophilic Urbanism Elements across scales with highlighted City Scale elements as the main focus of the reserach. Source: Author based on (Reeve, 2014).

Biophilic Elements		**Specific Benefits**	**Common Benefits**	**Description/ Considerations of Use**
Building Scale	Indoor Plants.	- Increase workplace productivity. - Improve air quality	**Economic Benefits:** - Increase property value. - Enhance Tourism and Urban Development opportunities. - Increase infrastructure longevity. **Social Benefits:** - Increase recreation opportunities. - Encourage social activity. - Reduce stress and improve well-being. - Improve urban amenity and quality of life for urban dwellers and residents. **Environmental Benefits:** - Increase urban biodiversity. - Improve air quality. - Reduce UHI levels - Reduce greenhouse gas emissions. - Assist in water cycle management and improve water quality. - Reconnects urban residents and dwellers with their natural environments.	- High potential for application of these features considering that the majority of urban lands is dedicated to private and individual lots. - Use of these feature is likely to be directed by property owners.
	Green Roofs and Green Facades	- Reduce building energy demand. - Improve water management.		
	Vegetation Surrounding Building.	- Increase property value.		
Street Scale	Pocket Parks and Green spaces.	- Increase property value. - Encourage physical activity. - Increase social capital.		- Ownership issues as roads and streets are typically publicly owned, in addition, - These types of features need to be developed to allow for, and enhance, other activities High potential in accumulating a positive impact on urban areas and cities
	Trees canopies and tree lined boulevards. Rain Gardens and Bio-swales, and Vegetated infrastructure.	- Improve urban amenity. - Mitigate driver stress and decrease traffic accidents. - Reduce storm-water runoff. - Extend infrastructure longevity. - Improve urban amenity.		
City scale	Urban Farming and Urban Agriculture.	- Catalyze economic development. - Encourage active transport. - Improve urban biodiversity. - Reduce storm-water runoff		- Number and size of features might make it difficult to retrofit into already developed urban areas - Potential benefits of these features include providing opportunities for recreation, experience with Nature and biodiversity conservation that aren`t possible at the building or street scale
	Green Corridors and linear green parks along riparian areas.	- Improve health and well-being. - Ensure food security. - Enhance social capital. - Retain nutrients and reduce waste.		
	Urban Water-ways: River, streams and creeks. Constructed wetlands.	- Improve urban amenity. - Increase urban biodiversity. - Increase property value. - Improve storm-water quality		

3.4 Urban Water-ways and Urban Waterfronts

The term "Green Space" is often used as a common term for natural areas in urban environments. However, green spaces are not limited to terrestrial urban parks and open areas, but also include urban water-ways and their adjacent urban areas (Hae et al., 2017; Völker & Kistemann, 2011). Urban water-ways include lakes, rivers, canals, creeks and streams, they can be natural or constructed and are often integrated with other elements such as linear green space along rivers or riparian vegetation (Reeve, 2014).

Benefits provided by water features have been widely acknowledged, both as ecological services and as places of high restoration, recreation and social interaction. They provide high restoration levels, mitigate temperatures, and are generally preferred places for relaxation and recreation (Siân De Bell et al., 2017; Dyson & Yocom, 2015; Faggi et al., 2013; Higgins et al., 2019; Mishra et al., 2020; Völker & Kistemann, 2013). Many cities in the world have invested in water-ways and waterfront projects as a means of attracting investments, improving social amenities, or revitalizing urban areas (Vollmer, 2009).

Urban water-ways and their influence on shaping structure of urban areas and cities around the world are the topic of many scholarly works in the fields of architecture, city planning and design, environmental psychology, political ecology, and health and well-being (Higgins et al., 2019; Mosler, 2021; Völker & Kistemann, 2011; Wessells & Lejano, 2017). However, they are often discussed according to a specific point of interest, such as functional, ecological, social and visual aspects, with little consideration to how these aspects interact, overlap, and influence each other (Smardon, 2018; Wessells & Lejano, 2017).

Recently, urban water-ways and waterfronts redevelopment became a worldwide phenomenon of policy targets in cities around the world. The competition for water-ways and waterfront space, the need for public access to the shore, the economic vitality of the waterfront, and the conservation of waterfront biodiversity as natural resources have thus become increasingly prominent issues in policies of urban development (Ansari, 2009; Avni & Teschner, 2019; Niemann & Weber, 2013).

3.4.1 Impacts of Urbanization on Urban Water-ways

The impact of urbanization on water-ways is multi-faceted and wide ranging. Currently, it is quite difficult to find any urban waterway in a natural, pristine state. Over the centuries, in most parts of the world, most urban water-ways and their flow have been artificially shaped, channelled, diverted, embanked or modified in other ways to serve human needs and purposes (Edgeworth, 2011; Iolin et al., 2011). The relationship between people and water-ways, the function of these water-ways and their influence, the way people thought of and perceived them has been ever changing throughout history (Higgins et al., 2019; Mačiukėnaitė & Povilaitienė, 2013).

Historically, Water-ways have played a significant role in human settlements, they were initially used as a source of food, water supply and for transportation of goods and people, and later as a source of leisure and recreation (Hae et al., 2017; Mačiukėnaitė & Povilaitienė, 2013). Moreover, many linkages between humans and water-ways have contributed to diverse forms of culture.

Rivers, for example, have had a very strong value in spiritualism and religion, the personalization of water as the source of life, of floods as sources of fertility or as an intimidating, destructive force of Nature, the aesthetic values of water, including the mirror effect of calm water surfaces or the rhythm effect of moving, running water as well as their significant role as fresh water resources (Wantzen et al., 2016). Rivers also played an important as form dominants in cities and urban areas, connectors of cultural and ecological landscapes, and special creators of the urban fabric (Mosler, 2021).

However, with rapid urbanization, these water-ways started to lose their importance and were subject to ecological degradation to the extent that some of them can no longer provide the ecological functions or services supporting human well-being they once provided (Everard & Moggridge, 2012; Kenwick et al., 2009) Most of these water-ways have been reduced to enable development, to carry waste, and to supply drinking water. This phenomenon isn’t confined to a particular geographic location, but one that is common to most water-ways within areas subjected to urbanization.

3.4.2 Conflicts of Economic, Social, and Ecological Oriented Development Approaches

There are multiple ways of knowing an urban water-way which, in turn, guide development decisions and shape policy interventions. Understanding waterfront spaces as an environmental policy target suggests a focus on conservation, restoration, and protection. Understanding them as an economic policy target means focus on job creation, tax revenues, and property values, while understanding them as a social equity policy target suggests a focus on public access, public space, and environmental justice (Wessells & Lejano, 2017). However, the problem is that most urban waterfront development decisions often attempt to cast these framings in a hierarchy of priorities when, in fact, the priority should be to combine all the above (Niemann & Weber, 2013).

By nature, urban waterfronts are relatively uncontrolled spaces which offer many opportunities for experience. Similarly, in a social sense too, urban waterfronts are often sites of tensions and ongoing change (Stevens, 2009). In its relation to its adjacent urban areas, urban waterfronts present a threshold, a transitional space in between city, a man-made product and Water, a purely natural element (Niemann & Weber, 2013). One of the major urban transformations and interventions related to urban water-ways are waterfront revitalization projects, which address more of the socio- economic aspects of urban water-ways development decisions. Such projects emphasize revitalization of waterfronts as an engine for economic vitality, open spaces, recreation, and heritage preservation (Smardon, 2018).

However, most socio-economic oriented development approaches rarely pay attention to designing these spaces to support biodiversity and other ecosystem services where prioritization of certain services (particularly transportation, infrastructure divisions, and other social/ cultural services) have limited the urban waterfronts of many cities around the world to accommodate other services such as habitat provision and storm protection (Dyson & Yocom, 2015).

3.4.3 Human Perceptions of Urban Water-ways and Waterfronts

"Perception" is defined as *"the recognition, identification, and interpretation of a sensation in order to form a mental representation"* (Schacter et al., 2011). According to Bell (2004), perception refers to *"the activity carried out by the brain by which we interpret what the senses receive. It is not merely a factual reporting, but tends to be referenced to associations and expectations already in the mind of the beholder"*. For the purpose of this research, perception generally refers to recognizing or becoming aware of something through the senses (Flotemersch & Aho, 2021).

Human preference for water environments is ancient. Natural or built open spaces close to water are among the most valued and preferred places that are often remembered in detail as part of people's person-scapes (Faggi et al., 2013; Lasiewicz, 2019; Mishra et al., 2020; Pitt, 2018; White et al., 2010). Possible explanations for this preference have been discussed by both evolutionary-based theories of environmental preference (Appleton, 1975; Kaplan & Kaplan, 1989; Ulrich, 1983; Wilson, 1984) and by socio-cultural-based theories (Herzog et al., 2000; Tuan, 1974; Zube et al., 1982).

In discussing the relationship between urban water-ways, urban waterfronts and human perceptions, meanings, and values of them, the most important concepts to be emphasized are the feelings people associate with these types of urban/ natural spaces and the values and meaning that underpin their cognitive process, subsequently affects their perception of these environments and ultimately their actions and behaviours within them (Faggi et al., 2013; Jones et al., 2016; Woodward, 2001).

People's perceptions of urban water-ways are shaped by prior experiences within the space or based on their expectations of that space and potential experiences within it. These experiences are influenced by many factors that are either directly related to the physical and spatial characteristics of urban water-ways and their environs or a product of individual experiences, values, and meanings of nature and life in general (Flotemersch & Aho, 2021; West et al., 2016). Therefore, to understand how people perceive urban water-ways, how these perceptions affect their experience of Nature represented in urban water-ways and waterfronts, and what they value in theses spaces, the next section provides a review of key aspects that contribute to shaping human

perceptions of urban water-ways and consequently urban waterfronts. These aspects are categorized into two main categories. The first is physical aspects which include natural/ locational characteristics and urban/spatial characteristics and the second are socio-cognitive aspects, with each category including a number of elements.

3.4.3.1 Physical Aspects of Human perceptions of Water-ways

From previous sections, it is evident that human perceptions of water-ways are in part a product of people's individual experiences, satisfaction of life, value and meanings of the environment they live in. However, the physical characteristics of water-ways also have a significant impact on how people perceive water-ways as part of urban nature.

3.4.3.1.1 Natural and Locational Characteristics

Human physical and social activities are affected in certain ways by nature and in the case of urban water-ways and waterfronts, by the presence of water and its characteristics. Likewise, human activities affect the nature of waterfront spaces by creating the urban space surrounding it. Understanding the natural and locational characteristics of waterfront spaces, along with the urban and spatial ones, have been directly linked to attempts at understanding how humans perceive water-ways and waterfronts spaces, how they experience them and what could affect that experience (Ansari, 2009).

A. Land and Water Form

Land and water forms are among the first characteristics that influence human experiences and perceptions of urban water-ways and waterfront spaces (Timur, 2013). Wrenn et al. (1983) categorized urban waterfronts under five categories according to land-water relation as follows:

- Urban area located on a peninsula,
- Urban area located on a bay,
- Urban area located on banks of a river,
- Urban area located on banks of intersecting rivers,
- Urban area located on a large body of water.

The first two categories represent coastal cities, while the latter three represent inland ones. Cities that are located on peninsulas or small islands are advantaged with longer waterfronts at a short distance from the city centre. The same could be said of cities located on the banks of intersecting rivers, estuaries and deltas, while cities that are located on linear shorelines, like rivers, end up with large urban areas deep in the hinterland and away from the waterfront (Ansari, 2009).

B. Waterway Topography

The configuration of the body of water in terms of shape, width, and depth affects the nature of uses and activities possible around it as well as their numbers (Ansari, 2009). Spatial perceptions of urban water-ways depend on the scale of the water-way and its scale in comparison to the scale of the city itself. In turn, it strongly influences the river's social role within the city, the degree of integration within the urban fabric of the city, and the degree to which it influences the city's form.

Most importantly, it influences human feelings which they associate to the water-way and the waterfront. Particularly, feelings associated with waterway's width and the ratio between surrounding building's heights and river width in the waterfront spaces. Such as perceptions of "Closeness", "Connectedness", "Closure", and "Freedom" (Kondolf & Pinto, 2016).

For example, in narrow streams, the proximity of the opposite bank makes it relatively easy for people to communicate across the river. In dense urban settings, this sense of intimacy often produces vibrant public spaces on both sides of the river (Kondolf & Pinto, 2016). As the width of the river increases, typologies of social interactions between people on opposite banks also changes; up to 15m, one can still be able to recognize other people or activities on the other bank of the river (Figure).

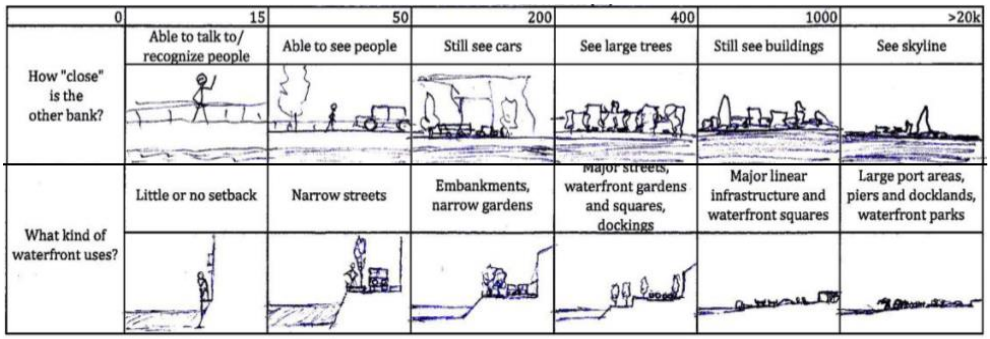


Figure 6: The Relationship between River Width, (in Meters) and Two phenomena; Perceptions of closeness to the other side and Types of Possible Uses. Source: Adopted from (Kondolf & Pinto, 2016).

In rivers that are 50 to 200m wide, people can still be clearly visible, but not distinguishable, the Chicago River and Seine River in Paris are good examples of this case. Yet, being able to observe activities occurring on the other side still gives vibrancy to the space. At greater distances, from about 200m and up, such as the Thames Riverfront in London, people blur, but the motion of vehicles can still be recognizable (Kondolf & Pinto, 2016).

Figure 7: Typologies of social interactions on River Banks according to their Width. A) Cheonggye-cheon stream in Seoul, B) Chicago Riverwalk C) Siene Plage, Paris, D) Thames River, England. Source: (Photo A: (Krieger, 2014))- (Photo B : www.architectmagazine.com)- (Photo C: www.npr.org)- (Photo D: www.greatruns.com).

C. Biophilia Ratio, Biophilic Performances and Settings

Biophilia ratio and biophilic settings are among the most significant aspects that shape people's perceptions of urban water-ways and their environments, including the percentage and quality of green spaces, riparian vegetation, and the waterway's banks composition and conditions.

1) Percentage and Quality of Green Spaces and Riparian Vegetation

As the heading suggests, this aspect is about the percentage and quality of green spaces and vegetation. On the one hand, from an ecological standpoint, the presence of vegetation along riparian areas can act as a buffer between the water-way ecosystem and the surrounding environments (Kenwick et al., 2009). On the other hand, from a socio-cultural standpoint, the presence of vegetation and wildlife can make water-ways corridors seem more “natural” and, thus, more appealing to the public (Gobster & Westphal, 2004). More natural vegetation can be a desirable ecological trait for water-ways. However, given the potential for misaligned perceptions of what is natural versus what is aesthetically pleasing, some studies reveal that the public sometimes perceive excessive vegetation growth to be “untidy” and aesthetically “unappealing” (Gabr, 2004; Hong et al., 2019).

Moreover, studies related to aesthetics and visual preferences of urban waterfronts landscape reveal that in urban settings, people prefer natural sceneries with what is termed “manicured nature” or “maintained nature”. Other studies reveal that natural sceneries with buildings or other facets of urbanization are also more preferred than those with extensive vegetation (Gabr, 2004; Gobster & Westphal, 2004).

2) Water Quality, Configurations and Water Appearance

Water quality is another dimension that could affect human perceptions of water-ways and waterfront spaces, as most recreational activities presuppose good water quality (Low, 2008). With the increased environmental awareness of the 1970s and 1980s and the introduction of new protective laws, water quality is considered as one of the main factors instigating the revival of urban waterfronts around the world (Ansari, 2009).

Wrenn et al. (1983) stated that, "*without clean water, not even the most innovative and appealing projects will succeed in attracting people and activities to the banks of a river or bay*". However, because humans have strong emotional and physical connections to water in the environment, it is only reasonable that they will have strong expectations of that environment that must be related to visible features (West et al., 2016). Vision is also a dominant component of people's perceptions of their environments in general (Zheng et al., 2020).

As such, most literature work on human perceptions of water environments cite "Colour" and "Clarity" as the directly visible attributes that strongly influence human perceptions of water quality (Artell et al., 2013; Flotemersch & Aho, 2021; Smith et al., 1995; West et al., 2016). The colour of water is a dominant feature in the perception of water quality. For example, blue water is considered more aesthetically appealing than brown water (Artell et al., 2013; West et al., 2016). Murky or turbid water is often associated with water pollution, which affects people's perceptions of risk or safety. Similarly, clarity of water is another key factor in discussing perceptions of water environments as it directly relates to the aesthetic qualities of water environments (Ma, 2016).

Personal safety and healthy aquatic environments are the most common issues related to this feature. However, most studies assert that perceived water quality doesn't necessarily correlate to the actual health of aquatic environments (Artell et al., 2013; Smith et al., 1995; West et al., 2016). This means that people's perceptions of water quality are highly tied to their visible perceptions of water and doesn't indicate the ecological conditions of water-ways. Odour is another aspect that affect people's perceptions of water quality. It is one of the most common indicators of pollution. However, people have varying sensitivities to odours (Pitt, 2019).

Another element that affects people's perceptions of water quality is the presence of floating plants, particularly algae. On the one hand, the presence of algae is mostly listed as an indicator of poor water quality. On the other hand, submerged vegetation can have a high aesthetic value (House & Sangster, 1991; West et al., 2016).

3.4.3.1.2 Urban and Spatial Characteristics

In most studies concerning urban waterfronts, the most discussed aspect is the urban character of the waterfront or its adjacent areas (Ansari, 2009). Complexities of urban forms, both physical and functional, in waterfront spaces are incorporated in nearly every policy framework for waterfront development. However, the main focus of these frameworks is often the multi-functionality of waterfront spaces (Bruttomesso, 2001).

Urban continuity is another dimension of spatial characteristics of humans perceptions of waterfront spaces. Alexander et al. (1977) recommended that urban areas adjacent to water-ways or water bodies should be maintained as a common land with considerations of the type of water, the density of the development along it, and the ecological condition of the water body itself. Building on their work, Bruttomesso (2001) argued that the composition of urban waterfronts, as a result of post-industrial activities of urban waterfronts, could be highly fragmented. He suggested that any work on the waterfront should unify those fragments both physically and functionally.

Another aspect of human perceptions of urban waterfronts is the degree of integration with water (Figure 7), which is generally discussed from two perspectives; integration between the waterfront zone and the water body itself, and integration between the city and the waterfront zone (Ansari, 2009), both are discussed on functional and physical basis. The functional side is discussed in the context of land uses and activities, which often overlap with social aspects of human perceptions of urban waterfronts, while the physical side is discussed in the context of accessibility and connectivity (Bruttomesso, 2001). Both sides will be discussed in a later section.

On the interface of waterfront zone -water relations, the highest degree of integration is represented in increasing uses that are either water-dependent or water-related (Ansari, 2009). On the other hand, achieving physical integration between the city and the waterfront zone is apparently hard, particularly when it comes to the continuity of street patterns and the maintenance of building scales (Ansari, 2009).

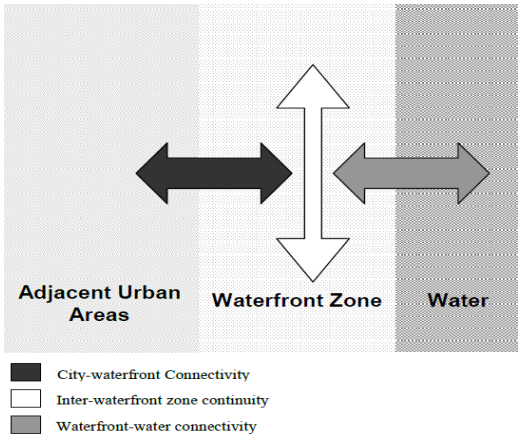


Figure 7:Typologies of Integration with water between urban waterfronts Constituents (Water, Adjacent Urban Areas, and the Transitional Waterfront Zone). Source: (Ansari, 2009).

Krieger (2004) suggests that one way to improve the degree of integration between the city and waterfront is to not visualize the waterfront zone as an edge or a thin line that separates land from water. In accord with this, Fisher (2004) suggests methods to enhance waterfront- city connections, functionally, by creating waterfront spaces that draw people to the water edge and visually by gradually decreasing buildings heights to allow more visual access to the water.

A. Physical Character and Place Identity

Building density, building aesthetics, and building heights also affect people's perceptions of water-ways and their adjacent urban spaces (Kothencz & Blaschke, 2017). Land use is another major factor that contributes to shaping and influencing users' experience and subsequently, affects their perceptions and/or expectations of urban water-ways and waterfronts (Timur, 2013).

Moreover, in most cities around the world, urban waterfronts are characterized by surrounding iconic buildings which, on top of being landmarks for the city, can also act as orientation points to which people associate the waterfront and the water body itself. Other structures such as bridges are also identified as orientation points as well as providing visual access to the water body (Völker & Kistemann, 2013).

Place Identity is another contributor to shaping human perceptions of urban spaces in general and urban water-ways and their environments in particular. As these spaces are inherently significant parts of the urban fabric of cities. Perceptions of Access, or users ability to access is another aspect discussed by Klein et al. (2021) where the authors discussed people's perceptions of access to a particular place in relation to their sense of belonging, association with others, and the activities they engage in while being in this place.

B. Connectivity and Accessibility

In research on urban water-ways, the term "connectivity" is one that comes up frequently. The term is a key concept in theoretical discourses related to city-water relations (Ansari, 2009). Kondolf & Pinto (2016) assert that connectivity can be social or physical, and that it has to do with communication and movement of people, goods, and cultures that it played a significant role in the historical development of urban settlements and cities.

However, the term has very different, sometimes conflicting, connotations in the context. For example, river ecologists and hydrologists use the term as an indicator of the health of riparian ecosystems and as a key to managing landscapes for biological diversity (May, 2006) while urban planners use it to refer to efforts of connecting residents and dwellers of urban areas to their riverfronts. Their main concerns are making the river accessible to people, linking the river visually and conceptually to the city, and providing social and cultural attractions along the riverfront while environmental (Hermida et al., 2019; Kondolf & Pinto, 2016). On the other hand, philosophers talk of connectivity in describing the way humans come to understand their place within their environmental context.

In some ways, these different connotations may overlap, but in others, they come to conflict (May, 2006). Most contemporary design approaches to urban waterfronts connectivity are opposed to the ecological and hydrological notions, because they promote human interactions with the waterfront. Such interactions may disrupt biophysical connectivity along the river and between river and shore, because it depends on crossing the banks with roads and bridges (Dyson & Yocom, 2015; May, 2006).

Since this section of the research is concerned with social dimensions of urban waterfronts, the term connectivity here will refer to aspects of "social connectivity" of urban waterfronts which is concerned with the human interactions between people and urban water-ways in their adjacent urban spaces.

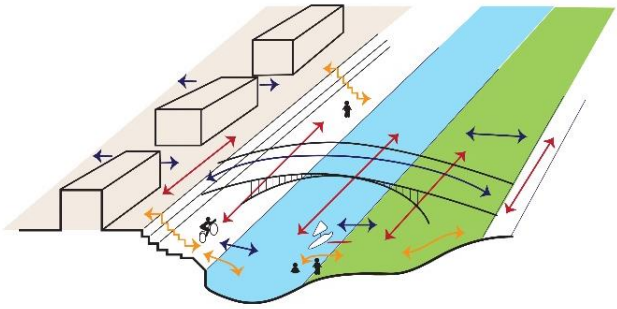


Figure 8: Diagram showing different typologies of connectivity to, along, and across an urban stretch of a river, (Lateral connectivity in blue arrows, vertical connectivity in orange arrows, and longitudinal connectivity in red). Source: author based on (Kondolf & Pinto, 2016).

In urban waterfronts, aspects of lateral, longitudinal and vertical connectivity in social interactions (Figure 8), much as these of hydrological connectivity of water-ways, are indicators of the degree of integration of these places within the urban fabric. Certain urban activities may require a combination of lateral, vertical, and longitudinal connectivity (Kondolf & Pinto, 2016; May, 2006).

Longitudinal connectivity refers to connectivity along the course of the rivers as routes for navigation and transportation of people and goods, which diminished with the industrial revolution whereas lateral connectivity refers to direct physical and visual access between cities and watercourses, which might be hindered by highways, railroads, and bridges while vertical connectivity refers to the vertical dimension of human connectivity with water-ways..

Many uses occur on the top of the bank, such as contemplation, strolling, or cycling along a riverside trail, while others depend on contact with the water itself, such as swimming, diving, or kayaking, all of which presupposes

good quality of water (Kondolf & Pinto, 2016). Therfore, connctivity of urban waterfronts is most often related to aspects of accessibility.

3.4.3.2 Social and Coginitive Aspects of Human perceptions of Water-ways and Waterfronts

This section provides a review of the social aspects that influence people's perceptions of water environments as it is evident that human perceptions of water-ways are influenced by their experiences that in turn are influenced by the cognitive processes that take place in the human mind to recognize their surrounding environments and generate their emotions and feelings about certain landscapes and settings.

3.4.3.2.1 Social Aspects

Gender, age, and education have been shown to influence perceptions of water-ways. On one hand, studies reveal that younger people are more likely to spend their time in outdoor spaces than elderly people, whereas elderly people prefer to spend it indoors. Moreover, young people who visit water environments are more likely to engage in passive activities, such as dining, walking/ strolling, and cycling, as well as active ones, such as water sports[1]. On the other hand, elderly people who visit the waterfront are likely to engage in more passive activities that require sitting and/ or observing the waterway (West et al., 2016).

Gender is also a key factor in the perceptions and use of urban water-ways. For example, concerns about personal safety for women is paramount as they highly affect women's use and perceptions of such places (Flotemersch & Aho, 2021). Narratives of places or people's interpretations of places is another aspect cited as a contributor to people` perceptions and

[1] Passive and active activities in waterfronts, within this context, are categorized based on the degree of interactions with water. For example, activities such as walking, cycling, and dinning are considered passive activities as they don`t necessarily require direct interaction with the water. Whereas activities such as canoeing, kayaking, and other water sports are considered active ones.

use of specific spaces. These interpretations are influenced by both personal experiences and socio-cultural constructs (Klein et al., 2021).

Frequency of use and familiarity with the water-way also affects perceptions of water-ways and their environments (Pitt, 2019). Place-based knowledge (i.e., social and cultural factors) was also reported as contributing to perceptions of urban water-ways and their adjacent urban spaces. Place-based knowledge generally refers to one's experience with a place's history, environment, and culture.

3.4.3.2.2 Sensory Experience

The final dimension of how humans perceive and experience waterfront spaces is Sensory Experience. People experience water environments in multiple ways. For example, the surface of the water, when calm or stagnant, has an extraordinary reflective capacity, this mirror effect of calm water gives life to not only the buildings reflected on its surface but also to the whole space while the vibrancy effect of moving water gives a sense of motion, animism, and ultimately life (Figure 9). Other biophilic qualities include sensory stimulation of the five senses, people can directly see the water, be able to touch it, if direct physical access is allowed, hear the sounds of moving water, smell it, or just breathe in the cool air over the water surface (Dutta & Sarkar, 2020; Timur, 2013; Völker & Kistemann, 2011, 2013).

Figure 9: Right: The Mirror Effect of Calm Water, Left: The Vibrancy effect of Running Water. Source: (Timur, 2013).

Similarly, sounds of the water crashing against stones, the wind or aquatic birds give sense and significance to space and allow users to effectively identify the waterfront's environment and convert them from a visual experience into a cognitive landscape recognition process with

familiarity (White et al., 2010). Therefore, the sensorial experience of the waterfronts is not complete without the human perception of its identifying elements. Hence, encouraging multisensory experiences of waterfronts spaces helps educate people about the heritage and cultural value of the area as well as the ecological value of these natural spaces, through deeply connecting them with the waterfront (Faggi et al., 2013; Nayan et al., 2020; White et al., 2010).

3.5 Biophilic Elements, Attributes, and Indicators in Urban Water-ways and Waterfronts

As discussed previously, aspects of human well-being in urban waterfronts prove to include the experience of Nature (Völker & Kistemann, 2011, 2013; Yocom et al., 2016) as well as other more common targeted development aspects, such as recreation, social cohesion, and economic vitality. The research recognizes that while Nature is everywhere, not all aspects of it are beneficial or attractive. Therefore, the research focus on aspects of utilizing urban water-ways, and consequently urban waterfronts, to enhance human health and overall well-being. Within this context, to serve the main purpose of the research, an evaluation criterion of biophilic indicators in urban waterfronts was developed to guide analysis of selected case studies in analytical and empirical parts.

The selection of the final study indicators was based on feasibility of measurement and relevance within the waterfront context, within “Biophilic Design and Urbanism” patterns and under their principles. For example, some items were excluded due to their focus on building scale more than city scale or because they were variations on other more suitable items. Other items that apply across scales were included with a description of each indicator with considerations to its relevancy within the research context. The chosen items were then categorized under the guidelines and principles for the approach of “Biophilic Urbanism”.

Table 4: Biophilic Attributes and Indicators in Urban Waterways and Waterfronts. Source: Author.

Element		Atrribute	Indicator
Physical Aspects	Biophilia Ratio, Biophilic Performances and Settings.	- Biophilic Infrastructure and Management.	- *Number and percentage of Green spaces, with consideration to its quality, conditions, and public access to these spaces.* - *Vegetation along riparian areas, local flora, fauna.* - *Water quality, water configurations, and water appearances.*
		- Biomorphic shapes and patterns.	- *Biomorphic shapes and forms inspired from Nature.* - *Using Natural Materials.*
		- Performances that celebrate Nature.	- *Festivals, sports, and activities that celebrate proximity to water.*
Social/ Coginitive Aspects	Sensory Experience	- Planning and design for built environments that invoke sensory stimuli based on human evolutionary adaptations to the natural environment.	- *Prospect and Refuge: offering a secure and protected setting and the capacity to discern distant objects and habitats and horizons.* - *Enticement and Mystery: Enticement fosters curiosity which reflects the human need for exploration, discovery, and creativit. The diversity in the physical design to create the opportunity to observe the different things.* - *Mental peace and security: personal safety within the waterfront.* - *Thermal comfort and airflow: People seek both physical and psychological comfort (e.g. shade and exposure to the sun, a breath of fresh air, shelter from elements).* - *Security and safety in the waterfront.*
		- Enhance Experience of Nature.	
		- Place -Based Knowledge.	- *Evironmental. Historical, and Cultural Literacy on the waterfront.*
Physical Aspects	Connectivity and Accessibility	- Social (Logtiudinal, lateral, and vertical connectivity).	- *Traffic and Pedestrian volumes on waterfront.* - *Physical, visual and material access to water.*
		Navigation and wayfinding.	- Signages and wayfinding infrastructure.
		Transportation and Accessibility.	- *Number of transportation modes available in the area.* - *Inclusive access to diverse user groups.*
		Land uses and Physical Character.	- *The number of water-dependent and related activities compared to non-dependent water activities.*
		Emotional, Cultural, ecological and historical attachments to place.	- *The Number of Cultural and historical facilities on the waterfront.* - *Unique place Identity.*

Conclusion

The quest for sustainability has been a global one for years and will continue to be for many to come. As presented in this chapter, mounting evidence suggests that achieving long-term sustainability isn't possible without fostering human- Nature connections and establishing strong attachments for the ecology, culture and history of places to guide stewardship for the environment.

This chapter presented an overview of typologies, scales and elements of biophilic urbanism and laid the foundation for the evaluation criteria of selected case studies in the upcoming analytical and empirical parts with an emphasis on urban water-ways as natural features. In this regard, the next part will provide a series of case studies analyzed and evaluated according to the evaluation criteria set in this chapter under the main themes presented previously; Biophilia ratio and Biophilic performances and settings, Sensory Experience, Connectivity and accessibility, and Physical character and place identity. The main purpose of presenting these studies is to explore biophilic indicators in urban development projects related to water-ways (Urban Waterfront Development) and to develop a set evaluation criterion to guide the analytical study of Cairo's central area Waterfront in Egypt.

PART 2: ANALYTICAL PART

CHAPTER 4: Adopting Biophilic Urbanism in Urban Water-ways Projects

Introduction

Recognizing the strategic value of urban water-ways and with mounting scientific evidence supporting the idea that urban water-ways are positive amenities for urban quality of life, cities are seeking new ways to harness potential benefits that inland water-ways can provide for their residents and dwellers (Beatley, 2011; Timur, 2013).

Based on literature work explored in the first part of this study, The degree of integration of urban water-ways within the urban fabric of their cities is an indicator of their role within their respective immediate surroundings, communities and ultimately cities. They give an insight into the values and meanings people hold for these water bodies, whether they perceive them as places of refuge, a part of their history, or a mean for generating economic prosperity. It also shows how willing the people are to advocate for these natural elements within their communities.

Within this context, this chapter sets out to illustrate the adaptation of biophilic urbanism metrics and principles in development projects related to urban water-ways and/or urban waterfronts. A number of international cases are selected, reviewed, and analysed in depth, using Biophilic indices to investigate planning, designing and implementation processes of these projects, evaluate the outcomes and impacts of such projects compared to their original set goals, and finally pinpoint key points that contributed to the success of these projects. The purpose of this chapter is to explore biophilic indicators in these widely model urban water-ways development projects and to use these indices as an evaluation criterion in the following part (Empirical part) for the Nile Waterfront in selected study area in Egypt.

4.1 Criteria for Selection of Case Studies and Methods of Data Collection

Since the approach of "Biophilic Urbanism" is relatively new, its application is yet to be mainstreamed. However, the potential benefits derived from the application of this approach are increasingly being recognized by global cities. For the purpose of this research, the basic premise of the selection of case studies was presenting international case studies demonstrating the application of biophilic urbanism in relation to integration

of water-ways as urban Nature in the built environment with emphasis on the impacts of such projects rather than the scale/ typology of the water-way itself.

Within this context, the set criteria for the selection of case studies was primarily presenting pilot projects and bench-marking case-studies for the application of biophilic urbanism in urban development projects along urban water-ways in which the development of the water-way was a catalyst for urban transformation of selected case studies. Descriptive, analytical and comparative methods were applied where selected case studies are qualitatively described, reviewed, and evaluated using ecological, social and functional/physical characteristics under the guidelines and principles of biophilic urbanism according to a set of factors listed as the following:

1. Different typologies of urban water-ways with different scales in comparison to the scale of the city itself.
2. The proximity of the selected case study location to the CBD area of a global city, as these sites are often subjected to heavy urban development projects with compact urban densities.
3. Selected case studies to be within global cities with compact urban area and high population density, different geographical locations and country classification of selected cities were also taken into consideration.
4. Availability of references and information resources. For this purpose, only completed large-scale urban development projects in relation to urban water-ways were considered in this study.

Methods of Data collection included a literature review. Data sources included a review of documents and reports produced by international organizations (e.g., World Bank Group, GIZ), governmental agencies and authorities involved in each case, and research institutions available on the internet. Satellite images produced by Google Earth were also utilized when needed. The data was then reviewed and analyzed using ecological, social, and functional/physical characteristics.

4.2 Cheonggye-cheon River Restoration, Seoul, South Korea

4.2.1 Context and Background

Seoul is one of the world's largest cities and is home to more than 10 million residents, which accounts for almost one-fifth of the country's population (Lee & Anderson, 2014). In 1932, The Joseon Dynasty (Modern day South Korea) was established with Hanyang (the current CBD area of Seoul) as its capital and in the middle of it flowed Cheonggye-cheon from west to east with a total length of 10.9 Km (Kim & Han, 2012; Ryu & Kwon, 2016). However, after the Korean War, the river turned to a sewage disposal site with the establishment of a massive refugee camp along its banks (Jung & Yi, 2017; Kang & Cervero, 2009).

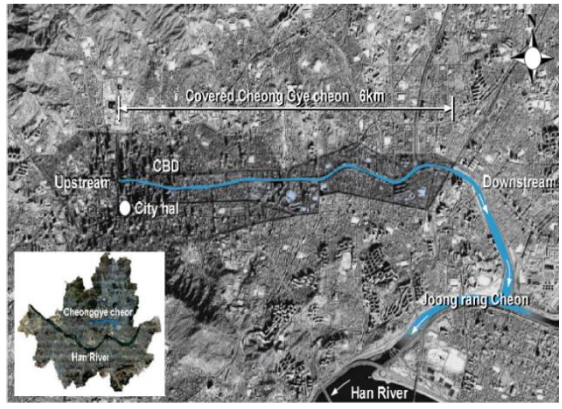


Figure 10: Cheonggye Cheon Stream in the heart of Seoul`s CBD Area.
Source: (Lee, 2006).

In the late 1950s, Seoul Metropolitan Government (SMG) was facing more persistent problems due to the rapidly increasing population of Seoul, including traffic congestion, which eventually led to a complete coverage of the river with a 6 km long road and then by a 16m wide elevated expressway that served as the main artery for transportation and logistics in downtown Seoul with more than 170,000 vehicles running the Cheongyecheon elevated expressway on a daily basis (GIZ, 2011; World Bank, 2015a).

Figure 11: Left: Refugee Camps and Shanty houses along Cheonggye-cheon in 1965. Right: Cheonggye-cheon Elevated Highway Under Construction in 1968. Source: (GIZ, 2011).

In 1992, a study conducted by The Korean Society of Civil Engineering revealed that more than 20% of the highway structures were deteriorated and a serious repair work was in need (Cervero, 2010). During the same time period, the decline in the downtown area of Seoul was gaining more public attention. With the city in a stage of transition, shifting from an industrialized city to a post- or neo-developmental city, environmental and cultural issues were the main priorities of the national urban agenda (World Bank, 2015a).

Therefore, in 2003, the Seoul Metropolitan Government (SMG) decided to bring back the buried river to life and reclaim its historical position for the first time in 47 years. The project symbolized a paradigm shift in national urban development approaches from development oriented to environment oriented where Nature and people can coexist (Hwang, 2005; Jeon & Kang, 2019).

Before the restoration of the river, the downtown area in Seoul was continuously changing. The economic shift of the country was affecting the economic development of the downtown area. However, any plans for the development of the CBD area was faced by the challenges of the existing expressway (World Bank, 2015a). Within this context, the main objectives if the restoration of Cheonggye Cheon were; restoring the environment, preserving cultural heritage, balancing economic growth within the city, and enhancing safety (Hwang, 2005; Kim, 2017; Lee, 2006).

4.2.2 Planning Process, Scoping, Governance, and Implementation

In the late 1990s, the idea of Cheong Gye Cheon Restoration was first initiated by academic scholars and environmental activists. However, it was deemed as too ambitious and beyond the Seoul's local government (Byun et al., 2016; World Bank, 2015a). In the 2000s, the idea of Cheong-gye-Cheon restoration was materialized when, then-mayoral candidate Lee Myung-bak and later appointed seventh president of South Korea, pledged the restoration of the river as his political campaign's main priority (Lee, 2006; Lim, Kim, Potter, & Bae, 2013).

To facilitate the restoration plans, Seoul Metropolitan Government (SMG) formed a collaborative network of citizens, experts, and interested parties to ensure effective management of construction and conflict resolution. It consisted of the Cheonggye-cheon Restoration Project Headquarters, which was in charge of project execution and implementation, The Cheonggye-cheon Citizens Committee, which served as the review board, gathered public opinion and promoted the project, and The Cheonggye-cheon Research Group, which was responsible for research and establishing a comprehensive plan for the project (Byun et al., 2016; Jung & Yi, 2017; Kim, 2017).

4.2.3 Key findings: Biophilic Indicators in Cheonggye-cheon

The main goal of the project was to restore Cheonggye-cheon as a human-environmental friendly space with a waterfront and promenades along the banks of the natural stream in the heart of the heavily urbanized and deteriorated CBD (Hwang, 2005). There were 3 major axes to confer diversity on the restored areas (Figure 12); Zone A (History-Urban), Zone B (Urban-Nature), and Zone C (Nature), starting from Upstream to Downstream respectively (Jung & Yi, 2017; Kim, 2017).

Based on the design concept of the restored river, it can be safely said that the project reflected the innate human need for nature and simultaneously the need for sustaining healthy ecosystems within a dense urban built environment**.** The following section highlight key findings regarding adopting "Biophilic Urbanism" guidelines and the previously set evaluation criterion

in the restoration of Cheonggye-cheon River and subsequently in urban regeneration of the Seoul's central area, drawing from the case study description presented above**.**

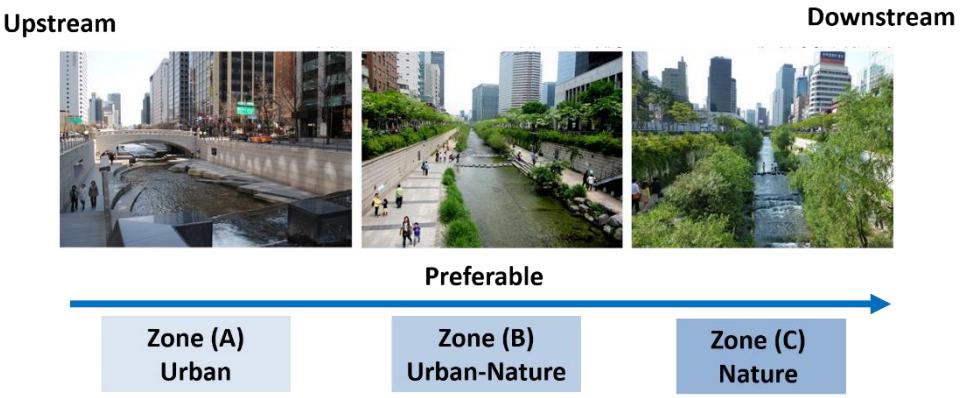


Figure 12: The Three Zones of the Restored Cheonggye Cheon. Left: Urban Zone, Middle: Urban-Nature Zone, Right: Nature Zone. Source: (Jung & Yi, 2017) with modifications by Author.

4.2.3.1 Biophilia Ratio, Biophilic Performances and Settings

The transformation of Cheonggye-cheon to a linear park with green spaces and vegetation set a prime example of utilization of natural features as a response mechanism to urban challenges, especially in a very dense urban area such as the CBD area. Some of the biophilic performances that occur in the space include observing flora and fauna, ecosystem classes, and paddling in water (Lee, Lee, Choi, Yoon, & Hart, 2014).

Figure 13: Public Access to the restored Cheonggycheon in multiple design inteventions Source: (Krieger, 2017).

4.2.3.2 Sensory Experience

Water proximity, visual and physical access to Nature, number of water touch points, and vegetation and green areas along the restored river indicate a high level of experience of nature. This is manifested in increased number of visitors, local residents and dwellers as well as foreigners, to the area. Another indicator is the high visitor satisfaction levels, according to a survey conducted by Seoul Metropolitan Government (Amirtahmasebi et al., 2013).

One of the significant benefits of the Cheonggye-cheon restoration was increasing citizens' awareness of the value of natural environment according to a survey conducted by Seoul Metropolitan Government confirming that the citizens of Seoul placed a higher value on the natural environment after experiencing the restored Cheonggye-cheon (Seoul Development Institute, 2014).

Figure 14: Water Proximity and Physical and Visual Access to the Restored River. Source: (Krieger, 2017).

4.2.3.3 Connectivity and Accessibility

Floating population in the Cheonggye-cheon area recorded a significant increase on weekdays and weekends, indicating that citizens visit the stream often in their daily life (World Bank, 2015a). In terms of ecological connectivity, the restored ecosystem of the river witnessed an increase in overall biodiversity (Figure 15). Decreased (UHI), decreased noise and air pollution is also a significant indicator of improvement in environmental qualities in the area. The design also encourages using natural materials (Figure 16) like natural stones that bridge both banks and within the river

course to provide pedestrian bridges, provide habitat for birds and aquatic life, and, regulate water speed (Amirtahmasebi et al., 2013).

Figure 15: Vegetation and Green areas on Both Banks of the River.
Source: www.landscapeperformance.org

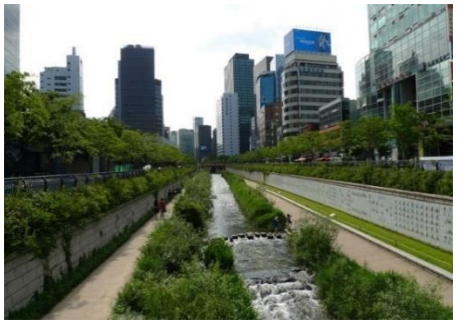


Figure 16: Natural Stones in Areas of slower or still water to support bidiversity an aquatic life.
Source: www.landscapeperformance.org

In parallel with the restoration project, Seoul government invested in renovating its public transport system as a part of its shift towards a mass transit-oriented policy. The improvements included integration of bus system and metro-rail system through physical routes and fare system integration (GIZ, 2011). Pedestrian access was also improved with the demolition of the expressway and narrowing down the width of the road. Pedestrian pathways and walkways along the river were increased, including around 22 vehicular and pedestrian bridges constructed or relocated to improve accessibility (Kang & Cervero, 2009).

4.2.3.4 Physical Character and Place Identity

The most striking change in land use was that of demolishing the expressway to uncover the river and create a new green space in the heart of the city's historical CBD area (Amirtahmasebi et al., 2013). Prior to the demolition of the expressway, the areas on both sides of it were occupied by a wide road flanked by private owned land plots and buildings, this represented an obstacle as bigger width was needed to create space for the stream flow, pedestrian walkways and to ensure flood control safety standards.

To ensure sufficient width, the city had to buy the land from the owners of private properties in the vicinity. The Seoul Municipality horizontally secured public space while allowing more vertical developments (Seoul Development Institute, 2014). With the completion of the project, changes in land use were most notable in land plot uses; new building's construction, renovating of existing buildings and an increase in redevelopment projects permits that were laid dormant in the years prior to the restoration project (Lim et al., 2013).

Figure 17: Cheonggye Cheon Before and After Restoration. Left: Before July 2003; Right: After October 2005: Source: (Kim & Han, 2012).

With the objective of a balance between preservation of the past and accommodating new land uses in mind, the Seoul Municipality set a principle to preserve all the heritage items excavated during the construction (Amirtahmasebi et al., 2013). A 600 years old Korean artefacts were excavated with the river, historical bridges were restored into their original state and location when available. The restored river now witnesses cultural events such as the lotus lantern festival, the Cheonggye-cheon festival, public artwork and marathons (Beatley, 2011; Cervero, 2010; Timur, 2013; World Bank, 2015a).

The Seoul Government also constructed cultural and historical facilities such as the Cheonggye-cheon Museum and The Cheonggye-cheon Shack Experience Center to document the history of the stream and its area, enhance people's experience of the new open green space in the city's central area and foster cultural and emotional attachments to the place.(Seoul Development Institute, 2014).

Figure 18: Cultural Events on the Restored River. Source: (Seoul Metropolitan Government, 2009; Timur, 2013).

4.3 Singapore River, Singapore

4.3.1 Context and Background

In 1819, the city-state of Singapore was established as a trading post for the British Empire. It has a total land area of 716.2 Km2 and is located on the southern tip of the Malay Peninsula, with a population of 5.4 million people. Since its independence, the city has been in a state of constant transformation in its quest to be a global city (Chang et al., 2004).

The Singapore River, located strategically within Singapore's historical central area (The Golden Shoe District) was at that time the focal point of a flourishing centre for trade and commerce. Ultimately, the river centrality for Singapore's trade resulted in the degeneration of its physical conditions. The River was choked with trading bumboats that polluted the water and was used for waste disposal (Amirtahmasebi et al., 2013; Chan & Kiang, 2004).

Figure 19: Singapore River in the mid-1990s. Source: (Chan & Kiang, 2004).

Figure 20: Singapore River in 1800s. Source: https://www.straitstimes.com.

In the 1970s, began the 10 years state-led ecological clean-up of Singapore River to be redeveloped as the new ecological and economic face of Singapore. The ecological clean-up was a result of environmental concerns and the government's interests in shifting the role of the river from a working river to that of a recreational waterfront (Chang & Huang, 2005; Jingyao, 2010). It also involved resettlement of about 26,000 families into public housing and relocation of small industries and backyard trades (World Bank, 2015b).

In 1985, with these objectives in mind, the government, namely, The Urban Redevelopment Authority (URA) embarked on developing a plan for conservation and revitalization of the Singapore River district, the development plans involved the clearing of vacant and dilapidated buildings in several areas and construction of additional infrastructure such as new river walls, roads, bridges, and pedestrian promenades on both banks of the river also had to be planned and constructed to support new developments (Amirtahmasebi et al., 2013; Low, 2008).

4.3.2 Planning Process, Scoping, Governance, and Implementation

In 1994, The Singapore River Concept Plan identified and divided the area into Three distinctive development subzones; Boat Quay, Clarke Quay and Robertson Quay (Figure 21), based on the historical and architectural background of each zone (Chan & Kiang, 2004). The main imperative objectives of the development plan were to make the river an exciting water

edge corridor, capitalizing on the waterfront resources and to conserve the unique historical characters of the area (Low, 2008).

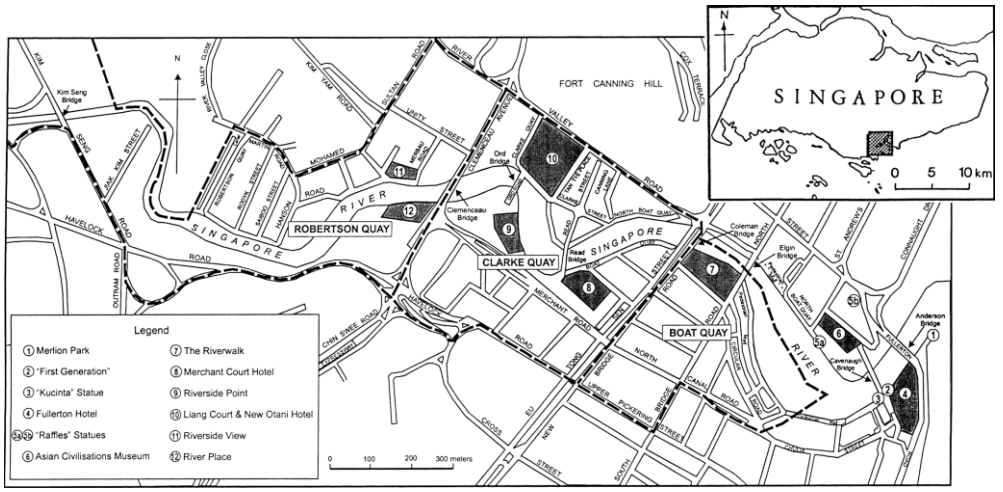


Figure 21: Singapore River and its Three Subzones of Development.
Source: (Chang et al., 2004).

Urban planning and design guidelines were stipulated by the URA to regulate development of these distinctive waterfront zones while aiming for preservation of historic fabric around each zone, integrated conservation and establishing appropriate activities along the river banks. (Low, 2008). By 1999, a 15-meter-wide continuous riverfront promenade connecting the three zones was completed, three new pedestrian bridges have been implemented along the river as well as restoration of historic bridges (World Bank, 2015b).

Urban Redevelopment Authority (URA) had the key role in the planning and implementation processes during all phases of the project. This role entailed detailed coordination with a number of public and private sector stakeholders in all processes, such as deciding which trees to be planted on the promenade and in what number (Low, 2008). Prior to the publishing of development plans in1994, a public exhibition was held to collect public views regarding the development plans and was also actively engaging the private sector through public exhibitions and consultations. The Government Land Sales Programme was a key planning mechanism that allowed for the structural redevelopment of inner-city precincts and unlocked the real estate development potential it represented (Amirtahmasebi et al., 2013; Low, 2008).

In this sense, the development of Singapore river was the fruit of public and private collaboration with the government demonstrating its commitment to urban revitalization through extensive upfront investment in infrastructures. This effort was followed by publicity and consultations with the people and the private sector. This collaborative approach helped the government realize the vision laid out for the Singapore River waterfront as "an exciting activity corridor that capitalizes on the river frontage and reflects the unique historical character of the area" (Amirtahmasebi et al., 2013).

4.3.3 Key findings: Biophilic Indicators in Singapore River

The development project for Singapore river, initiated and led by the government, transformed the river from a polluted water-way to a green and clean landscape (Figure 22), created an appropriate environment to generate economic development as well as a place for people's leisure and recreation.

Figure 22: Singapore River before and after Regeneration. Source: (Wang, 2010).

4.3.3.1 Biophilia Ratio, Biophilic Performances and Settings

Environmentally, the improvements following the ecological clean-up were of great importance. Aquatic life has returned to the river and the river now hosts various water-based activities such as rowing events and festivals (Yuen, 2013). Moreover, to offer variety, and also a unique sense of place for each zone of the River, Urban Redevelopment Authority (URA) encouraged private developers to landscape the stretches of promenade fronting their developments, according to pre-stipulated design guidelines (Jingyao, 2010).

Furthermore, URA has introduced a series of giant environmental mitigation mechanisms that imitate natural elements “lilypads”, “blue bells”, and “angels” to help cool the streets, maximize the waterfront experience and create a private zone for diners. Although installation of these features didn’t go without criticism of being insensitive to local historical identity of the waterfront, they definitely add a unique sense of place for the waterfront (Chang & Huang, 2011; Jingyao, 2010; Low, 2008).

Figure 23: Giant Lilypads on Singapore River in Daytime and Night time.
Source: www.singaporeguidebook.com.

4.3.3.2 Sensory Experience

To help improve people’s experience of waterfront in Singapore river, Urban Redevelopment Authority collaborated with Singapore Tourism Board (STB) and the National Heritage Board to encourage the installation of public art in outdoor public areas (Low, 2008). Such popular sculpture installations as those of the People of the River, Kucinta Cats (A type of Native cats found in Singapore), River Merchants, and the Boys Jumping into the River (Figure 24) lend a sense of identity to different nodes on the riverfront and emphasize local identity of th city (Chang et al., 2004).

The river sculptures serve as tourist attractions and educational sources for local students. Through such interactions with arts, new “Practice of Memories” will be created, thus deepening place meanings and attachments for people (Chang & Huang, 2005). The private sector is also actively involved in various schemes ranging from “Arts-Experience” at Riverside Point in Boat Quay to weekend flea markets and traditional Chinese operas at Clarke Quay (Chang & Huang, 2005).

Moreover, URA collaborates with the Singapore Tourism Board to coordinate the provision of night lighting along the Singapore River's banks. These guidelines help enhance the overall harmony of the river promenades and improve users experience of the waterfront.

Figure 24: Examples of Public Art and Sculptures on Singapore River Waterfront.
Source: www.publicarttrust.sg.

In addition, other uses such as festivals and large-scale signature events are encouraged to develop a sense of identity for the Riverfront and enhance the waterfront ambience (Chang & Huang, 2005; Jingyao, 2010; Low, 2008). The river waterfront is also home to important cultural institutions; the Asian Civilizations Museum (at Boat Quay), the Singapore Repertory Theatre (at Robertson Quay), the Victoria Theatre and Concert Hall adjacent to the museum, and the Esplanade Theatres on the Bay (Chang & Huang, 2005). The presence of these cultural and historical facilities increase historical and cultural literacy of the riverfront and place attachments.

4.3.3.3 Connectivity and Accessibility

Spatially, a good part of the enhanced pedestrian flow is attributed to improved longitudinal and lateral connectivity because of the continuous riverside promenade. Since its completion in 1999, people can now walk along the river's full length without interruption and cross the river at intervals of about 270 meters. Although, the river's longitudinal connectivity as transportation route was sacrificed in favour of transforming the river into a public space for leisure and recreation (Low, 2008). In addition, pedestrian and vehicular access, both along and across the River, were also enhanced. River boat landing points were constructed as the Singapore River's historic river walls were reinforced and restored (Amirtahmasebi et al., 2013). Moreover, an Underground Pedestrian Network plan was implemented to support the on-ground pedestrian network and provide a direct connection to Rapid Transit System Stations (URA, 2019).

4.3.3.4 Physical Character and Place Identity

Transformations in land use were primarily in form of relocation of small industries and families to capitalize on the area adjacent to the river. The emphasis was on the mix of developments, with 20% residential development and 80% commercial use. To ensure activities by the riverfront, the government, led by (URA) imposes restrictions which only allows commercial use at the ground level (Jingyao, 2010). The 1994 development plan identified three subzones for development, each with distinctive development theme (Yuen, 2013).

Table 5: Singapore River Planning Area and its Three Subzones development Source:(Yuen, 2013).

Sub Zone	Thematic development
Boat Quay	Commercial entertainment district with riverside entertainment area, outdoor cafes, historic views, tree-lined promenades.
Clarke Quay	Riverside festival village of conserved shophouses and new developments offering traditional food and crafts, river rides, fringe theatre, eating houses.
Robertson Quay	Residential district with new condominiums, service apartments and hotels located amidst historic warehouses

The redevelopment of the Singapore River has introduced many new activities to the waterfront, inevitably affecting the way in which people relate to it and where new place meanings are created through a strategic reworking of activities and memories associated with the site (Chang & Huang, 2011).

However, recent studies of the case of Singapore River's development had revealed that the waterfront development had rendered certain activities, people and memories of places invisible, replaced by other landscape elements and their associative, distinctive yet foreign identities (Chang & Huang, 2005, 2011). In terms of buildings` heights, buildings fronting the promenade were allowed a maximum height of only four stories, while these set back from the water were allowed to be as high as 10 stories. (URA, 2019).

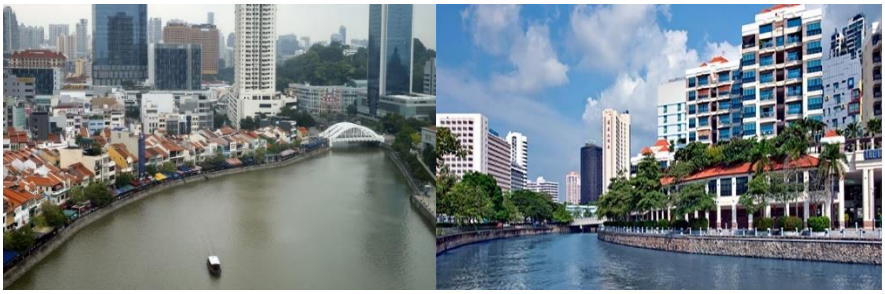


Figure 25: Buildings heights guidelines stipulated to ensure visual access to the River. Source: https://www.newlaunchonline.com.sg. Retrieved January 09, 2020.

Land sales for new residential and commercial developments were also launched as catalysts to seed developments along different parts of the river. In order to ensure successful sales and subsequent development of sites, the URA incorporated feedback through consultations with the private sector (Amirtahmasebi et al., 2013; World Bank, 2015b).

4.4 Chicago River-Walk, Chicago, USA

4.4.1 Context and Background

In many ways, the main branch of the Chicago River has a long history that mirrors the development of the city of Chicago itself. As early as the 1600s the river was a major trade route (Chesla, 2017). Later, during the early 1900s, the working waterfront along the Chicago River was heavily focused on industry and commerce. With the disappearance of factories and industrial facilities, the public started demanding the riverfront to be reclaimed as a recreational amenity for the city's residents and visitors (Blair, 2015; City of Chicago, 2018).

Although the idea of a Riverwalk was included in Burnham's 1909 Plan of Chicago which included proposals for a multi-level roadway along the river as well as a river promenade. Given the river's high levels of pollution, embracing the river for recreation seemed impossible (City of Chicago, 2018).

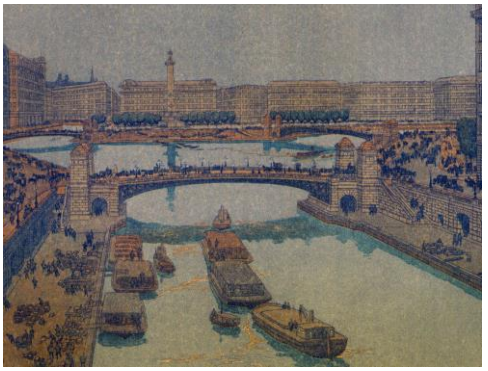


Figure 27: Burnham's proposal for Riverwalk in his1909 Plan of Chicago. Source: (Chesla, 2017).

Figure 26: Wacker Drive, a multi-level roadway constructed along the Chicago River in the 1920s. Source: (Chesla, 2017).

Although the area has been referred to as the Riverwalk for many years, the path was interrupted by each crossing street, people had to cross to the other section and descend to the lower-level along the river via stairs located adjacent to bridge infrastructure, thus rendering the river inaccessible to certain user groups (i.e., people with disabilities and elderly people)(Blair, 2015; Chesla, 2017).

4.4.2 Planning Process, Scoping, Governance, and Implementation

Four groups of objectives were identified; economic, cultural, recreational, and ecological. The economic objectives were focused on the ability of the Riverwalk to generate revenues. The cultural objectives were intended to bring people together. The recreational objectives were focused on giving users different ways to enjoy the river, while the ecological objectives were intended to improve the health of the ecosystem and minimize the detrimental aspects of construction (Hellenthal & Gross, 2016).

Located in the heart of downtown Chicago, the Riverwalk is composed of six blocks, each defined by bridges at either end. In order to establish new connections to the river and enrich people's life, each block was designed to provide diverse programs through changes in shape and form (Chesla, 2017).

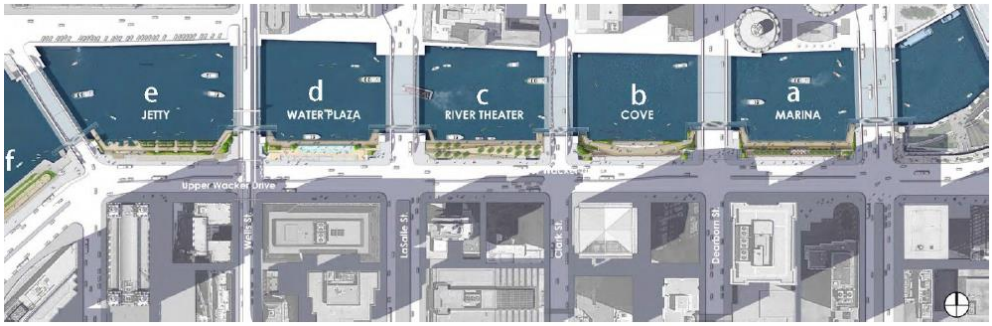


Figure 28: The Six blocks of Chicago Riverwalk. Source: (Hsieh et al., 2018).

The Marina Plaza: It consists of restaurants and outdoor seating areas to provide views of vibrant life on the river.

The Cove: It is the intermediate zone between land and water with concrete benches and beach grasses. It provides physical connections to the water through Kayak rentals and boat dockings.

The River Theater: A block-side amphitheater-like staircase linking Upper Wacker and the Riverwalk with an accessibility ramp.

The Water Plaza: It is a space of water feature as splash pad for children and families to engage with water at the river's edge.

The Jetty: It contains terraces and floating wetlands. It offers opportunities for interactive learning about the ecology of the river, including fishing and identifying native plants**.**

The Boardwalk: It is an accessible walkway access to Lake Street.

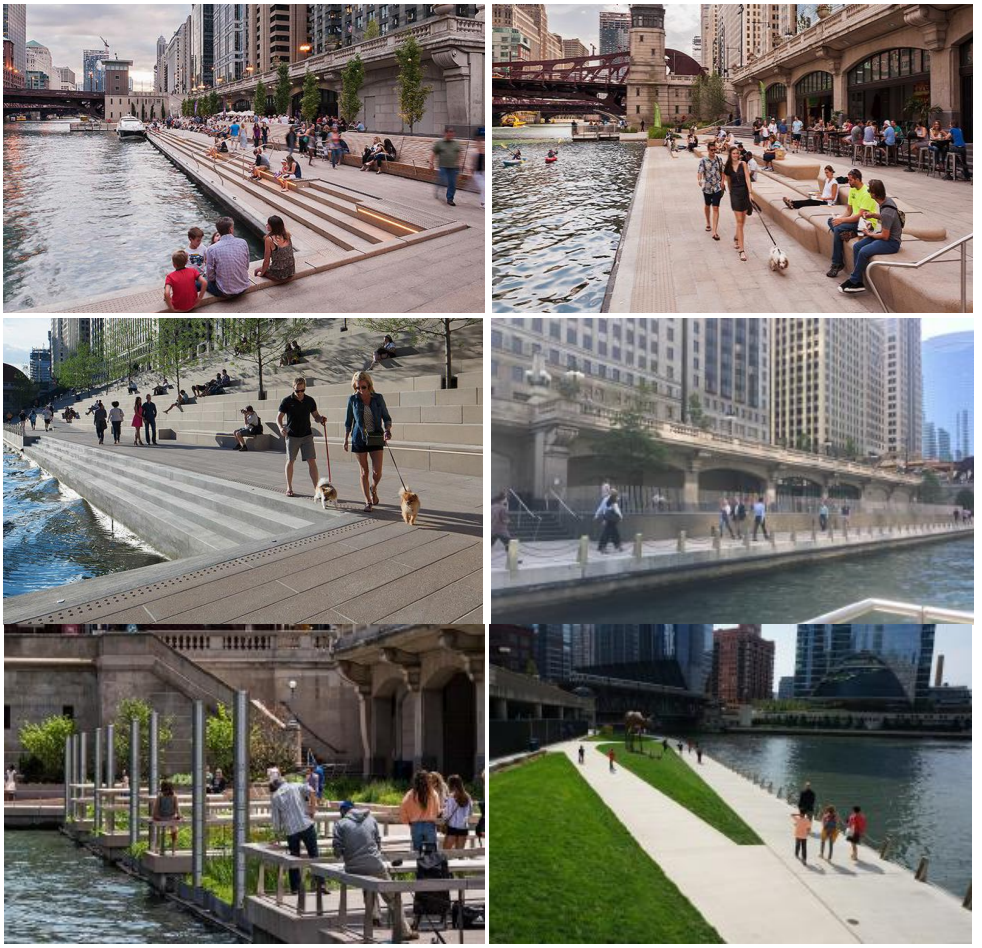


Figure 29: The Six blocks of Chicago Riverwalk, from Top left to Bottom right; The Marina Plaza, The Cove, The River Theater, The Water Plaza, The Jetty, and The Boardwalk. Source: (Hsieh et al., 2018).

4.4.3 Key findings: Biophilic Indicators in Chicago Riverwalk

The goal of the project was to provide an area for Chicago's residents and dwellers to connect with nature in the heart of the city and to reclaim the Chicago River for the ecological, recreational, and economic benefit of the city. The Chicago Riverwalk represents a transformation of a series of barren concrete arcades along the Chicago River into a series of vibrant waterfront public spaces (Chicago Department of Zoning and Planning & Chicago Department of Transportation, 2009).

4.4.3.1 Biophilia Ratio, Biophilic Performances and Settings

For example, The Jetty fosters interactions with the river and the floating wetlands and supports activities like fishing and observing ecological processes and water movement. The area is provided with etched markings on stainless steel pylons to visually indicate the water level for visitors. The floating wetlands provide shelter for fish from river currents and boat activity, they are designed to improve water quality and provide aquatic habitat. Further, the design had to account for the river's annual flood dynamics of nearly seven vertical feet (Hanson et al., 2019; Hsieh et al., 2018).

Figure 30: People observing floating wetlands and water levels. Source: (Hanson et al., 2019)

4.4.3.2 Sensory Experience

The distinct programs and forms of each typological space allow for diverse experiences on the river. The Riverwalk offer a variety of water dependent and water-related activities such as kayaking, canoeing, boat dockings, and observing water levels and water movement as well as other

recreational activities like relaxing, strolling, and dining, thus improving people's experience of the waterfront (Chesla, 2017).

Figure 31: Different typologies of activities possible on the Chicago riverwalk. Source: www.choosechicago.com.

Moreover, to give users a feeling of being closer to nature and to allow water to flow behind the under-bridges, steel gratings that span from the under-bridges to the adjacent rooms at each end have been installed. At the same time, design materials, details, and repeated forms provide visual cohesion along the entire length of the project, including paving materials and lighting solutions (Hanson et al., 2019).

4.4.3.3 Connectivity and Accessibility

The Riverwalk provides an uninterrupted continuous path for the city's residents and dwellers. The number of access points, water taxis and boat operations were increased. Moreover, a series of vertical access improvements comprised of universally accessible ramps and elevators were implemented to provide access to all people, and to improve the function and commercial viability of the Riverwalk (Chesla, 2017).

4.4.3.4 Physical Character and Place Identity

The Chicago Main Branch Riverwalk is comprised of four distinct areas, each has its own character and function. These areas can be programmed and marketed as distinct districts to attract public access and support commercial functions. These districts are; The Confluence, The Arcade District, The Civic District, and The Market District (Chicago Department of Zoning and Planning & Chicago Department of Transportation, 2009).

Figure 32: The Four distinctive Districts of Chicago River main branch.
Source: www.landscapeperformance.org

The project also helps emphasize the distinctive architectural identity and character of the waterfront and foster cultural and historical attachments to the river and its waterfront through specialized architectural tours provided by the Bridgehouse Museum and the Chicago Architectural Centre where visitors can have special tours to observe Chicago's famous bridges.

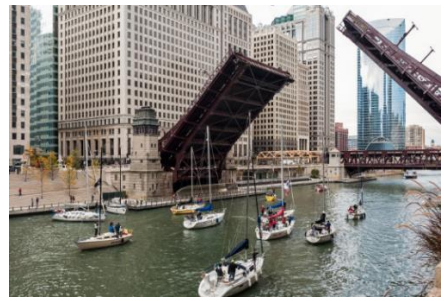


Figure 33: Specialized Architectural Boat Tours. Source: (Chesla, 2017).

4.5 Comparative Analysis of Case Studies, Findings, and discussion

The purpose of this comparative analysis is to evaluate the selected case studies according to the evaluation criteria, set in the previous chapter to emphasize emerging commonalities, differences, and patterns between them and to provide a comprehensive understanding of each case compared to the others regarding planning and design policies for urban development related to urban water-ways and its adjacent urban areas.

Data sources for weighting/ measuring indicators and sub-indicators include a literature review of project documents published by city municipalities, government agencies, academic institutions, research groups, conference papers, and satellite imagery. Four levels of values were set for all indicators- High, Moderate, Low, and None. The fourth was considered as it was presupposed that some indicators/ sub-indicators might not be applicable in a specific case study. The value of each indicator falls into one of Three domains (0-30%, 30-60%, 60-100%) which correspond to each of the three levels of values from Low to High.

A higher value for a specific indicator indicates that this indicator was applicable. It should be noted that all information about the set indicators/sub indicators were extracted from data sources mentioned previously. For some indicators, weighting value indicates higher percentage or number of this specific indicator while for others it is based on more subjective data like user satisfaction levels, quality of life index, etc.

Table 6: Comparative Analysis of selected benchmarking Case Studies. Source: Author.

Element of Comparison		**Cheonghyecheon River**	**Singapore River**	**Chicago Riverwalk**
ECOLOGICAL/ ENVIRONMENTAL	**Biophilia Ratio, Biophilic Performances and Settings**	- High Ratio of Biophilia; - High number of accessible public green spaces. - Vegetation along the waterway, both terrestrial and aquatic. - Good water quality and configuration of water. - Improved overall biodiversity (H. Kim et al., 2009). - Biophilic performances include observing flora and fauna and ecosystem classes.	- Moderate Ratio of Biophilia; - High number of accessible public green spaces. - Vegetation along the waterway, both terrestrial and aquatic. - Good quality of water, however, there is lack in visual qualities of water configurations regarding water colour. - Improved overall biodiversity (Rowe & Hee, 2018).	- High Ratio of Biophilia; - High number of accessible public green spaces. - Vegetation along the waterway, both terrestrial and aquatic. - Good water quality and configuration of water. - Improved overall biodiversity (Hanson et al., 2019). - Biophilic performances include observing floating lands and engaging in ecological programmes.
SOCIO-CULTURAL	**Sensory Experience**	- Enhanced passive and active sensory experience of waterfront through enhancing physical and visual access to water. - Enhanced sensory experience through environmental and ecological literacy.	- Enhanced passive and active sensory experience of waterfront through enhancing physical and visual access to water.	- Enhanced passive and active sensory experience of waterfront through enhancing physical and visual access to water. - Enhanced sensory experience through environmental and ecological literacy
	Connectivity and Accessibility	- longitudinal and lateral connectivity to the waterfront. - Integration within the local public transit system.	- Improved longitudinal and lateral connectivity to the waterfront through integrated on-ground and underground pedestrian network.	- Improved longitudinal and vertical connectivity to the riverfront through improving vertical access points. - Improved water-based transportation modes.
FUNCTIONAL / PHYSICAL	**Physical Character and place identity**	- Preservation of all heritage items excavated during the construction. - Relocation and restoration of historical bridges when available.	- Conservation of local historical character and identity while ensuring economic vitality.	- Emphasize the distinctive architectural identity of the riverfront.
GENERAL/LEGAL	**Conflicts of Land Ownership**	- To ensure urban land for the pedestrian promenade along the river, the government allowed vertical development in favour of buying on-ground private land.	- The government gave owners of private properties a lease to restore their buildings - Relocation of small industries and farms.	- No conflict of land ownership.
	Governance, Actors and Stakeholders	- Government-led development. - Political commitment is a key principle.	- Government-led development. - Political commitment is a key principle.	- Government-led development. - Political commitment is a key principle.
	Public Participation	- The government established a network for that consisted of: Cheonggye-cheon Restoration Project Headquarters, The Cheonggye-cheon Citizens Committee, and The Cheonggye-cheon Research Group.	- Public exhibitions were held to collect public views regarding the development plans. - Active Partnership between public and private sectors in planning and implementation	- Public participation was only emphasized through the Friends of The Chicago River Organization.

Table 7: Assessment of Biophilic Indicators across the selected case studies. Source: Author.

	Biophilic Element	Biophilic Indicator	Cheonghyecheon River				Singapore River				Chicago Riverwalk			
			High	Moderate	Low	None	High	Moderate	Low	None	High	Moderate	Low	None
Aspects of Ecological Integration	Biophilia Ratio, Biophilic Performances and Settings.	percentage of Green spaces, with consideration to its quality, conditions, and public access to these spaces.												
		Vegetation along riparian areas												
		Water quality, configuration, and appearance												
		Biomorphic shapes and forms												
		Natural Materials and settings												
		Activities that celebrate proximity to water												
Aspects of Social Integration	Sensory Experience	Prospect and Refuge												
		Enticement and Mystery												
		Mental peace, security, and safety												
		Thermal comfort and shelter from elements												
		Experience of Nature.												
		Environmental, Historical, and Cultural Literacy on the waterfront.												
Aspects of Physical Integration	Connectivity and Accessibility	Traffic and Pedestrian volumes on waterfronts.							.					
		Inclusive access to diverse user groups												
		Physical, visual and material access to water.												
		Signages and wayfinding infrastructure.												
		Number of transportation modes available in the area												
	Physical Character and Place Identity	Number of water dependent and related activities compared to non-dependent water activities												
		The Number of Cultural and historical facilities on the waterfront												
		Unique place identity												

Conclusion

The three cases presented have been globally hailed as model projects for integration of urban water-ways within the urban fabric of their respective built environments as a natural catalyst for urban revitalization. However, it is important to keep in mind the distinctive circumstances for each of them and that each urban river, or urban waterway, is a unique place with a unique conjunction of ecological and cultural demands, and models from one city don't necessarily adapt to another.

The analytical review of selected case studies examined local narratives surrounding each case to show how social, political, economic, and environmental aspirations led to a hierarchy of deservedness among development decisions and different forms of policy investments. Comparative analysis of selected case studies shows that one common important factor in all three cases was manifesting the significant role of political commitment and governance, both in planning and implementation phases and long-term ongoing planning and evaluation process to deliver successful urban water-ways projects.

Moreover, it is evident that the success of large-scale strategic development projects related to urban water-ways is measured not by their ability to deliver discrete and isolated benefits but in their ability to generate benefits across sectors and issue areas.

PART 3: EMPIRICAL PART

CHAPTER 5: The Nile River in Egypt
A Case Study of The Nile Waterfront in Central Cairo

Introduction

The Nile is the longest river in the world; it flows through a total of Nine countries; Ethiopia, Zaire, Kenya, Uganda, Tanzania, Rwanda, Burundi, Sudan, and Egypt. For Egypt, the Nile has been a source of life since the ancient Egyptian civilization. Throughout its long history, Egypt has been centred around the Nile, dependent upon the river for communication, navigation, and upon its periodic floods to bring water to its fertile agricultural lands (Wohl, 2011).

Cairo, the capital city of Egypt and the largest city of Africa, is one of the densest cities in the world, with a population of over 9 million and a projected population of 13.5 million in 2025 (CAPMAS, 2020). The city has a strategic location as it is situated at the point where the Nile Delta fans out to the north (Sims, 2012). Cairo witnessed a significant increase in population in the past decades and is struggling with many challenges.

For Cairo, the Nile serves as the line of communication with the Delta and Upper Egypt (Kondolf & Pinto, 2016). Historically, the river banks were lively and most of the city's life occurred along around it. However, by the end of the 20th century, the river's waterfront was largely cut off from public access and its banks were subjected to severe environmental degradation and littered with trash and debris (Gabr, 2004; Kondolf et al., 2011; Kondolf & Pinto, 2016). Moreover, as the city's population is under-served by public spaces, this is putting the compelling attraction of the river in a sharp focus as an underutilized natural asset and its waterfront as a potential public open space, a much-needed space for Cairo's residents and dwellers (Kondolf et al., 2011).

This chapter is concerned with the empirical part of the study, therefore, a review of historical development of the Nile waterfront in Central Cairo will be discussed as well as current conditions and problems of the Nile waterfront. An analysis of the selected case study area will follow using the same set of Biophilic indicators in urban waterfronts framework to assess the degree of integration of the Nile waterfront as a natural asset in the urban fabric of the city, explore typologies of Nature valuations within the selected study area, and and finally, identify potential opportunities and challenges of utilizing the river.

5.1 Overview of Urban Development in The Nile Valley

Throughout its long history, Egypt has been centred around the Nile, dependent upon the river for communication, navigation, and upon its periodic floods to bring water to its agricultural lands (Wohl, 2011). The Nile valley in Egypt runs over 1100 km from Aswan in the south to the Mediterranean Sea in the north and contains nearly all of Egypt's population and economic activities, it flows from South to North through most of Egyptian cities, from Abu Simbel in the South to Damietta and Rosetta in the North (Figure 34), with a population of over 65 million, representing almost 72 percent of the total population of the country and a density of about 2000 person/km2 (Fouad et al., 2013; Qutb & Shalaby, 2016).

Human settlements in the Nile valley have grown over time under very similar economic and social conditions, with the Nile river as the most important natural resource and agriculture as the main economic activity in its valley. However, over the past decades, the Nile valley has undergone accelerated and dramatic social, economic, and demographic changes with the impacts of the industrial revolution through a multitude of major projects (AbdelRaheam et al., 2020). The Aswan High-Dam project, completed in 1968, was a turning point in the history of development in the Nile Valley, agriculture became an all-year around activity, the dam was the main provider of electricity for the country and provided protection from floods (Aboukorin, 2018). Although this hydraulic modification of the river resulted in altering its original ecological conditions, it also reduced seasonal variations and minimal rise in its flood stages as a result (Kondolf et al., 2011).

Along the Nile, Greater Cairo has the most significant influence on the north part of the Nile Valley, extending about 215 km into it, and reaching up to 50 km to the north of Assuit, with a population of over 21 million in its region. The city of Cairo has a persistent problem of lacking open and green spaces. As per CAMPAS estimates in 2008, the individual share of green space is estimated to be 0.8 square metres per capita, a number far from the minimum requirements suggested by the World Health Organization (WHO), which is nine square meters per capita (Aly, 2017).

Figure 34: Major Cities and Urban settlements in the Nile Valley.in Egypt.
Source: (Aboukorin, 2018), with modifications by Author.

Within this context, Cairo city was selected as the prime geographical location for the study area, partly for its strategic location, the length of its Waterfront, population size as well as its influence on urban development and economic changes as the capital city of Egypt. Moreover, the symbiotic relationship between the urban transformation of Cairo and the Nile River provides a unique case to be investigated and studied.

5.2 Cairo's urban Evolution and the Historical influence of the Nile

As a great source of influence in shaping Egypt's history, the Nile has influenced the development of Cairo and its greater region in different aspects. Dating back to Ancient Egypt, Memphis, the first known settlement in the vicinity of modern Cairo and one of the earliest urban settlements in the world, was strategically located on the west bank of the Nile and was chosen as the ancient capital , the city flourished between 3100 and 2500 BC (Abu-Lughod, 1971; AlSayyad, 2011). On the west bank, the Pyramids were constructed, activities were confined to collecting drinking water from the river, and the river was used for transportation and fishing (Sami, 2011).

The following centuries witnessed a decline of the city and the ascendance of Alexandria as the capital during the rule of the Roman Empire where the Nile's islands were used as fortresses for the Roman forces until the Arab forces conquered Cairo in 640AD where the seeds of contemporary modern Cairo sprang (Abu-Lughod, 1971). During that time, many defined roads emerged along the Nile corridor and activities around the Nile were limited to agriculture, trade, transportation, and fishing (Sami, 2011).

By 641AD, the Arabs, under the leadership of Arab general Amr ibn al-As had subdued Egypt and built Al-Fustat as a camp fortress to host the Arab forces under the instructions of Caliph Umar to establish his headquarters in the country's interior and on the east bank of the Nile to assure access to Arabia. It was sited at a considerable distance from the local population to avoid unnecessary conflicts between them and the soldiers (Abu-Lughod, 1971). Hence, Cairo emerged on the trade routes along the Nile. This decision to establish al-Fustat in this location was instrumental in confining urban growth to the eastern bank of the Nile during the following centuries, while the western bank remained mostly undeveloped.

In 750AD, another settlement was founded as the new capital. To celebrate the Abbasids's victory over the Umayyads. Al-Askar was founded just north of Al-Fustat and during the following years, the two cities were fused together until Ahmad ibn Tulun founded Al-Qataii in 870AD (Sayyid, 2015). Finally, Al-Qahira (present day Cairo) was founded by the Fatimids in 969 AD (Abu-Lughod, 1971; AlSayyad, 2011). Around that time, the

combined population of Al-Fustat and Al-Qahira was about 500,000, one of the largest urban settlements in the 11th Century (Raymond, 2000).

When the Ayuubids took over under Salah- Uddin's rule, then came the most significant change of this period. Salah-Uddin sought to cleanse the city of all traces of the Fatimids' legacy. As a result, a significant part of that history has been lost due to the deliberate destruction of Fatimid Cairo's built heritage (Sayyid, 2015). Most Shiites' iconic mosques and structures were destroyed to eradicate all traces of the heritage, traditions, and rituals of the Fatimids. Moreover, the construction of the Salahuddin citadel, built originally to protect against possible Fatimid uprisings or foreign invasions, was instrumental in changing the direction of urban growth towards the east (Rymond, 2000).

In 1250, Mamluk Sultans seized power and until the Turks' invasion, they built large houses on the new route to the citadel, and later a series of luxurious houses overlooking the Azbakeyah Lake (Abu-Lughod, 1971), this expanded the city's fabric on an east-west axis of growth. At that time the Nile recessed from its original course and new plots of land were added to the city. The Mamluks made significant efforts to protect the country from floods and several structures were founded for flood protection (Sami, 2011).

Following the French Expedition under Napoleon in 1798, Cairo's urban landscape underwent another significant structural and functional transformation during the first half of the 19th century under Mohammad Ali's rule. Ali was greatly influenced by western ideologies and his reign was characterized by a great scale of modernization and westernization, including reforms in public works and urban planning. One of these reforms targeted the cleaning of Cairo by leveling rubbish mounds and using resultant excess debris to fill in its lakes and canals. As a result, several lakes and canals were either partially or entirely filled, including the two largest ones; birkat al-Azbakkiyya and birkat al-Fil (Abu-Lughod, 1971; Raymond, 2000). This urban transformation started under Mohammad Ali and continued during the reign of Khedive Ismail. Consequently, the result was a densely built urban fabric lacking the recreational, cultural, and economic qualities that were once available to Cairenes when the Nile's traditional water system was embraced as an integral part of the city's landscape (Echols & Nassar, 2006).

Khedive Ismail (1830–1895) realized his version of Paris on the Nile by planning and constructing the Ismaili Cairo, a Haussmann-style city outside the Old City walls and overlooking the Nile to the west. Garden City stood out on the Nile's east bank as a distinct neighborhood with an exclusive European character with organic streets with aligned palm trees, vast gardens, and luxurious residences. The Azbaqiyah and areas between Cairo and the Nile developed based on European style (Kondolf et al., 2011).

Following the 1952's revolution, the new leadership adopted a socialist agenda, with emphasis on social equality, the right to free education, and adequate social housing. The state-led social housing programs commissioned the establishment of middle-class communities adjacent to business and industrial centers on the Nile's riverfront, which encouraged further internal rural-urban migration, causing its population to grow to more than 6 million by 1975 (Echols & Nassar, 2006) and creating marginal zones around the city such as Nasr City and Al-Muhandseen (Kondolf et al., 2011).

Nasser's Cairo witnessed a major transformation in its urban fabric as well as its social structure. Driven by the desire for social upgrading, military officers and statesmen replaced foreigners in downtown apartments and adopted a similar lifestyle. As a result, national mega-structures, such as Mogamaa Al-Tahrir Building and Maspero Building, were built as evidence of the nation's independence. The Nile-bound institutions indicated how the riverfront resembled the sought-after image of the modern Egypt. This transformation could also be seen in the renaming of the central square of downtown Cairo, from Al-Ismailiah Square to Tahrir Square (Abdelmonem, 2016; Kondolf et al., 2011; Raymond, 2000).

Hence, The Nile River was not only strongly present and integrated into the urban fabric of Cairo, but it was also central to Cairo's social, cultural, and recreational life. Similarly, the canals and lakes of Cairo that were used to mitigate the river's annual floods provided great opportunities for entertainment and recreation for Cairenes. (Figure 35) illustrates Cairo's urban transformation through different eras and provides an idea of the symbiotic relationship between the city and the Nile.

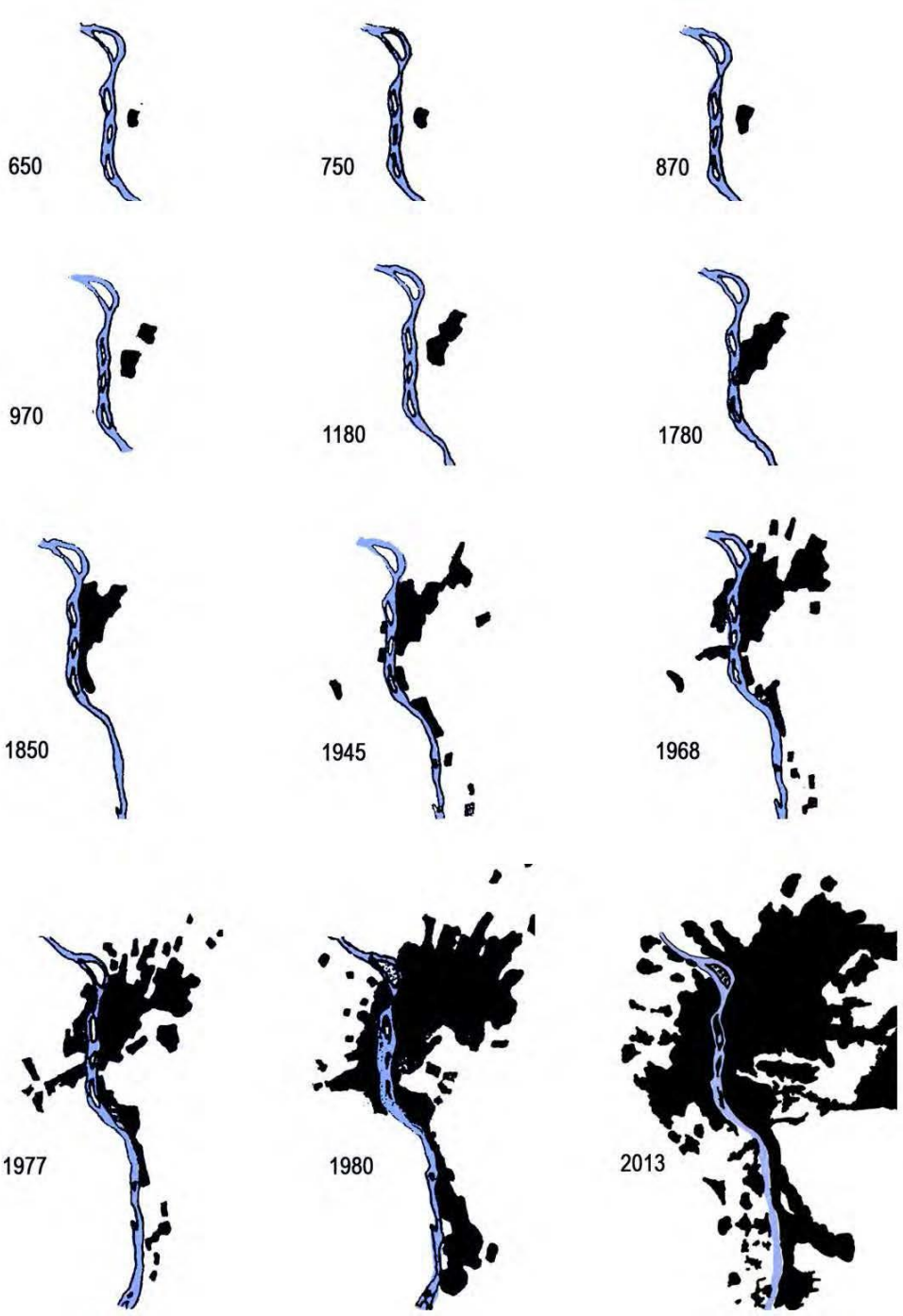


Figure 35: Cairo's urban evolution through different eras.
Source: (Mouad, 2013), with modifications by Author.

5.3 The Nile Waterfront in Cairo: Urban Development and Current Problems

From the previous section, it can be conferred that the development of Cairo was strongly tied to the Nile. However, as the city transformed through different eras, it lost that dominant presence of water among its urban fabric as a result of massive population growth (Echols & Nassar, 2006).

On the one hand, the Nile was subjected to excessive environmental degradation in its ecological nature. With the construction of Aswan High Dam, the country's agricultural lands lost the silt and fertile that were carried by annual flood leading to the need of excessive use of chemical fertilizers and pesticides (Kondolf et al., 2011). On the other hand, as the main water source in Egypt, it is also the main waste dump for industrial, agricultural, and even domestic activities (Gabr, 2004). Moreover, the privatization of the Nile banks to regenerate economic revenue and attract private investments raised concerns of social segregation and exclusive access to the riverfront, a trend that started with Nasser's era and only solidified from that point.

Within this context, with the Nile subjected to such pressures, The Nile waterfront in Cairo has experienced numerous changes in the form of development projects to take advantage of the river's potential for attracting users and to capitalize on economic opportunities for attracting investments. However, most of these projects focused on the beautification of the waterfront banks rather than any actual physical transformations (Gabr, 2004). A number of these projects are already implemented, while others are still under construction or postponed due to a shortage in funding.

5.4 Biophilic Indicators in Central Cairo's Waterfront

This section sets out to investigate current conditions of the Nile waterfront with the underlying assumption that understanding users' perceptions of such unique natural-cultural spaces will help shed light upon the degree of integration of the river within the fabric of the city, identify Nature valuations of the waterfronts and explore biophilic indicators within the area and ultimately identify potential opportunities and challenges in future development plans.

To assess biophilic indicators in the Nile waterfront, Central Cairo area was selected as the study area, as it is one of the most vibrant and attractive areas in Cairo politically, socially, and economically, specifically because of its strategic location. The area is also home to the city's downtown, functions as the social, economic, and political heart of the city, and is home to many affluent urban areas like Zamalek and Garden City. Moreover, a large part of the area underwent recent development as part of "Ahl-Masr Promenade", a national project seeking to connect Egyptian cities, including Cairo, to the river banks and provide outdoor public spaces for recreation while preserving the river and improving the city's image (Abd Alaziz, 2017). Therefore, studying it will give a clear insight into users' perceptions and valuations of the river and its waterfront, assess the degree of integration of the Nile waterfront as a natural element within the city's fabric, and pinpoints existing challenges and opportunities for future development of the river banks.

Selection of the study area was also influenced by other factors; originally, the study area was planned to be within the stretch of the Nile waterfront running from Imbaba Bridge in the north to Qasr Al-Nile Bridge in the south, however, at the time of conducting the study, construction of the Third phase of "Ah-Masr Promenade Project" was taking place in the area stretching from Imbaba Bridge to 15th of May Bridge, thus resulting in the exclusion of this sector from the selected area due to difficulties in conducting on-site observations and field survey. Therefore, the sector stretching from Al-Gamaa Bridge to Qasr El-Nile Bridge (Sector 1) was then selected specifically for river topography, as the width of the river decreases significantly in the channel of the river between Roda Island and Garden City, it was selected to provide an insight into the role of waterway/river width in users perceptions of the waterfront as well as its effect on their experience of the waterfront.The study area consists of a very dense built-up area with embassies, cultural centres, government administrative buildings, and commercial high-rise buildings, 15th May Bridge forms the northern border of the study area, while Al-Gamaa Bridge forms the southern border.

For purposes of data collection and analysis, the almost 3.2 Km study reach is further divided into three sectors (Figure 36) with a 100m width offset from east and west banks to include the first row of urban functions as follows:

Sector 1: It extends from Al-Gamaa Bridge in the south to Qasr El-Nile Bridge in the north, Garden city area to the east, and the eastern bank of Roda Island to the west.
Sector 2: This sector extends from Qasr El-Nile Bridge as the southern border to 6th October Bridge as the northern border.
Sector 3: This sector extends from 6 th of October Bridge in the south to 15th of May Bridge in the north, bordering Maspero area in the east bank and Zamalek Island in the west bank.

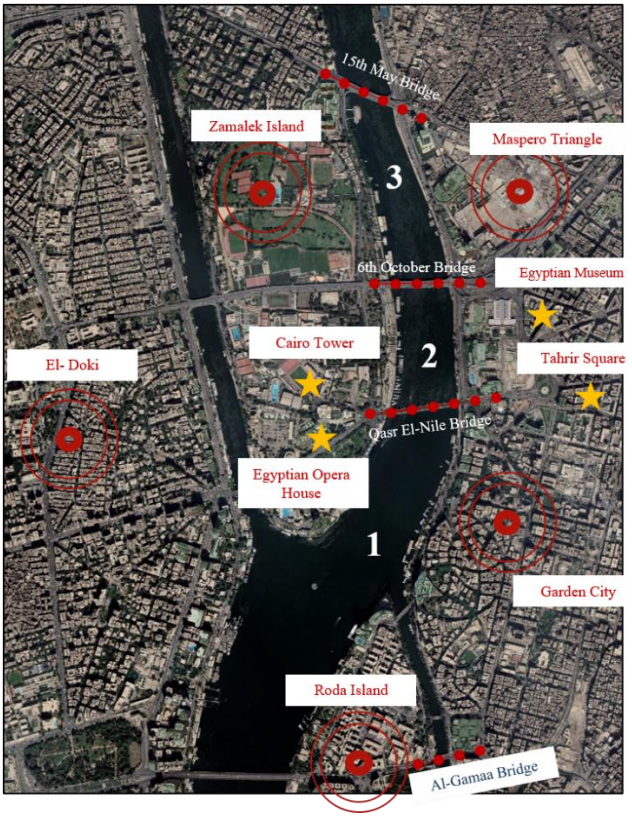
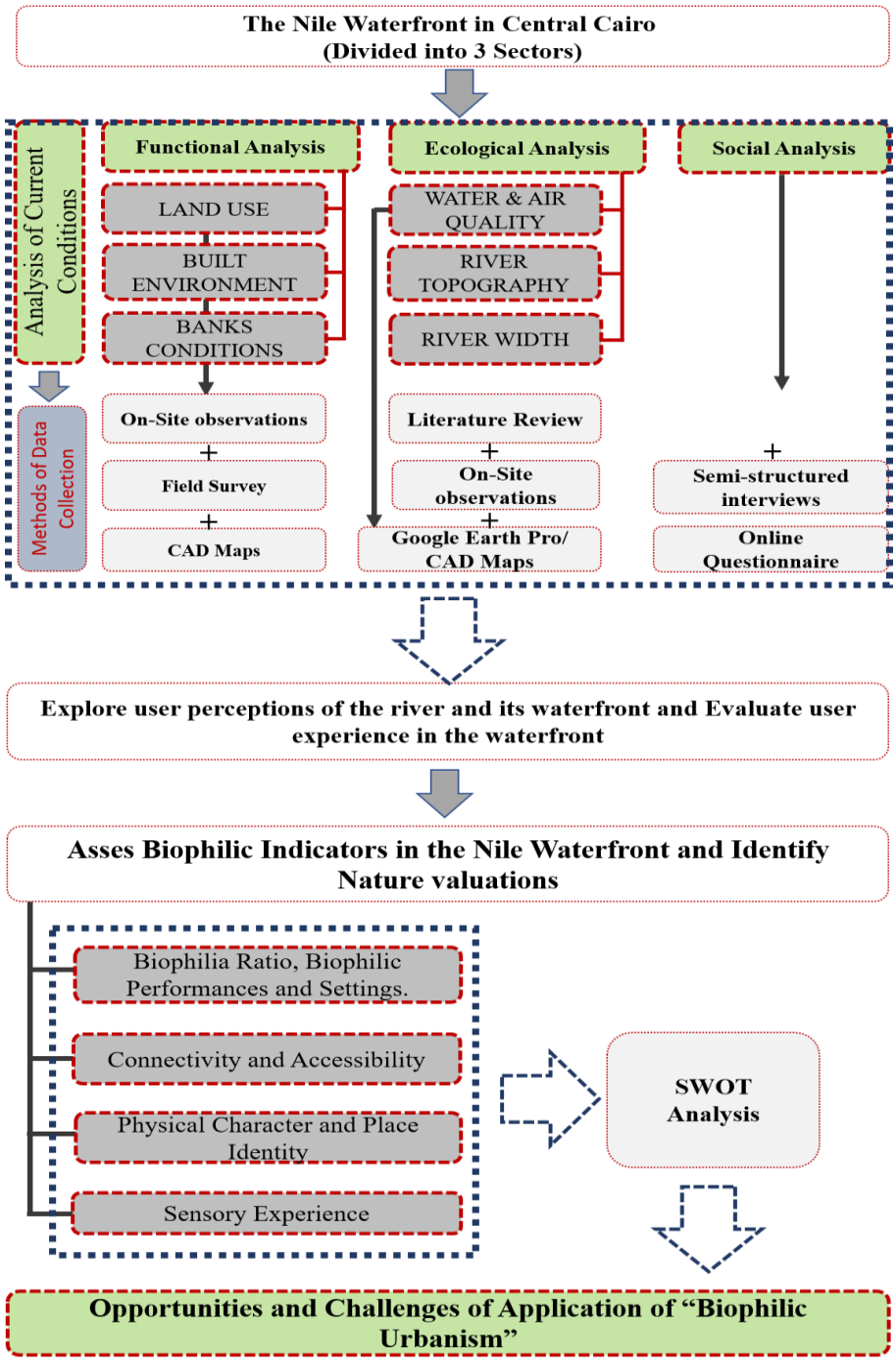


Figure 36: Satellite image of study area and surrounding communities. Source: Google Earth with modifications by Author.

The next section of the study will provide a detailed analysis of each of the selected study area's sectors, to investigate indicators of Biophilia within the study area and assess the degree of integration of the Nile waterfront within surrounding urban areas. It will be divided into two parts; the first one is an analysis of current conditions observed during the fieldwork, the second will be an analysis of conducted online and on-site surveys and questionnaire.


The Nile Waterfront in Central Cairo
(Divided into 3 Sectors)
Analysis of Current Conditions
Functional Analysis
Ecological Analysis
Social Analysis
LAND USE
BUILT ENVIRONMENT
BANKS CONDITIONS
WATER & AIR QUALITY
RIVER TOPOGRAPHY
RIVER WIDTH
Methods of Data Collection
On-Site observations
+
Field Survey
+
CAD Maps
Literature Review
+
On-Site observations
+
Google Earth Pro/ CAD Maps
+
Semi-structured interviews
Online Questionnaire
Explore user perceptions of the river and its waterfront and Evaluate user experience in the waterfront
Asses Biophilic Indicators in the Nile Waterfront and Identify Nature valuations
Biophilia Ratio, Biophilic Performances and Settings.
Connectivity and Accessibility
Physical Character and Place Identity
Sensory Experience
SWOT Analysis
Opportunities and Challenges of Application of "Biophilic Urbanism"

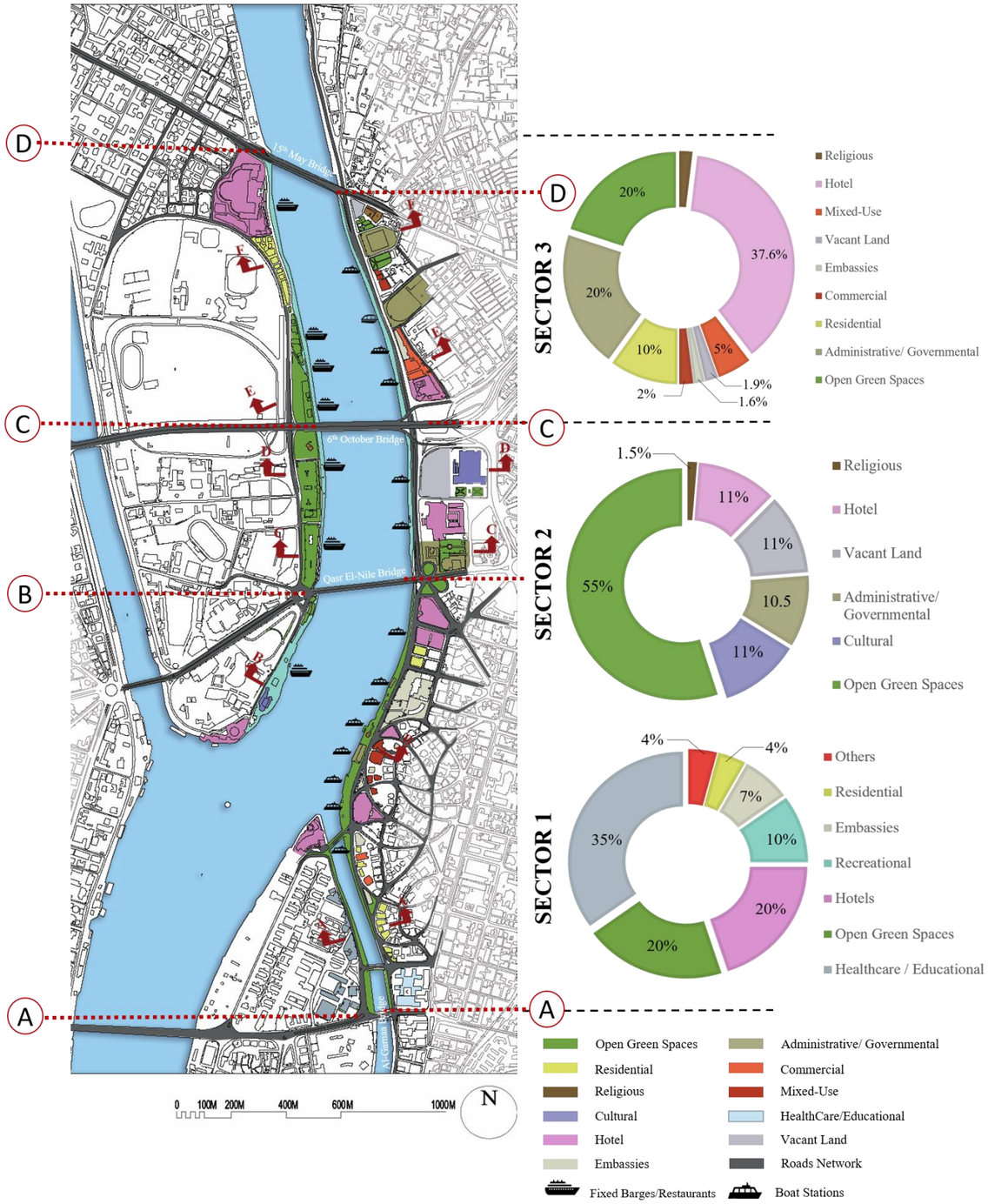


Figure 37: Land-use map in study area and locations of representative Cross Sections.
Source: Author based on CADMAP.

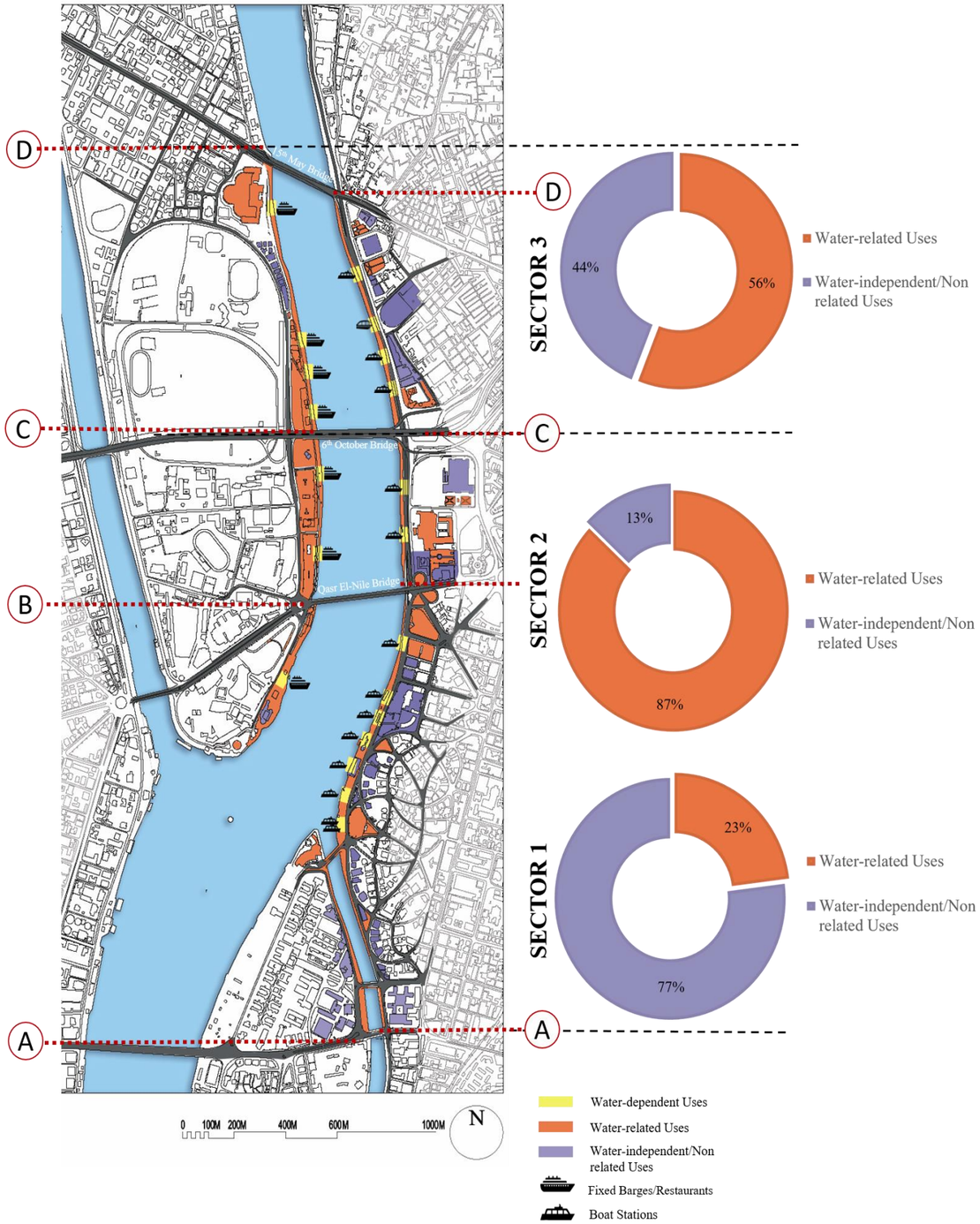


Figure 38: Water Dependency Plan in study area.
Source: Author based on CADMAP.

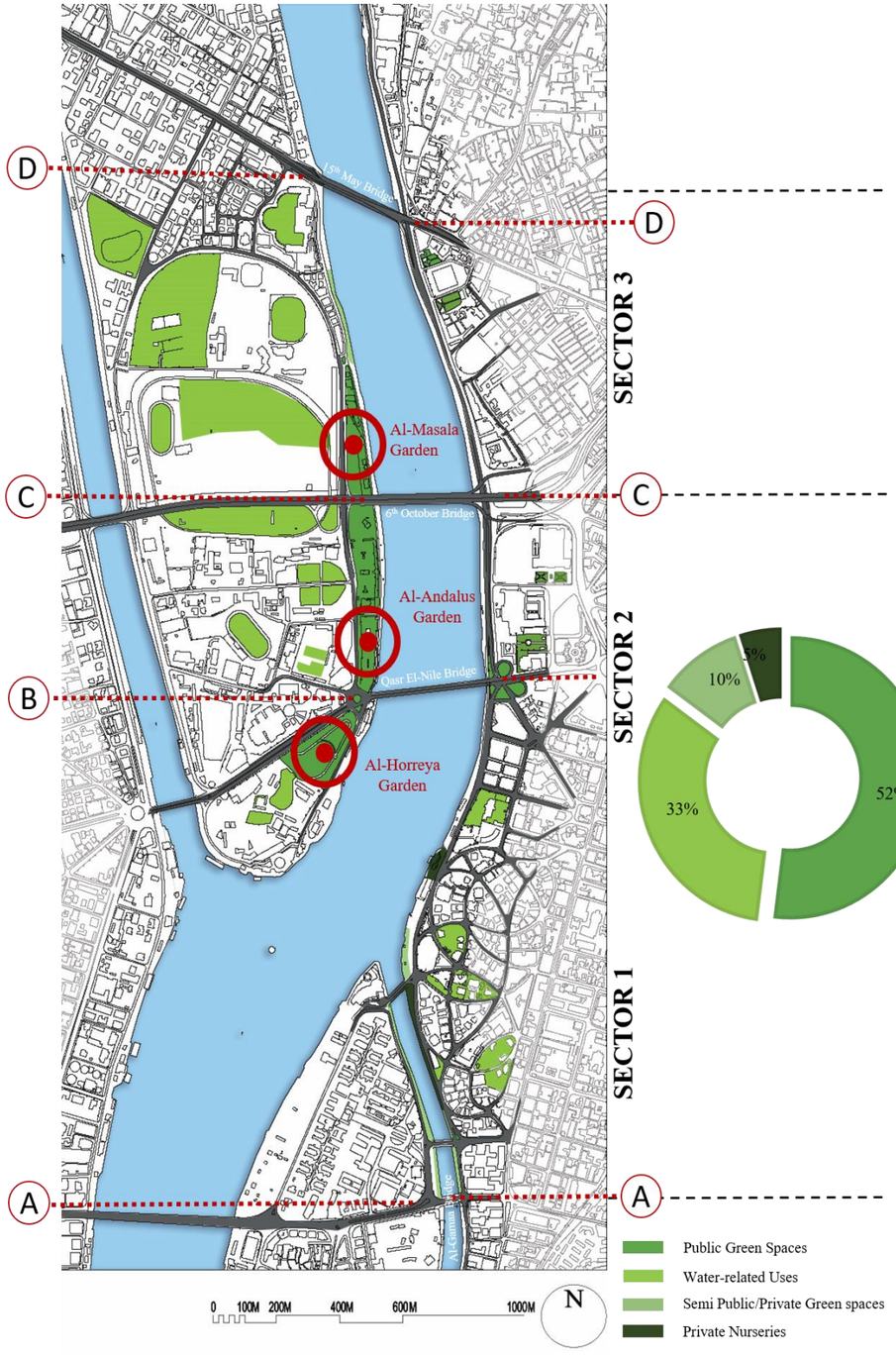


Figure 39: Green Areas Plan
Source: Author based on CADMAP.

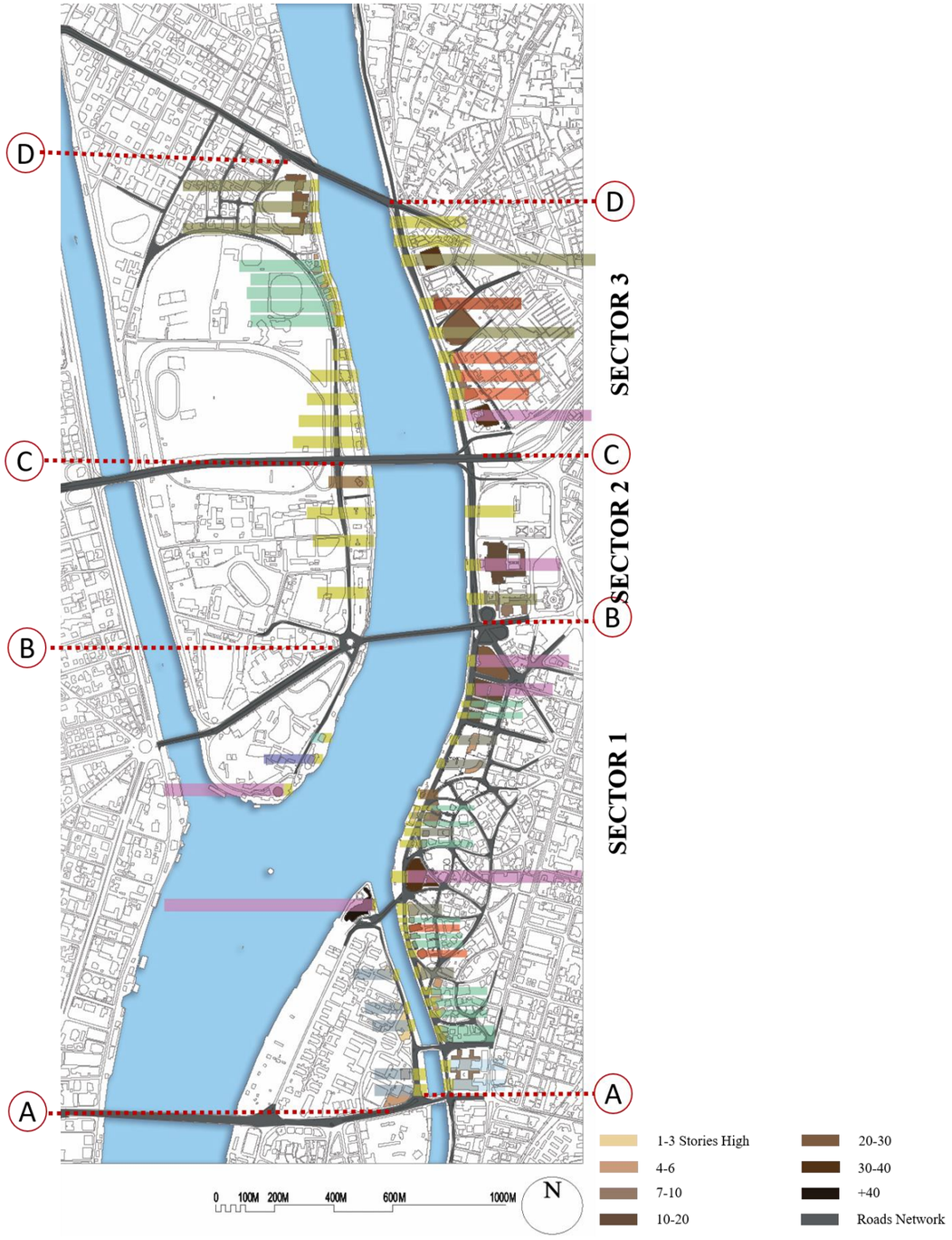


Figure 40: Map shows the Ratio between Open Space and SetBack Buildings Heights and available open space.
Source: Author based on CADMAP.

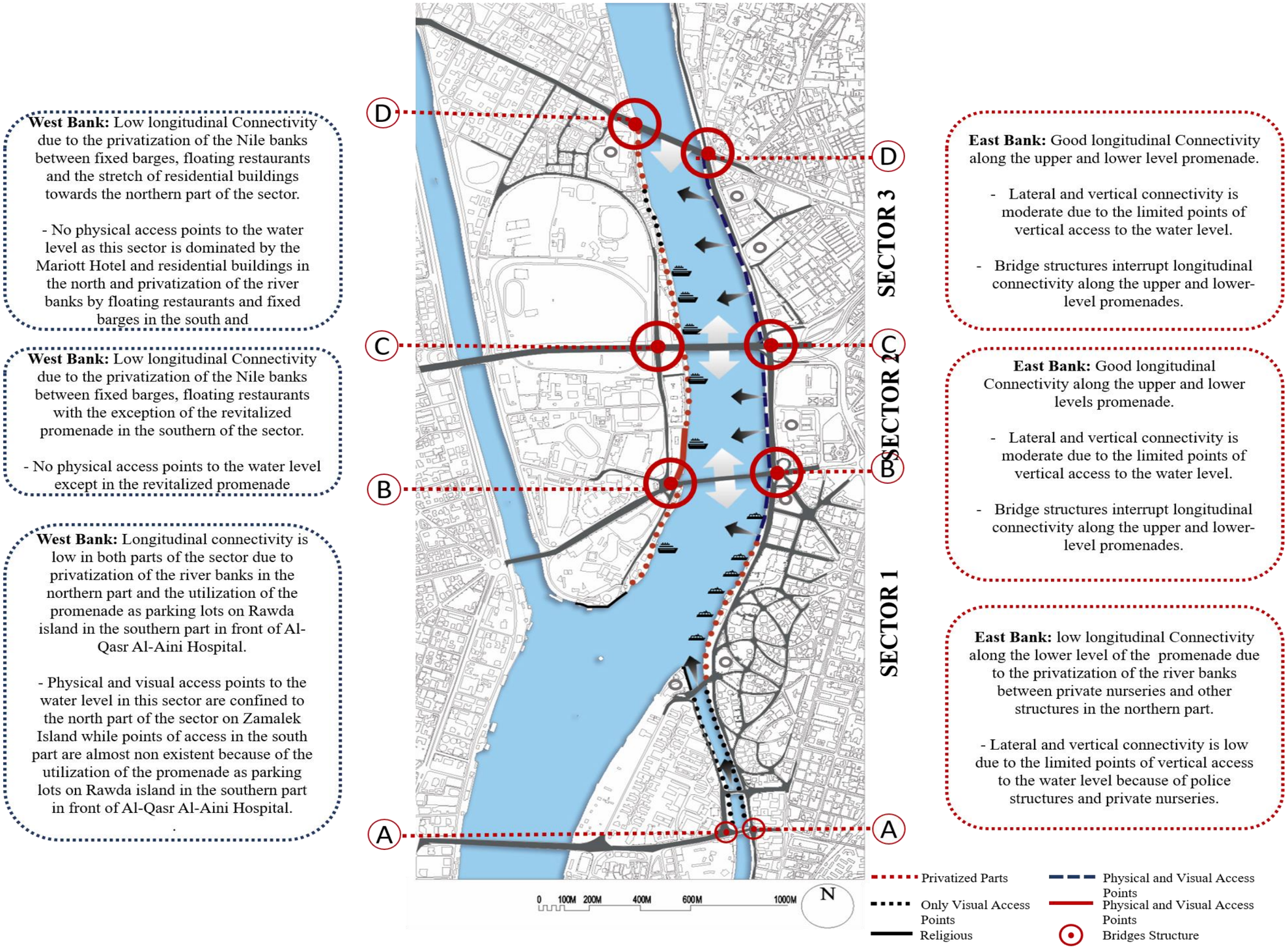


Figure 41: Visual and Physical Accessibility and Connectivity. Source: Author based on CADMAP

5.4.1 Context and Background

Sector (1) is the largest sector of the study area with a total length of 1.7 Km. This sector is one of the most important sectors as it borders Garden city area and the southern tip of Zamalek island, one of Cairo's most affluent urban areas. The area is home to several cultural and administrative facilities, including several embassies. In addition, it is home to multiple high-rise residential buildings and hotels. This sector is distinguished by the Architectural style of its buildings that date back to Khedive Ismael era, specifically on the east back of the River, Garden City area.

5.4.2 Functional Analysis

This section focuses mainly on the current conditions of the Nile waterfront in Sector (1). A detailed analysis of the Nile waterfront area within this sector follows with emphasis on Land uses, Built environment, and Banks conditions.

- ***Land Use***

This sector has a wide range of land uses; residential, administrative, and governmental. The east bank of the river in Garden City area is dominated by residential buildings, hotels and embassies. The area is home to Intercontinental Semiramis Hotel, Hilton Shepheard Hotel, Kempinski Hotel, and Four Seasons Hotel, multiple embassies including USA embassy, UK embassy, and Italy embassy. Other uses include multiple health care facilities like Qasr El-Aini New Educational Hospital. On the opposite side, the River banks are dominated by private nurseries, floating restaurants and some low-rise administrative buildings.

The west bank of this sector is divided into two areas with distinctive character; first is the eastern bank of Roda island in the south, dominated by health care and the teaching hospital of Cairo University where the river banks are dominated by ill-maintained and inaccessible green areas, and second, the northern tip of Roda Island, anchored by the Grand Hayat Hotel.

- ***Built Environment***

The built environment in this sector consists primarily of buildings maintained for economic and civic purposes. Generally, buildings are in good conditions, as the area is one of Cairo's affluent residential areas.

Architectural style varies from Khedive era residential buildings to hotels with more modern architectural style. Buildings heights also vary greatly from an average of 4 to 5 stories-high residential buildings in the east bank towards the south of Garden City and an average of 10 stories-high building towards the north. A tree-lined pedestrian promenade with an average width of 3 M extends from Al-Gamma Bridge to Qasr El-Nile Bridge.

5.4.3 Key Findings on User's Experience

This section showcases key findings of analysis of sector 1, identifying Biophilic indicators outlined in the previous chapter to evaluate user's experience of the waterfront and assess the integration of the river, and consequently its waterfront, within the fabric of adjacent urban areas.

5.4.3.1 Biophilia Ratio, Biophilic Performances and Settings

This section provides an in-depth evaluation of indicators under this element of biophilic perceptions of the waterfront in this sector.

- ***Percentage and Quality of Green Spaces***

Generally, Green spaces within this sector are in good conditions and well-maintained, however, most of these green spaces are private like nurseries and green spaces in front of private clubs for selected user groups. Others include El-Horreya Garden and Al-manial Garden in the south which are mostly allowed for public access, however, there is entrance fare, also, at the time of conducting the research, public access wasn't allowed.

Moreover, the southern part of the sector is dominated by natural banks with over-grown ill-maintained riparian vegetation, which negatively affects the aesthetics of the waterfront. In addition, the pedestrian promenade in this part is on the same level as a heavy traffic route with high levels of noise.

- ***Vegetation along riparian areas***

Mostly, Vegetation is limited except within the southern part of the sector. Most vegetation exists as part of streetscape or in the form of private nurseries. Riparian vegetation also exits abundantly in the southern part on both east and west banks of the river.

- ***Water Quality, Configurations, and appearances***

Water appearance in the part of the river that runs in the narrow channel between Roda Island and the southern part of Garden City is visually disconcerting, with litter, debris, and trash floating in the water, particularly in the linear section of the east bank of Roda Island, adjacent to Al-Qasr El-Aini Hospital. The color of the water is also visually unattractive, the water is very still and turbid, and its color is green rather than blue, which decreases its visual qualities and negatively influences its aesthetic perceptions. In contrast, going downstream towards Zamalek Island, water appearance changes drastically, The river banks are very well-maintained, this in part is due to the abundance of floating restaurants and private clubs, the water movement is captivating and calming and the water has extraordinary reflecting capacity.

- ***Biomorphic shapes and forms inspired from Nature***

Current promenade design gives little consideration to make users feel connected to the river, streetscape is very systematic and linear and seating areas are lined in a very monotonous pattern, and the natural edge of the river banks are hardly recognizable to users due to building structures, boat docks and other physical barriers that obscure the river's edge.

- ***Using Natural Materials and settings***

The northern part of this sector has a more natural appearance due to the width of the river that evokes a sense of freedom. On the other hand, the southern part of this sector, where the width of the river decreases significantly, with its rugged river edge characterized with unspoiled, natural-appearing elements of nature, mainly trees and vegetation gives a sense of closeness to the river. However, close proximity to adjacent buildings and adjacent heavy traffic routes decreases positive feelings associated with such natural settings as they are considered distracting.

Landscaping materials in both sectors are very monotonous and is dominated by barren hardscape with few exceptions in the eastern bank of the river in Garden City and western bank of Roda Island with vegetation and greenery in the form of private nurseries and overgrown natural vegetation on Roda Island.

5.4.3.2 Sensory Experience

This element depicts sensory stimulating features found on the waterfront in this sector.

- ***Prospect and Refuge***

Similar to previous indicators, this sector can be analysed as two separate ones because of the observed significant differences between them. The first part is the narrow channel of the river that runs along the eastern edge of Roda Island and the western edge of Garden City. Due to the narrow stretch of the river in this part, user groups express feelings of enclosure and safety as a result of the relative proximity of the opposite side of the banks.

Going downstream towards Zamalek Island, the river's width increases significantly, few numbers of buildings form the backdrop, traffic volumes increases as well, consequently, lessening feeling of closure and ultimately closeness to water. Movements on the opposite side of the river banks isn't distinguished but vehicles and boats are still recognizable.

- ***Enticement and Mystery***

The design of the pedestrian promenade extending from Al-Gamaa Bridge in the south to Qasr Al-Nile Bridge in the north is very monotonous, with very minimal changes. The only recognizable changes along it are on the lower-level promenade that starts from Abd Al-Aziz Alsoud Street to Qasr Al-Nile Bridge and which is mostly cut off from public access by structures, private boat docks, and private nurseries. This design offers very little opportunities for users to explore.

- ***Mental peace and security***

In terms of personal safety, people seem to be relaxed when close to the river's edge and show no signs of fear of potential incidents due to the relatively good countermeasures of safety. While on the opposite bank in Roda Island, dilapidated metal railings are a dominant sight, with completely ripped or broken parts in some places, which people typically avoid getting close to.

The presence of and proximity to the river itself generally evokes positive feelings. However, noise levels generated by heavy traffic volumes, coupled with the fact that the pedestrian promenade is on the same level as vehicles routes, separated only by a 3-4 m wide sidewalk, make feelings of relaxation or solitude almost impossible.

- ***Thermal Comfort***

Design interventions for shelter are lacking. Trees lining the pedestrian promenade along the whole sector in the east bank of the river are the only exception, and even these are very few and far in-between.

- ***Experience of Nature***

Generally, the presence of the river itself is very dominating. However, prohibited/exclusive physical access to the river in most areas of this sector hinders users of specific aspects of experience of Nature that are associated with proximity to water and physical contact with it.

- ***Environmental, Historical, and Cultural Literacy on the waterfront***

There are few facilities that provide information in the area. Most users didn't seem to know of the historical or cultural value of the river, with the exception of being informed of the current political conflict over the construction of Al-Nahda Dam in Ethiopia. No public institutions that might inform about the river's nature or history exist within this sector.

5.4.3.3 Connectivity and Accessibility

- ***Pedestrian and Traffic Volume on the Waterfront***

To the south, towards Garden City and Roda Island, the number of pedestrians differs greatly according to the time of day and weekends/ weekdays. Pedestrian volumes increase significantly on working days during daytime and decrease during night-time.

Most pedestrian volumes were observed to be people who work in the area, and people visiting Al-Qasr Al-Aini Hospital. Going towards Zamalek Island in the north, most pedestrian volumes are detected to be during daytime on weekdays and nighttime on weekends. Traffic volumes are observed to be very high during most of the daytime on working days and decrease during nighttime. Many informal minibus stops exist in the sector as well as multiple public transit stops.

- ***Longitudinal, lateral, and vertical connectivity***

Within this sector, there is a lack of lateral connectivity with river banks because they are occupied by uses that prevent public access such as many of the embassies in Garden city, police clubs, and private installations that decrease potentials of the utilization of river banks for leisure or recreation. There is lack of longitudinal connectivity aspects on both east and west banks of the southern part of the sector, Garden City and Roda Island. While in the northern part of it, the issue of lack of longitudinal and lateral connectivity persists due to private installations, fixed barges, and floating restaurants.

Vertical connectivity points are lacking due to the presence of private nurseries, police installations on the east bank in the southern part in Garden City, while there are no points of access to the water level in Roda Island at all. In the northern part, boat stations occupy most of the lower-level banks on the east bank, while the west bank in Zamalek Island is dominated by private properties.

- ***Navigation, Signage, and way-finding infrastructure***

For pedestrians, due to the monotonous and linear pattern of the promenade, it is very easy to navigate through the area. However, it is quite the opposite for vehicles. Most signages are installed by private property owners as they occupy most of the river banks. Lower-level promenades lack basic signage and navigation infrastructure. Generally, there is a lack of navigation and way-finding infrastructure in the sector.

- ***Accessibility***

The area is well-connected to surrounding neighbourhoods, partly due to its strategic location. Abundant public transit infrastructure exists adjacent to the riverfront along this stretch of the Nile. A number of transportation modes are available, including informal mini-buses, metro stations, and public transportation.

5.4.3.4 Physical Character and Place Identity

- ***Number of Water dependent and Water-related Activities***

In this sector, it can be observed that water-independent uses dominate the area in the southern part, with the west bank of the river in Roda Island almost entirely occupied with educational facilities under the administration of Al-Qasr Al-Aini Hospital and the east bank occupied by residential buildings and embassies. While in the northern part of the sector, water-dependant and water-related activities dominate in the forms of fixed barges, floating restaurants, Hotels and open green spaces.

- ***Number of Cultural and historical facilities on the waterfront***

There are no significant cultural or historical facilities to promote or provide tours on the river. However, there are iconic buildings that could act as orientation points and serve as landmarks that people associate with the waterfront, without necessarily being related to the Nile itself.

Figure 42: Overgrown natural vegetation on Roda Island in the southern part of Sector 1, with educational facilities of Al-Qasr Al-Aini Hospital in the background. Source: Author.

Figure 43: Bare concrete levee on the east bank of the Nile in Garden City in the southern part of Sector 1, with Italy's embassy in the back. Source: Author.

Figure 44: The space Infront Al-Qasr Al-Aini Hospital of the west bank in Roda Island used as illegal parking lots. With ill-maintained natural vegetation lining the sidewalk. Source: Author.

Figure 45: Private nurseries occupying long stretches of the lower-level promenade on the east bank in Garden City. Source: Author.

Figure 46: Boat stations lining the lower-level promenade in Garden City. Source: Author.

Figure 47: Structures obscuring the view of the river on the east bank in Garden City. Source: Author.

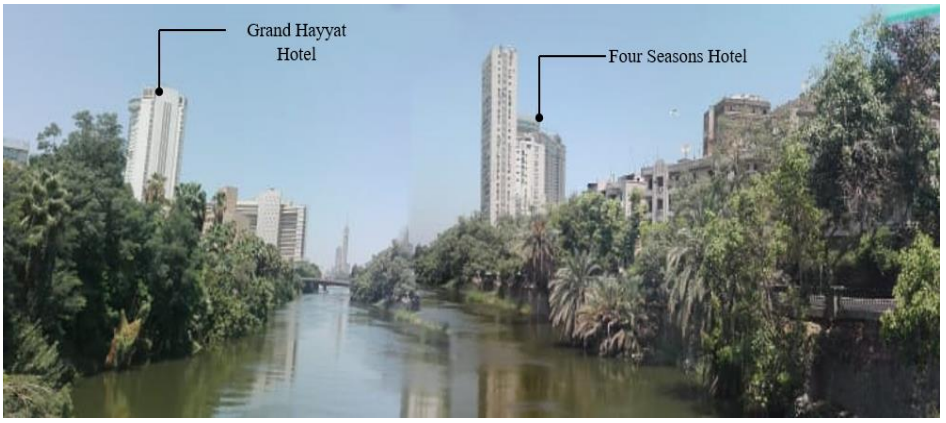


Figure 48: View of the Nile banks in Roda Island and Garden City from Al-Gamaa Bridge, looking downstream. Source: Author.

Figure 49: View of the Nile banks in Zamlek Island and Garden City, looking upstream. Source: Author.

From detailed analysis of current conditions of the Nile banks in Sector 1, it can be concluded that there is a significant contrast within this sector in land uses and the conditions of the banks itself. The southern part of the sector is dominated by residential and educational buildings, with natural vegetation lining most of the river banks, while the northern part is dominated by Hotels, private barges and semi-private open spaces. However, one common factor in both parts is restricted public access to the river's edge either by boat stations, private nurseries, private floating restaurants, and cafes or other structures making human contact with the river difficult.

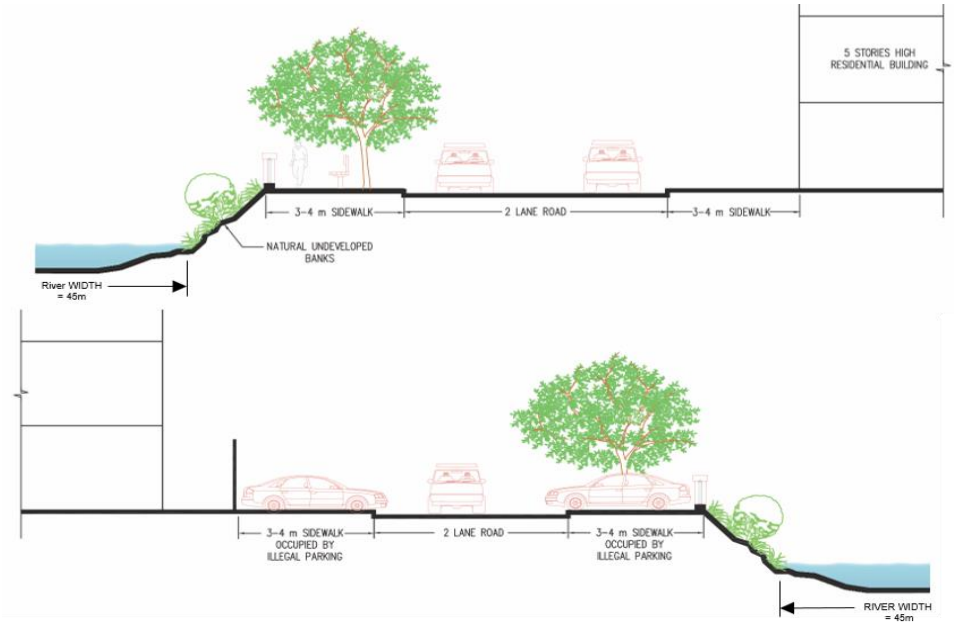


Figure 50: Section (A-A), representative cross section of the Nile banks in Sector 1, looking downstream. Source: Author.

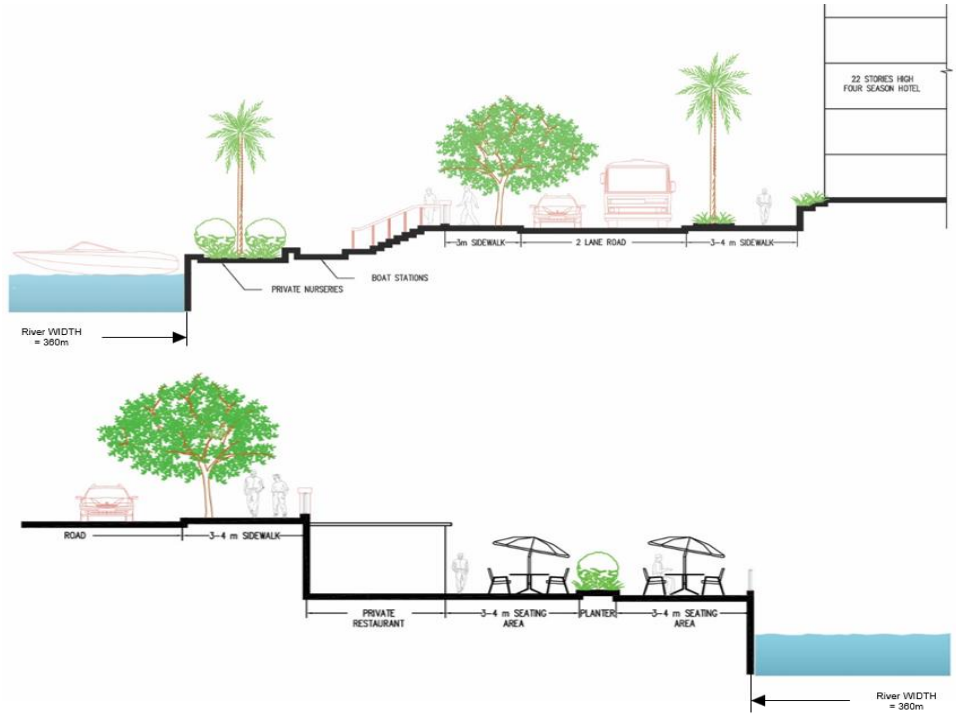


Figure 51: Section (B-B), representative cross section of the Nile banks in Sector 1, looking downstream. Source: Author.

5.4.4 Context and Background

Sector (2) extends from Qasr El-Nile Bridge in the south to 6th October Bridge in the north with a length of 0.6 Km. It borders Zamalek island to the west and the area from Tahrir square to Abd El-Moneim Riad Square to the east. This sector is considered the most important despite its relative length, partly due to its sensitive location as well as high pressure and usability. It is home to very distinct public squares such as Tahrir and Abdel Moneim Ryad Square and iconic buildings including Cairo Tower, Egyptian Opera House, and the Arab League Building. The east banks of this sector undergone a major transformation as part of Phase 1 of "Ahl Masr Promenade", completed in 2016 (Abd Alaziz, 2017; Aly, 2017). However, this study will not focus on comparing past and present conditions of the river banks as it is not within the scope of the research, nor does it serve its purposes.

5.4.5 Functional Analysis

This section focuses mainly on the current conditions of the Nile waterfront in Sector (2). A detailed analysis of the Nile waterfront area follows with emphasis on Land uses, Built environment, and Banks conditions.

- ***Land Use***

One distinctive feature of this sector is that it is dominated by administrative, governmental, and cultural uses. The east border of the river banks is home to the famous Tahrir square and Abd El-Moneim Riad Square. It houses major iconic buildings such as the Egyptian Museum, Mogamaa Al-Tahrir, Arab League building, and the former National Democratic Party building, most of which are governmental and administrative buildings. Other uses include the Nile Ritz Hotel and Hilton Hotel. the banks are lined with a 2-level pedestrian promenade, each of about 3-4 m width.

The west bank, on Zamalek Island, is dominated by Al-Ahly Sports club. It is home to the Egyptian Opera House, Cairo Tower, and Novotel Cairo Hotel. The banks are lined with fixed barges and floating restaurants and the recently revitalized waterfront park along the southern edge of Zamalek

Island. Other land uses include religious buildings such as Al-Jazira Mosque and the Egyptian Obelisk on Zamalek Island.

- ***Built Environment***

The built environment in this sector consists primarily of buildings maintained for governmental and civic purposes. Generally, most buildings are in good conditions. The east bank of the river houses most buildings in this sector, while the west bank is dominated mostly by open spaces, with few exceptions.

- ***Bank Conditions***

The east bank is lined with a 2m low-level promenade with an additional 3m stepped seating areas, with mostly barren concrete and landscaping materials with limited vegetation and few tree planters. Litter and debris scattered in the water. The west bank is lined with boat stations, fixed barges, and floating restaurants. The areas in between are completely access-restricted. The revitalized promenade on the southern edge of Zamalek Island is the only fully developed area along the west banks within this sector.

5.4.6 Key Findings on User's Experience

This section showcases key findings of the previous analysis of sector 2, identifying Biophilic indicators outlined in the previous chapter in an attempt to evaluate user's experience of the waterfront and assess the degree of integration of the river and its waterfront within the fabric of adjacent urban areas.

5.4.6.1 Biophilia Ratio, Biophilic Performances and Settings

This section provides an in-depth evaluation of indicators under this element of biophilic perceptions of the waterfront in this sector.

- ***Percentage and Quality of Green Spaces***

Generally, Green spaces within this sector are in relatively good conditions. A good number of these green spaces are public ones, however, most of them are fenced and not free, like Al-Andalus Garden, Rod-Alfarag Garden, and Al-Massala Garden. In addition, public access wasn't allowed at the time of conducting the research. Moreover, most of these spaces are on

the west bank on Zamalek Island while few green areas exist on the east banks, mostly on the upper-level promenade. However, the lower-level pedestrian promenade provides a refuge of sorts for users for relaxing and recreation with its proximity to the water level and fewer noise levels.

- ***Vegetation along riparian areas***

Vegetated areas are confined to the space in the revitalized pedestrian promenade in Zamalek Island and in areas in front of fixed barges and private floating restaurants. Limited vegetation exists on the east banks of the river and is mainly found on the upper-level promenade.

- ***Water Quality, Configurations, and appearances***

Water appearance in this sector is relatively good, except for the linear stretches along the lower-level promenade where debris and trash can be seen scattered in the water. Otherwise, the water has a clear appearance with an extraordinary reflecting quality. Movement of water can be detected, particularly in daytime.

- ***Biomorphic shapes and forms inspired from Nature***

Current promenade design is very monotonous with a sharp-edged steep concrete levee extending from the upper-level promenade to the lower-level. Street furniture, although in good conditions, is very systematic, linear lined in a very monotonous pattern, and the natural edge of the river banks are hardly recognizable to users due to the extremely barren landscape.

- ***Using Natural Materials and settings***

The east bank is dominated by concrete barren landscape with limited vegetation and shading trees. On the west bank, landscaping materials are very rare, this is due to the fact that public access is mostly restricted in most areas because of the fixed barges and restaurants. This stretch of the Nile banks is dominated by barren hardscape even within the revitalized promenade on Zamalek Island, where most of the space is dominated by hardscaping materials, with few elevated tree planters.

5.4.6.2 Sensory Experience

This element depicts sensory stimulating features found on the waterfront in this sector.

- ***Prospect and Refuge***

Due to the width of the river, users can detect movement on the other side of the river banks, but can't distinguish it. Another factor is that most of the river banks are open spaces with few buildings, with relatively different heights, as a setback, which increases feelings of freedom and decreases those of enclosure. Moreover, social interactions across river are almost impossible because of the river that at some points is more than 300m wide.

- ***Enticement and Mystery***

On the east bank, the design of the pedestrian promenade, on both levels, is very monotonous, with very minimal changes. This design offers very little opportunities for users to explore. On the west bank, since public access is restricted in most areas, the only spaces available for public access are the revitalized promenade on Zamalek Island.The design of the promenade encourages people to explore the space with its elevated seating areas.

- ***Mental peace and security***

In terms of personal safety, people seem to be relaxed when close to the river's edge and show no signs of fear of potential incidents due to the relatively good countermeasures of safety. While on the opposite bank in Roda Island, dilapidated metal railings are a dominant sight, with completely ripped or broken parts in some places, which people typically avoid getting close to.

The presence of and proximity to the river itself generally evokes positive feelings. However, noise levels generated by heavy traffic volumes, coupled with the fact that the pedestrian promenade is on the same level as vehicles routes, separated only by a 3-4 m wide sidewalk, make feelings of relaxation or solitude almost impossible.

- ***Thermal Comfort***

Design interventions for shelter are lacking on both banks, shading trees on both levels of the promenade are in short supply. Some sectors of the Nile-

level promenade are shaded by upper-level terraces overlooking the Nile. However, the structures of these terraces are dilapidated that users feel unsafe setting by them.

- ***Experience of Nature***

Generally, the presence of the river is dominating. On the east bank, users try to get as close to water as they can, some of them disregard safety countermeasures to be closer to the water. Some users were observed scrambling down the promenade at informal access points to get to the water level while others climbed the metal railings separating the promenade level from the water edge to be directly above water level. On the west bank, the revitalized promenade, with terraces extending into the water and overlooking the Nile, encourages people to be close to the river.

- ***Environmental, Historical, and Cultural Literacy on the waterfront***

There are no facilities that provide information in the area. Most users didn't seem to know of the historical or cultural value of the river, with the exception of being informed of the current political conflict over the construction of Al-Nahda Dam in Ethiopia. No public institutions that might inform about the river's nature or history exist within this sector.

5.4.6.3 Connectivity and Accessibility

- ***Pedestrian and Traffic Volume on the Waterfront***

Traffic volumes are very high, particularly during daytime on working days, this is because the area is home to two of Cairo's major squares, Tahrir square and Abd El-Moneim Riad Square. Pedestrian volumes are also relatively high, particularly on the upper-level promenade. Multiple public transit stops exist within the area including major bus terminals in Abd El-Moneim Riad Square as well as multiple metro stations.

- ***Longitudinal, lateral, and vertical connectivity***

On the east bank, lateral connectivity with the river is generally fulfilling, partly because of the revitalized Nile-level promenade and the fact that there are no adjacent structures obscuring visual or physical access to the river. Aspects of longitudinal connectivity are also mostly good, however,

bridges structures interrupting pedestrian access points to the river on both levels is a major point of weakness A number of vertical connectivity points are available. On the other hand, the west bank is a striking contrast. Most of the riverbank is cut off from public access with the only exception of the revitalized promenade in Zamalek Island.

- ***Navigation, Signage, and way-finding infrastructure***

Generally, navigation and way-finding infrastructure in the sector is lacking. The simple linear design of the promenade is rather navigable for pedestrians. Most navigation signages are found on the upper-level promenade, mainly for vehicles with no signages for access points to the river, while the lower-level promenade doesn't have any signage infrastructure.

- ***Accessibility***

This sector is well-connected to adjacent urban areas, partly due to its strategic location. Abundant public transit infrastructure exists adjacent to the riverfront along this stretch of the Nile. A number of transportation modes are available, including metro stations and public transit transportation.

5.4.6.4 Physical Character and Place Identity

- ***Number of Water dependent and Water-related Activities***

In this sector, it can be observed that water-dependent and water-related uses dominate the area, with a 2-level pedestrian promenade stretching along the east bank of the river. While the west bank is dominated by fixed barges, floating restaurants, and open green spaces. Most users are observed either walking along the promenade, contemplating, or simply engaging in conversations with their companions.

- ***Number of Cultural and historical facilities on the waterfront***

No significant cultural or historical facilities related to the Nile exist within this sector. However, there are a number of civic facilities that could act as orientation points that people associate with the waterfront, without necessarily being related to the Nile itself, such as the Egyptian Museum and Cairo Tower.

Figure 52: Barren concrete levee extending from the upper promenade to the lower-level with dilapidated structures, broken metal railings, and informal seating areas on the east bank. Source: Author.

Figure 53: Barren non-shaded stepped seating areas occupied by street vendors and informal uses. Source: Author

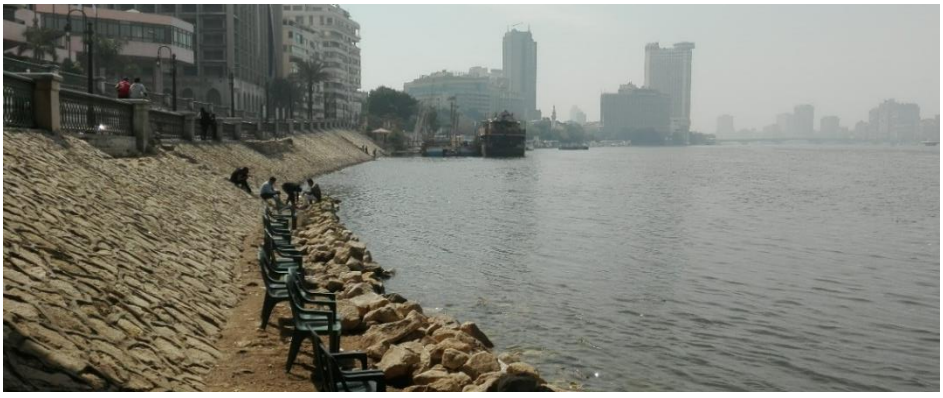


Figure 54: Young people scrambling down the concrete levee to be closer to the water and to avoid harassment of street vendors on the east bank. Source: Author.

Figure 55: Pictures showing current barren Nile Promenade on both levels.
Source: Author.

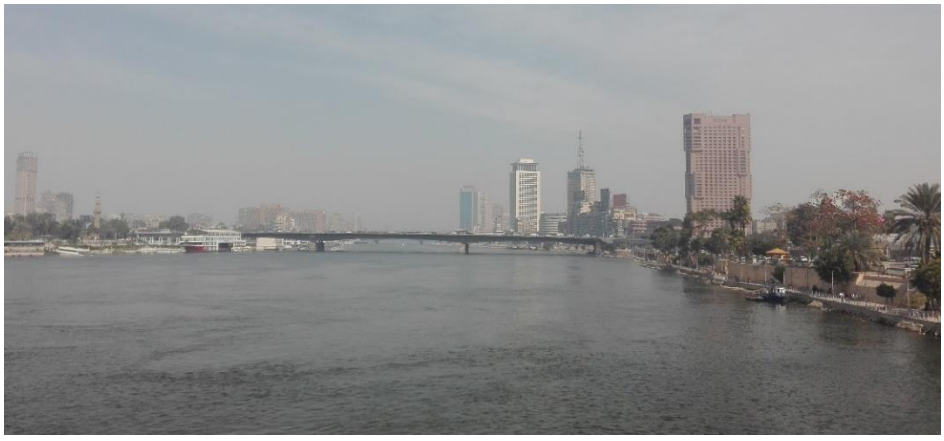


Figure 56: View of the east bank, from Qasr Al-Nile Bridge. Source: Author.

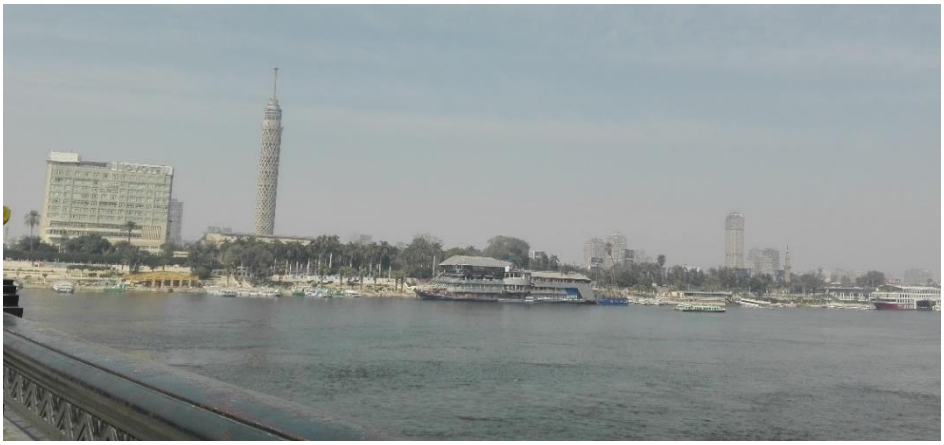


Figure 57: View of the west bank, from Qasr Al-Nile Bridge. Source: Author.

Figure 58: Unused restricted Nile-level promenade in front of fixed barges on the west bank. Source: Author.

Figure 59: Revitalized promenade on Zamalek Island on the west bank. Source: Author.

Figure 60: View of the Nile banks in Sector 2, looking downstream. Source: Author.

Figure 61: View of the Nile banks in Sector 2, looking upstream. Source: Author.

From the detailed analysis of current conditions of the Nile banks in Sector 2, it can be concluded that despite the fact that this sector is mostly dominated by open green spaces, yet most of these spaces are restricted to public access. The recently revitalized pedestrian promenade on the east bank, although definitely provides access to the river, it is still lacking in terms of public amenities and biophilic infrastructure. The west banks are mostly cut off from the public, typically because of the presence of fixed barges and floating restaurants.

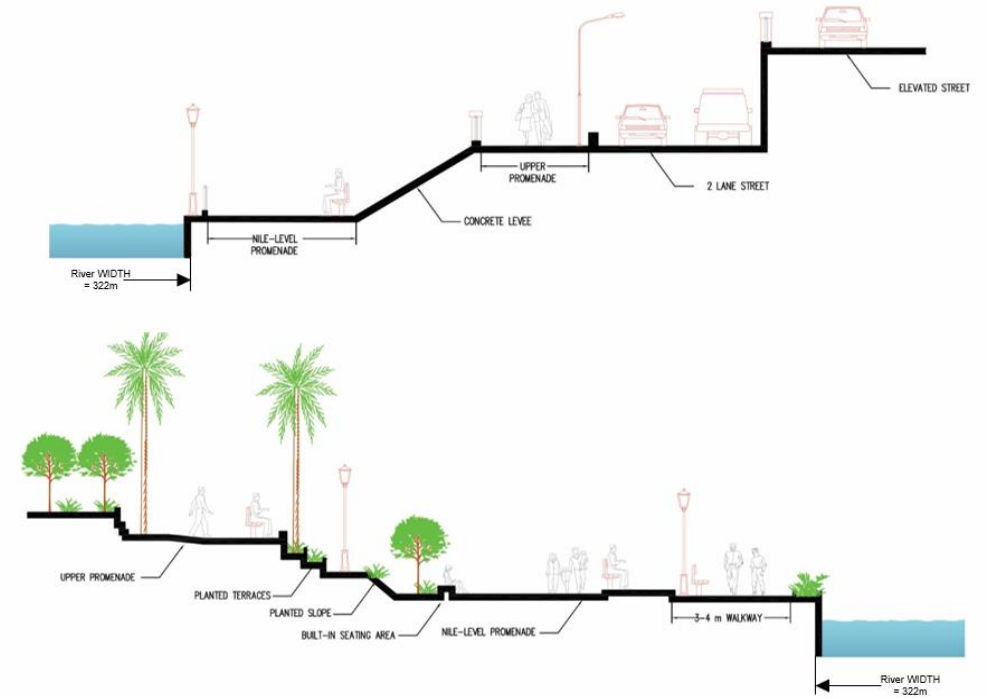


Figure 62: Section (C-C), representative cross section of the Nile banks in Sector 2, looking downstream. Source: Author.

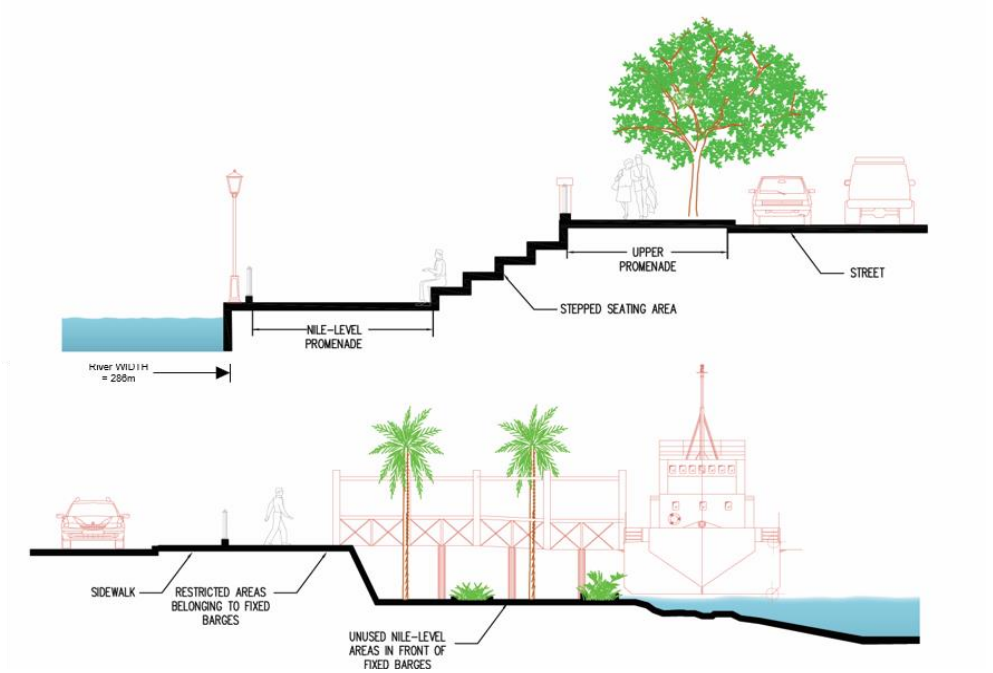


Figure 63: Section (D-D), representative cross section of the Nile banks in Sector 2, looking downstream. Source: Author.

5.4.7 Context and Background

Sector (3) extends from the 6th of October Bridge in the south to 15th of May Bridge in the north with a length of 0.8 Km, bordering Maspero area in the east and Zamalek Island in the west. This sector can be considered as an extension of Sector 2 mostly, in terms of character and land uses. Similarly, the east bank of this sector underwent a major transformation as part of Phase 2 of "Ahl Masr Promenade", completed in 2017 (Abd Alaziz, 2017; Aly, 2017). It is home to iconic buildings including Maspero Building and the Ministry of Foreign Affairs Building.

5.4.8 Functional Analysis

This section focuses mainly on the current conditions of the Nile waterfront in Sector (3). A detailed analysis of the waterfront area follows with emphasis on Land uses, Built environment, and Banks conditions.

- ***Land Use***

Similar to Sector 2, this sector is dominated by administrative and cultural uses, however, residential buildings also reappear in this sector in the northern part of Zamalek Island. Other uses include the Cairo Marriot Hotel and Hilton Hotel. The east bank is lined with a 2-level pedestrian promenade, each of about 3-4 m width, it also home to only water-taxi station within the study area. The west bank on Zamalek Island is dominated by Al-Jazeera Club. Similar to the previous sector, the west bank is lined with fixed barges, floating restaurants, and a strip of residential buildings stretching along the river bank that ends with the Cairo Marriot Hotel. Other land uses include religious buildings like Sultan Abu-Alaa Mosque, the National Bank of Egypt, and high-rise commercial buildings to the east and the embassy of Tunisia and All Saints Cathedral to the west.

- ***Built Environment***

This sector consists primarily of buildings maintained for governmental, civic, and commercial purposes. Generally, most buildings are in good condition. The east bank of the river houses most buildings in this sector, while the west bank is dominated mostly by open spaces in the form of Al-Jazeera Club and residential buildings up to 12 stories high.

- ***Bank Conditions***

The east bank is lined with a 2-level pedestrian promenade similar in design to the one in Sector 2. The two are separated only by bridge structures. Litter and debris scattered in the water. The west bank is lined with boat stations, fixed barges, and floating restaurants. The areas in between are completely access- restricted.

5.4.9 Key Findings on User`s Experience

This section showcases key findings of previous analysis of sector 3, identifying Biophilic indicators outlined in the previous chapter in an attempt to evaluate user's experience of the waterfront and asses the degree of integration of the river, and consequently its waterfront within the fabric of adjacent urban areas.

5.4.6.1 Biophilia Ratio, Biophilic Performances and Settings

- ***Percentage and Quality of Green Spaces***

Generally, green spaces are prevalent in this sector, most of which are on the west bank on Zamalek Island. However, these spaces are either private like Al-Jazeera club or prohibited areas with public utilities in front of fixed barges while almost no green areas exist on the east bank.

- ***Vegetation along riparian areas***

Vegetated areas mostly stretch along the river west bank in front of residential buildings where naturally overgrown vegetation can be found. Vegetation also is limited in the areas in front of fixed barges and private floating restaurants. Limited vegetation exists on the east bank of the river and is mainly found on the upper-level promenade.

- ***Water Quality, Configurations, and appearances***

Water appearance in this sector is relatively good, except for the linear stretches along the lower-level promenade where debris and trash can be found. Otherwise, the water has a clear appearance with an extraordinary reflecting quality. Movement of water can be detected, particularly in daytime.

- ***Biomorphic shapes and forms inspired from Nature***

Barren hardscape characterizes the pedestrian promenade on the east bank of the river, with sharp-edged steep concrete levee extending from the upper-level promenade to the lower-level, making the natural edge of the river banks hardly recognizable.

- ***Using Natural Materials and settings***

The east bank is dominated by concrete barren landscape with limited vegetation and shading trees. On the west bank, the areas in front of fixed barges and floating restaurants are mostly vegetated, however, because these areas are restricted, users can't really enjoy such settings. Moreover, the only completely natural area on river banks is the linear stretch of riparian vegetation along the west bank, however, this area is mostly undeveloped.

5.4.6.2 Sensory Experience

- ***Prospect and Refuge***

Due to the relative width of the river, users can detect movement on the other side of the river banks and distinguish it, particularly in front of Mariott Hotel, as the width of the river is only 225m. the Strip of residential buildings stretching along the Nile west bank as a setback to naturally vegetated banks increases feelings of enclosure. Social interactions across the river are possible but difficult.

- ***Enticement and Mystery***

On the east bank, the design of the pedestrian promenade, on both levels, is very monotonous, with very minimal changes. This design offers very few opportunities to explore. On the west bank, since public access is restricted in most areas because of the fixed barges and floating restaurants, very limited spaces are allowed for the public to explore.

- ***Mental peace and security***

In terms of personal safety, people seem to be relaxed when close to the river's edge and show no signs of fear of potential incidents due to the relatively good countermeasures of safety. The presence of and proximity to the river itself generally evokes positive feelings. However, noise levels

generated by heavy traffic volumes, coupled with the fact that the pedestrian promenade is on the same level as vehicles routes, separated only by a 3-4 m wide sidewalk, is distracting at best.

- ***Thermal Comfort***

Shading trees on both levels of the promenade are in short supply. Design interventions for shelter are lacking on both banks.

- ***Experience of Nature***

Generally, the presence of the river is overwhelming. On the east bank, users try to get as close to water as they can, however, seating areas within this sector are confined to the stepped concrete seating area along the lower-level promenade, which contradicts user's preference for being as close to the water as possible. On the west bank, restricted public access in most areas decreases the potential of people getting close to the river level, despite the Nile-level developed promenade that exists in these areas.

- ***Environmental, Historical, and Cultural Literacy on the waterfront***

There are no facilities or infrastructure that provide information in the area. Most users didn't seem to know of the historical or cultural value of the river, with the exception of being informed of the current political conflict over the construction of Al-Nahda Dam in Ethiopia. No public institutions to inform about the river's nature or history exist within this sector.

5.4.6.3 Connectivity and Accessibility

- ***Pedestrian and Traffic Volume on the Waterfront***

Traffic volumes are very high, particularly during daytime on working days. Pedestrian volumes are also relatively high, particularly on the upper-level promenade. Multiple public transit stops exist within the area including major bus terminals in Abd El-Moneim Riad Square as well as multiple metro stations as well as the heavily used water-taxi on the east bank.

- ***Longitudinal, lateral, and vertical connectivity***

On the east bank, lateral connectivity with the river is generally fulfilling, partly because of the revitalized Nile-level promenade and the fact that no adjacent structures are obscuring visual or physical access to the river. Aspects of longitudinal connectivity are also mostly good, however, bridges

structures interrupting pedestrian access points to the river on both levels is a major point of weakness A number of vertical connectivity points are available. However, the west bank is mostly cut off from public access because most of these areas are in front of fixed barges, where public access isn't allowed. Moreover, the only area available for the public is the linear stretch in front of residential buildings which is completely undeveloped.

- ***Navigation, Signage, and way-finding infrastructure***

Navigation and way-finding infrastructure in the sector is lacking. The simple linear design of the promenade is rather navigable for pedestrians. Most navigation signages are found on the upper-level promenade, mainly for vehicles with no signages for access points to the river. Moreover, the lower-level promenade doesn't have any signage infrastructure.

- ***Accessibility***

This sector is well-connected to adjacent urban areas, partly due to its strategic location. Abundant public transit infrastructure exists adjacent to the riverfront along this stretch of the Nile. A number of transportation modes are available, including metro stations and public transit transportation. This sector is also home to the only water-taxi station in the study area, opposite to Maspero Building, which is a distinct feature compared to the other sectors.

5.4.6.4 Physical Character and Place Identity

- ***Number of Water dependent and Water-related Activities***

Water-dependent and water-related uses dominate the area, with a 2-level pedestrian promenade stretching along the east bank of the river, lined with boat stations as well as the only water-taxi station in front of Maspero Building. While the west bank is dominated by fixed barges, floating restaurants, and open spaces with the exception of the strip of residential buildings stretching along the north part on the west bank.

- ***Number of Cultural and historical facilities on the waterfront***

No significant cultural or historical facilities related to the Nile exist within this sector. However, there are a number of civic facilities that could act as orientation points that people associate with the waterfront, without being related to the Nile itself.

Figure 64: View of the west bank in Sector 3. Source: Author.

Figure 65: Barren hardscaping material of the lower -level pedestrian promenade with no shading in the east bank. Source: Author.

Figure 66: Private boat stations along the pedestrian promenade on the east bank. Source: Author.

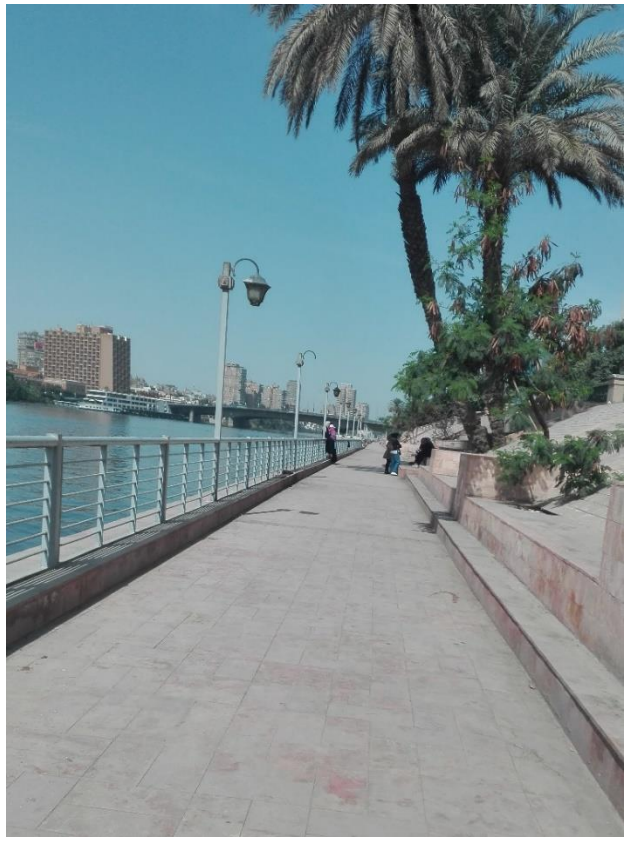


Figure 67: View of the pedestrian promenade on the east bank. Source: Author.

Figure 68: Restricted areas in front of fixed barges and floating restaurants on west bank. Source: Google Earth with modifications by Author.

Figure 69: View of the east and west banks in Sector 3, looking downstream. Source: Author.

Figure 70: View of the east and west banks in Sector 3, looking downstream. Source: Author.

From the analysis of current conditions of the Nile banks in Sector 3, it can be concluded that the recently revitalized pedestrian promenade on the east bank, although provides access to the river, it is still lacking in terms of public amenities and biophilic infrastructure. Most of the west bank is cut off from the public, because of the presence of fixed barges and floating restaurants and the Mariott Hotel.

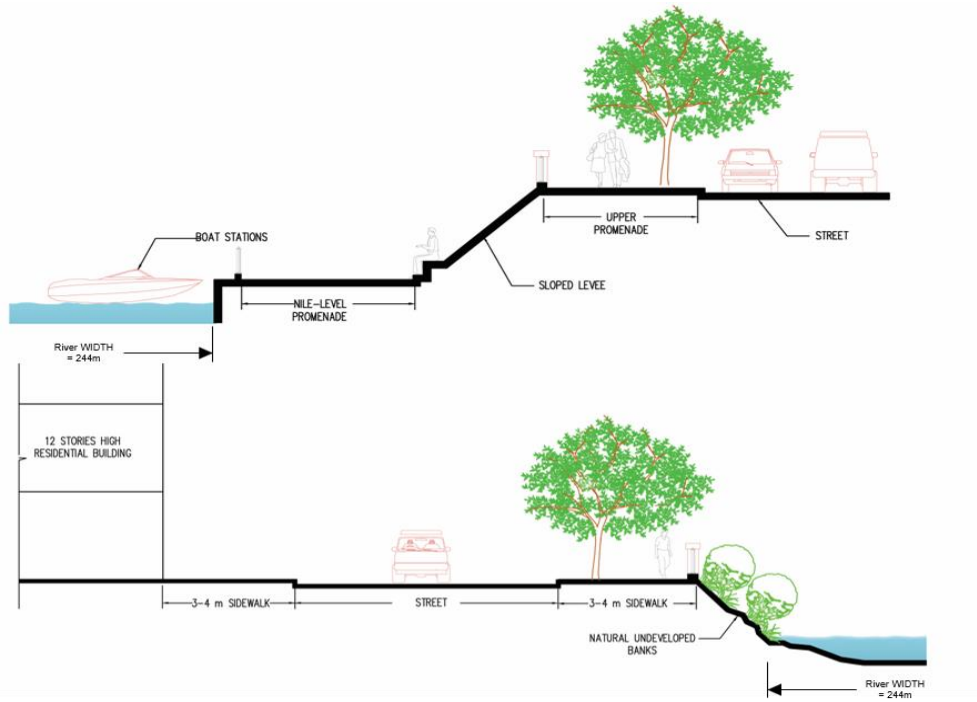


Figure 71: Section (E-E), representative cross section of the Nile banks in Sector 3 looking downstream. Source: Author.

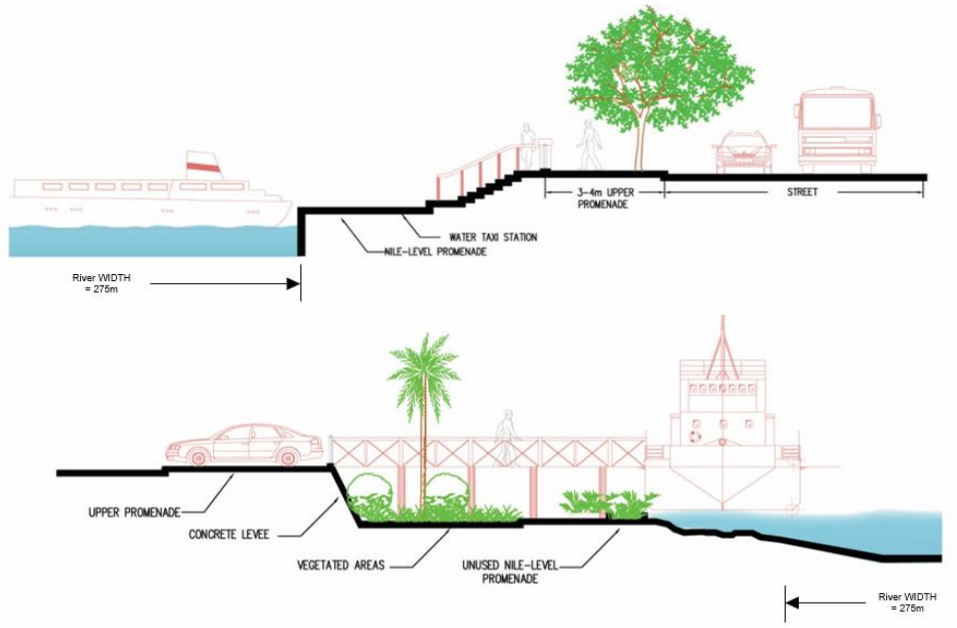


Figure 72: Section (F-F), representative cross section of the Nile banks in Sector 2, looking downstream. Source: Author.

5.5 Ecological Analysis

Generally, studies reveal the deterioration of the Nile water quality. Studies conducted by (Abdel-Satar et al., 2017; El-Sheekh, 2016) revealed that the continuous discharge of contaminants and pollutants generated by anthropogenic activities, such as heavy metals or human waste products as well as organic and industrial wastes generated by touristic activities on the Nile banks negatively affected river's health, diminished its self-purification capability, and the suitability of supporting aquatic life. Another study revealed that annual average values of WQI of Nile River at Cairo were poor for drinking water and good for aquatic life (Al-Afify et al., 2018).

As per on-site observations, litter, debris, and trash along the Nile promenade is a persistent problem within all three of study sectors. Moreover, water configuration and appearance were key issues, particularly in the southern part of Sector 1. Aquatic life, plants and animals that exist within the water-ways space and which represent a transition between the land-water forms to the waterfront space and enrich the visual qualities to the space, is almost non-existent in all sectors of the study area whereas riparian vegetation is limited to specific reaches of the river banks, specifically natural undeveloped areas along the river banks in the southern part of Sector 1 and along the west bank of Sector 3.

The Nile corniche, especially in Graden city area is well recognized for its centuries-old Banyan Trees. Most of the noticed vegetation on the river banks is introduced as part of the streetscape, such as the Ficus Nitida trees and palm trees. Perhaps the most famous one is the massive Banyan Tree of Zamalek Island, located at Al-Borg Street and at the entrance of Cairo tower, one of the oldest banyan trees in the city of Cairo, planted in 1868 and one that became an icon for Zamalek district.

Air quality is another issue, as the study area suffers from heavily congested traffic problem. However, a study conducted by (Kondolf et al., 2011) reveals that air particulate matter level on the lower-level promenade is approximately 30% lower than those on the upper pedestrian promenade level, which provides an opportunity for creating a continuous trail along the water-level promenade.

5.5.1 River Topography

The Nile has a relatively gentle slope, with a total drop in bed level of 80 m over 1250 Km from Aswan to the Mediterranean Sea. Moreover, the river has a controlled discharge and water level (Raslan, 2006). River flood level is about 1-2m, a result of the construction of the Aswan High Dam, whereas it used to be about 6-7 before its construction (Kondolf et al., 2011). The highest flood level doesn't exceed the level of the lower-level promenade (Mouad, 2013). River bed level varies significantly from one place to another. (Figure 73) shows the relationship between river width and the average river bed level. Average river bed level ranges from 13m to 15m across sectors.

5.5.2 River Width

River's width varies from one sector to another, the most significant change can be detected in Sector 1, where the maximum width of the river is about 467 m in the northern part of the sector and about 65 m in the southern part, which is the lowest river's width within the study area.

Moreover, River's width to adjacent building height ratio consequently varies within all sectors of the study area and even within each sector, depending on land uses along the river banks. In addition, the ratio between available open space along the river banks and the river width also varies significantly in accordance with land ownership, land uses, and banks' condition. River width also plays a role in typologies of activities and land uses along the river banks and aspects of navigation as well.

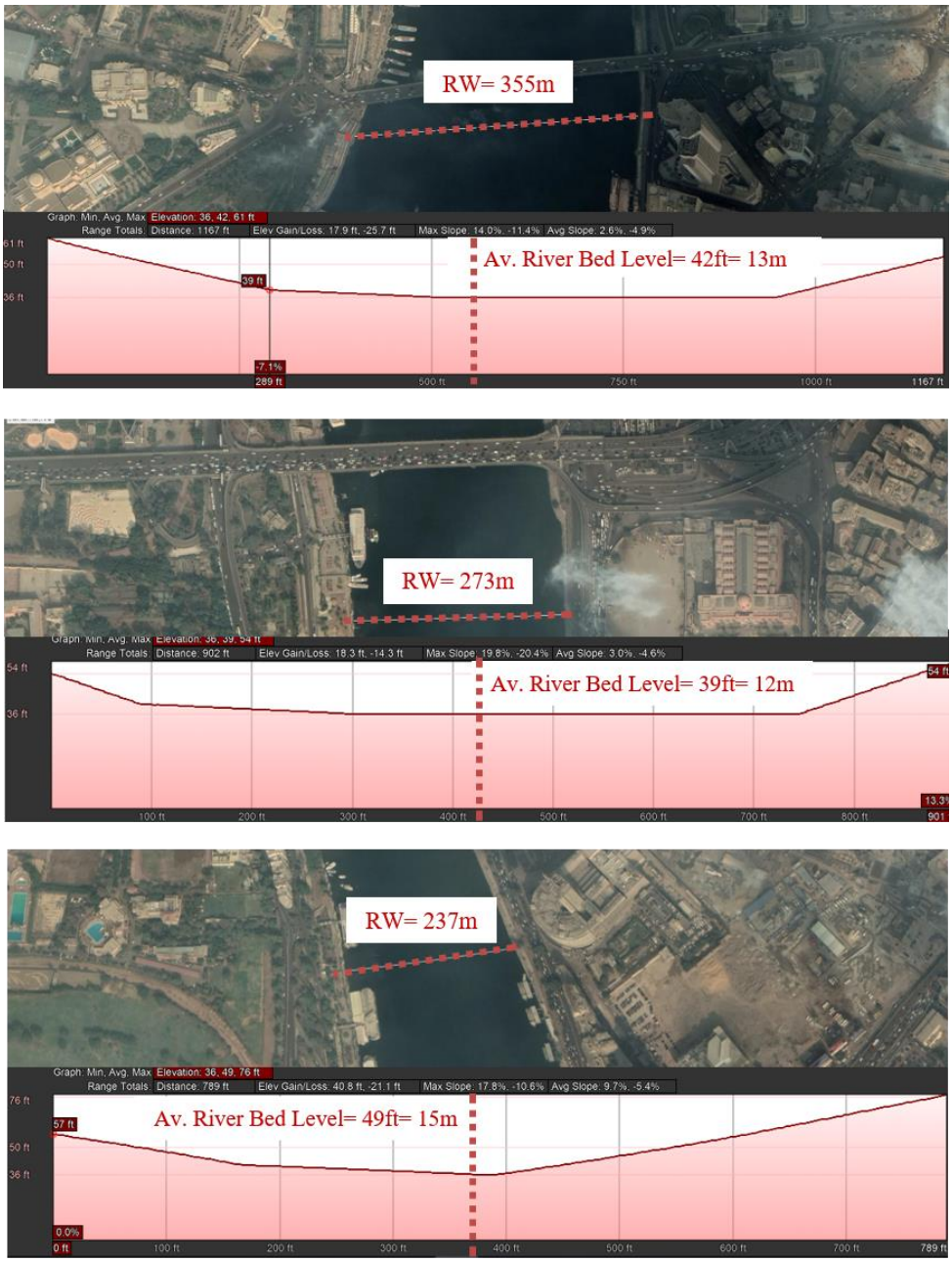


Figure 73: Cross sections in the Three Sectors of study area showing river showing the relationship between river width (RW) and Average River bed level.
Source: Author based on Google Earth.

5.6 Social Analysis

To assess user's perceptions and experience of the Nile waterfront in selected study area, an online questionnaire[2] was circulated on the internet in both Arabic and English to reach a wider population. However, due to the timeframe available, only a total number of 53 responses were gathered. The questionnaire design consists of 25 questions. These include demographic information (7 items), purpose of visit (2 items), duration of visit and familiarity (3 items), types of engagement and activities (1 item), users preference (1 item), place identity (8 items), and perceptions of comfort and safety (3 items).

The questionnaire was designed using mostly closed-ended items with multiple-choice formats. In the last question, a 5-point Likert- scale from "strongly disagree' to 'strongly agree' was used to assess aspects of place attachment and sense of belonging. The following section will discuss the findings and results of the questionnaire to investigate users' perceptions of the Nile waterfront in the selected study area, how these perceptions affect their experiences in the waterfront, and consequently determine what these indicate in relation to the social perceptions of the Nile waterfront as a natural resource.

5.6.1 Main Findings

Questions (1-7): These sets of questions concerned with demographic information of user's groups. 86% of respondents were females, 13.6% were males while around 18% of respondents chose not to state their gender (Figure 74). More than 85% of respondents are well educated with a bachelor or a higher degree, 7% are students and almost 7% chose not to specify their level of education.

[2] The online questionnaire can be found through the below link:

https://docs.google.com/forms/d/e/1FAIpQLSfzhik0ax2sOxL5JNdUUFuGSKT-Oc5hDDMZEgGVnOeLCzDPyA/viewform?vc=0&c=0&w=1&flr=0&gxids=7628&fbzx=-3714408200440766063

Around 66% of respondents are between 26-35 years old, almost 16% are between 15-25 years old, and another 16% are above 35 of age (Figure 75). This aligns well with on-site observations and indicate that the waterfront in selected study area attracts certain age groups (e.g., young people) while others (e.g., elderly people) don't particularly visit the Nile waterfront within the selected study area.

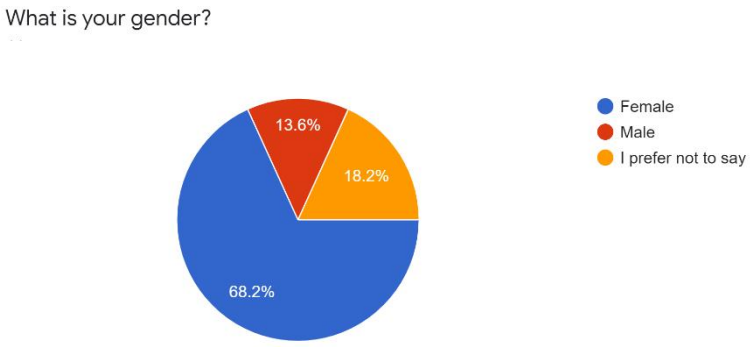


Figure 74: Chart showcasing responses to Question (1) about gender of the participants. Source: Author.

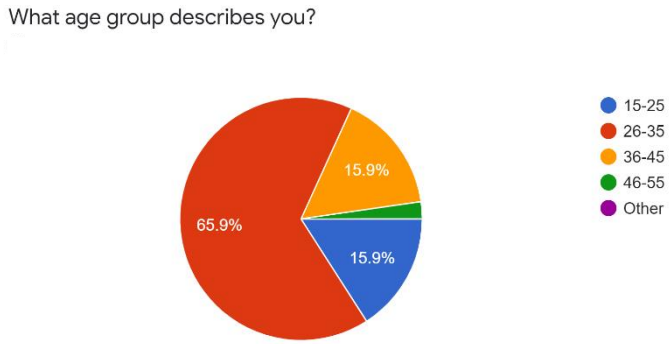


Figure 75: Chart showcasing responses to Question (2) about the age group of the participants. Source: Author.

All respondents are residents of Cairo and most of them are residents of areas relatively far or not within walking distance from the waterfront in Central Cairo. Almost 50% of respondents are full-time employees and the other 50% are either part-time employees or self employed. A very low percentage are either unemployed or stay at home parents, of those the higher percentage are women.

Question (8): Almost 70% of respondents visited the Nile waterfront for recreational purposes and 40% of respondents visited the waterfront for work, residence or other purposes (Figure 76). This indicate that the waterfront is already a vital destination for recreational activities.

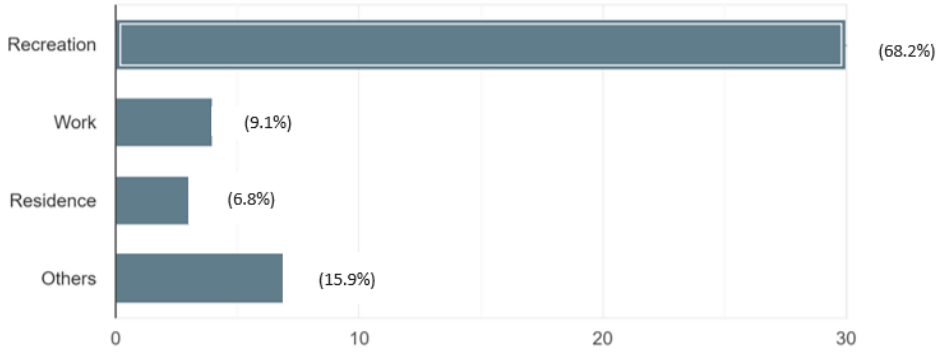


Figure 76: Chart showcasing responses to Question (8) about the purpose of visit to the waterfront. Source: Author.

Question (9): Only 20% of respondents visit the waterfront on a regular basis, more than 35% visit it occasionally while the largest number of respondent, more than 40%, either visit it rarely or on special occasions (Figure 77).

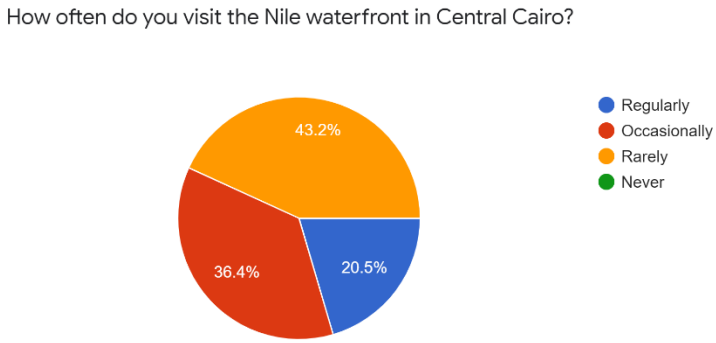


Figure 77:Chart showcasing responses to Question (9) to inquire about how often participants visit the waterfront. Source: Author.

Questions (10-12): More than 50% of respondents visit the waterfront for dining, almost 30% for strolling and walking, and 6% visit it for contemplating, fishing, or other activities (Figure 78). Most respondents (68%) spend between 1 hour to 3 hours when visiting the waterfront.

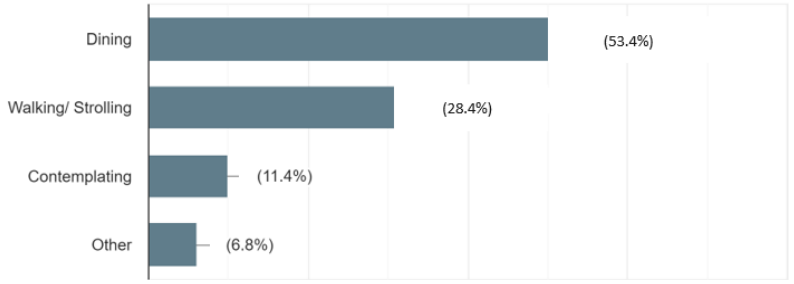


Figure 78: Chart showcasing responses to Question (10) about the types of activities users engage in while visiting the waterfront. Source: Author.

More than 50% and 25% of the respondents visit the place for purposes of dining and strolling/ walking, respectively. while around 11% visit the in the area in most of them visit it on special occasions, and most respondents prefer to visit the waterfront during night-time, both on week-days and weekends (Figure 79). This could be attributed to lack of shaded areas for users and lack of thermal comfort within the space.

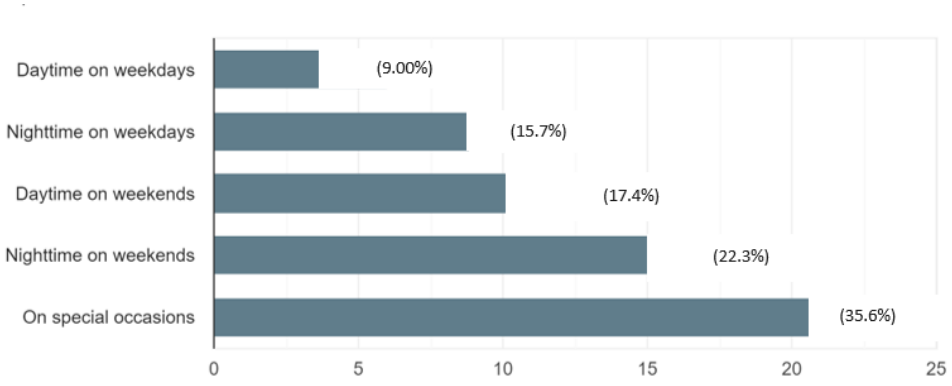


Figure 79: Chart showcasing responses to Question (12) about the time of day when participants prefer to visit the waterfront. Source: Author.

Question (13): When asked about how they feel when visiting the waterfront, most respondents reported feeling "Content", "Relaxed", and "Happy" when visiting the waterfront, while a relatively small percentage felt "distracted" (Figure 80). It is important to take into consideration that all reported feelings associated with visiting the waterfront and more generally of contact with any type or setting of natural environments are mostly self-reported.

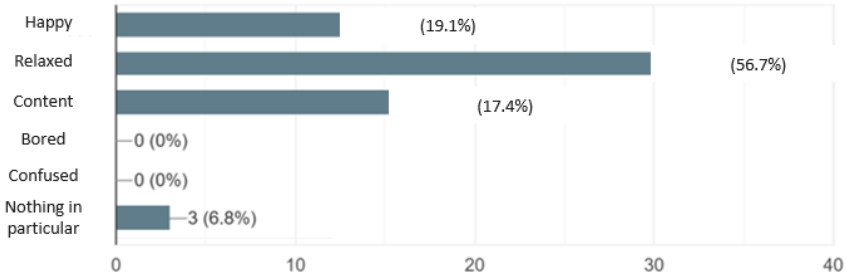


Figure 80: Chart showcasing responses to Question (13) about reported feelings when visiting the waterfront**.** Source: Author.

Question (14): Almost 80% of respondents preferred to stay as close to the water as they can get, 15% preferred to stay at a considerable distance from the water, and less than 5% chose to stay away but with visual access to the water for safety measures (Figure 81). This indicate people's preference to be in close proximity to water and therefore supports development decisions that provide both physical and visual access to the river.

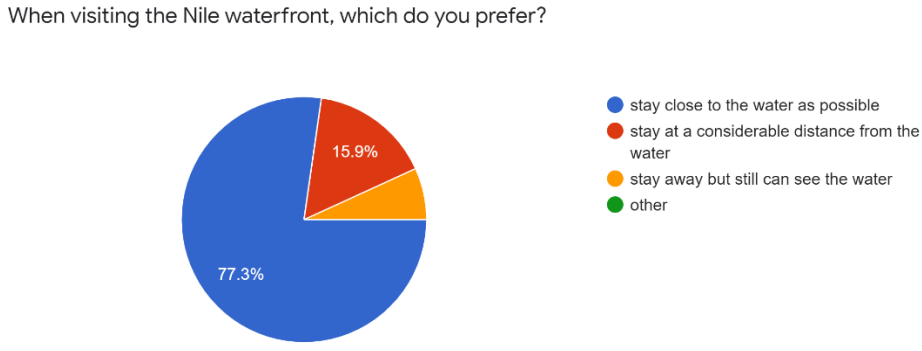


Figure 81: Chart showcasing responses to Question (14) about preference of proximity to water when visiting the waterfront. Source: Author.

Questions (15-16): When asked about feelings of personal safety on the waterfront, around 85% of respondents said they felt "safe" within the waterfront while 15% said they didn't feel safe (Figure 82). Reasons for feeling unsafe included insufficient lighting, over-crowding, harassment of street vendors, and some said that they don't feel safe in close proximity to water in the absence of good safety countermeasures. Question (15) was a closed-ended question with answers of "yes" or "No" while the latter is an open-ended question.

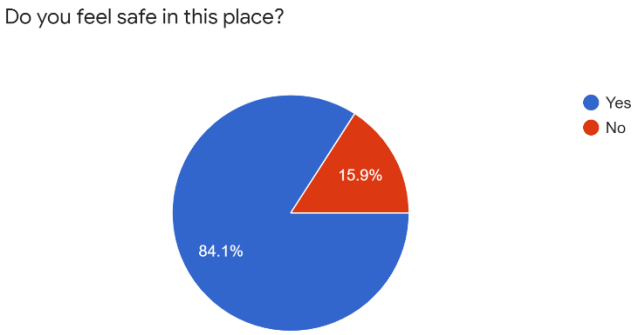


Figure 82: Chart showcasing responses to Question (15) about feeling of safety in the waterfront. Source: Author.

Questions (17-19): Most respondents chose the Nile itself as the most attractive/distinctive aspect about the waterfront while some chose the visual quality of the whole place as its most distinctive feature (Figure 83). For most respondents, the Nile was the defining characteristic of the waterfront (Figure 84).

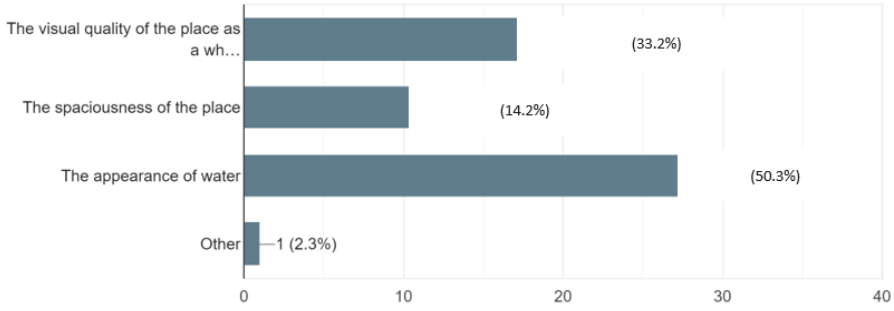


Figure 83: Chart showcasing responses to Question (17**)** about the attractive aspects/ features of the waterfront. Source: Author.

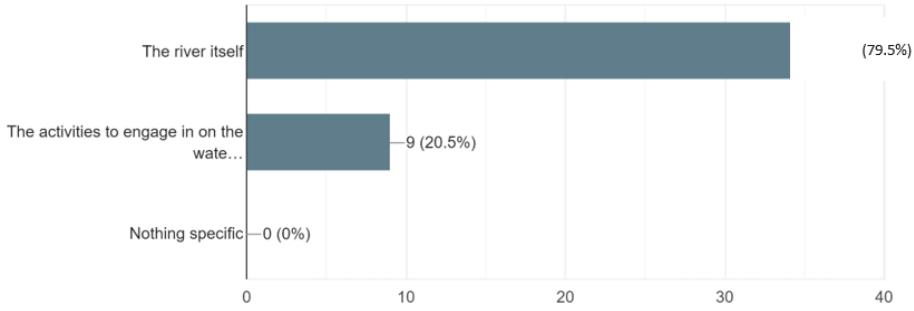


Figure 84: Chart showcasing responses to Question (18) about the main characteristics of the waterfront**.** Source: Author.

Questions (20-21): Almost 70% of respondents associate the waterfront with a distinctive image or scenes and about 30% don't associate it any with any image at all (Figure 85). Those who do can recall the image of boats and ships floating in the water, families lining the waterfront promenade, and the Nile itself with Cairo Tower in the background. Around 11% of respondents who do associate it with specific image couldn't recall a specific image when the "Nile" or "the waterfront" was mentioned (Figure 86).

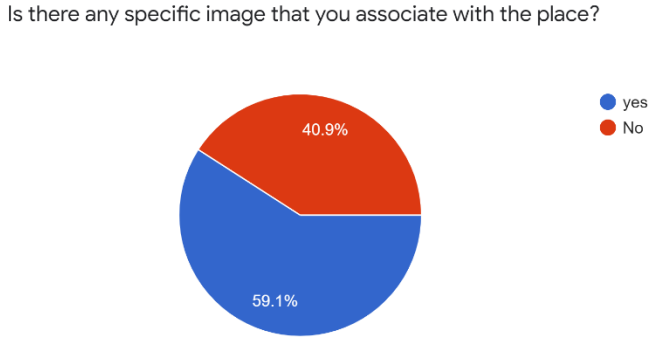


Figure 85: Chart showcasing responses to Question (20) about any distinctive image they associate with the waterfront. Source: Author.

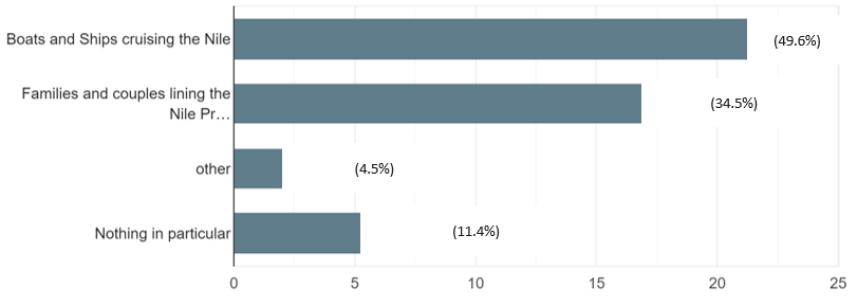


Figure 86: Chart showcasing responses to Question (21) about types of distinctive images they associate with the waterfront. Source: Author.

Questions (22-23): Most respondents (91%) mentioned that they can see the water clearly when visiting the waterfront, around 31% mentioned they can hear its movement and most of them mentioned they can't touch the water.

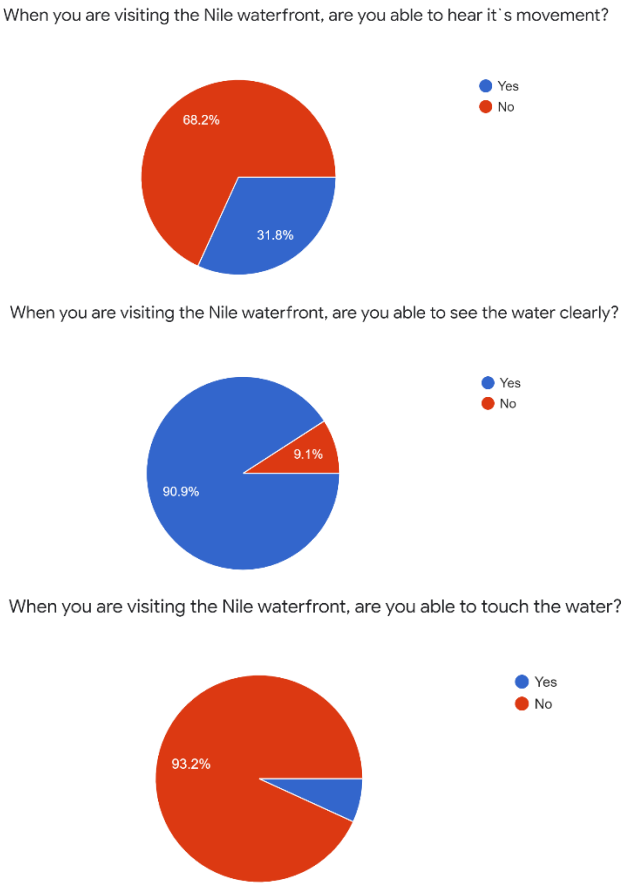


Figure 87: Chart showcasing responses to Questions (22-23). Source: Author.

Questions (24): This question used a 5-point Likert scale to investigate users' perceptions of sense of place and connectedness to the waterfront and the river (Figure 88).

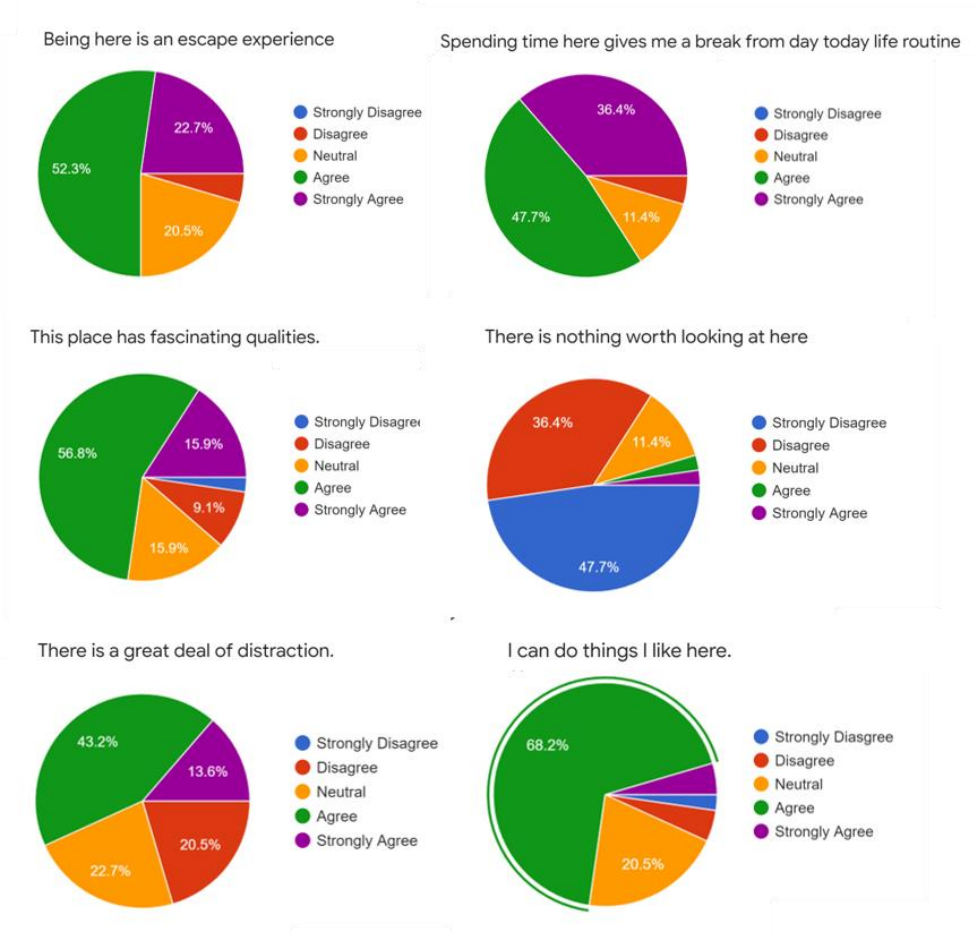


Figure 88: Responses to Perceptions of sense of place and connectedness to the waterfront and the river and the waterfront. Source: Author.

Question (25):. Almost 70% of respondents were satisfied with the current conditions of the waterfront, most respondents were concerned about poor conditions in the waterfront, "cleanliness", safety, the absence of adequate facilities, the lack of shaded areas, and over-crowding.

5.7 Results and Discussion: Typologies of Nature Valuations and Biophilic Indicators in the Nile Waterfront

Based on data collected from the social analysis from both the online questionnaire and on-site interviews with users of the study area. Results were then categorized according to a set of keywords that represent an expression of one or more value of the types of Kellert's nature valuations (Kellert, 2005), discussed in Chapter 1.

The results indicate that users of the waterfront hold different values for the waterfront and as such supports the notion that people's relationships with water-ways and their environments are multi dimensional. These values aren't discrete and often occur together. (Figure 89) illustrates the typologies and concurrence of recorded environmental values.

Concurrence occurrence of valuations

Value	Key words/Description	No. of times repeated
Aesthetic	- Visual appeal of water: "I like to see the water moving", "I like the color of the water". "The appearance of water is the most attractive aspect of the Nile waterfront".	**33 (53.2%)**
Naturalistic	-Feel a sense of isolation: "I like to come here to be away from people" and " I like to come here to think about everything away from people", "Contemplating", "Being here is an escape experience", "Spending time here gives me a break from day today life routine". -Feel relaxed, calm and peaceful when near the water: "I feal happy, relaxed, and content when visiting the waterfront". -Experience sensory pleasures: sights, sounds, smells: "I like to see the water moving" and " I wish i can touch the water".	
Humanistic	- A special bond between people and water. "Water can keep my secrets" and "I only come here with my friends".	**2**
Negativistic	- Fear of water and proximity to water: "Stay at a considerable distance from water" and "Stay away from water but can still see it".	**11 (17%)**
Spiritual	-Sense of belonging and connectedness to water. "Being here suits my personality", "I can do things I like here", and "I have a sense of oneness with this setting".	**42 (79%) agreed on these statements**
Moralistic	- Concern for poor water quality. "However, it is expressed through user`s perceptions of optical water quality, which doesn`t necessarily indicate actual ecological water quality: "Color", "Clarity", "Cleanliness".	**35 (56.4%)**

Figure 89: Typologies and Concurrence Of Nature Valuations Recorded in Selected Study Area. Source: Author.

These values represent meanings and values they attach to the waterfront. Analysis revealed many values were widely common between users, with aesthetic, naturalistic, and moralistic values recorded more often together. An interesting finding of the study is that some values that are commonly perceived to be in conflict can occur together. For example, some users expressed fear of being so close to water yet they can appreciate the beauty of it and prefer to stay at a distance but to still be able to see the water.

A framework was developed to assess the degree of integration of the Nile waterfront within the urban fabric of the city as urban Nature using the Biophilic indicators framework adopted in Chapter 3 and modified through the analytical review of international case studies (Chapter 4). It is important to clarify that all indicators have a symbiotic relationship in which all indicators affect each other and thus can't be replaced or measured individually. It is also important to mention that each indicator might include a group of sub-indicators.

As the research follows a qualitative analytical approach, each sector was then evaluated using values from None to High that represent the score of its indicator and sub-indicator, respectively. The results are showcased in (Table 8). It is noteworthy to clarify that each sector might score a high value in one sub-indicator but a low value in another, hence, highlighted cells represent the relative score of each indicator. Cells highlighted in Red represent points of weaknesses, while those highlighted in Blue represent strengths. Weighting technique used to measure/ evaluate indicators and sub-indicators is similar to the one used in the previous chapter, with the addition that data sources included field survey, on-site observations, unstructured interviews with users of the waterfront at the time of conducting the field survey and finally, online web-questionnaire.

Table 8: Assessment of Biophilic Indicators in Central Cairo Nile's Waterfront. Source: Author.

	Biophilic Element	Biophilic Indicator	Sector 1				Sector 2				Sector 3				**Aggregation**		
			High	Moderate	Low	None	High	Moderate	Low	None	High	Moderate	Low	None	High	Moderate	Low
Aspects of Ecological Integration	Biophilia Ratio, Biophilic Performances and Settings.	Percentage of Green spaces, with cosideration to its quality, conditions, and public access to these spaces.															
		Vegetation along riparian areas															
		Water quality, configuration, and appearance															
		Biomorphic shapes and forms															
		Natural Materials and settings															
		Activities that celebrate proximity to water															
Aspects of Social Integration																	
	Sensory Experience	Prospect and Refuge															
		Enticement and Mystery															
		Mental peace, security, and safety															
		Thermal comfort and shelter from elements															
		Experience of Nature.															
		Environmental, Historical, and Cultural Literacy on the waterfront.															

Table 8: Continued.

	Biophilic Element	Biophilic Indicator	Sector 1				Sector 2				Sector 3				**Aggregation**		
			High	Moderate	Low	None	High	Moderate	Low	None	High	Moderate	Low	None	High	Moderate	Low
Aspects of Physical Integration	Connectivity and Accessibility	Traffic and Pedestrian volumes on waterfronts.							.								
		Inclusive access to diverse user groups															
		Physical, visual and material access to water.															
		Signages and wayfinding infrastructure.															
		Number of transportation modes available in the area															
	Physical Character and Place Identity	Number of water dependent and related activities compared to non-dependent water activities															
		The Number of Cultural and historical facilities on the waterfront															
		Unique place identity															

Results indicate that a significant percentage of users visit the waterfront for recreational purposes, mainly for dining, compared to those who visit it for purposes of Nature experience (contemplating). On the other hand, users' preference for closeness to water is irrelevant to the type of activity they engage in while visiting the waterfront. However, results demonstrate that a high percentage of users prefer being as close to the water as possible. Moreover, the lack of visual connections as well as the replicability and monotony of landscape elements decreases the overall visual aesthetics of the waterfront.

Across the Three identified sectors of the study area, the levels of modifications by artificial structures vary significantly, it is especially most notable within Sectors 2&3. On the other hand, the levels of degradation are more notable in Sector 1. At the individual level, measures of connectedness to the waterfront are good predictors of concern for and perceived knowledge of the waterfront environment but not necessarily support for development decisions and architectural and engineering solutions for the development of the waterfront. For example, people expressed their dissatisfaction with the barren landscape of the waterfront, specifically in Sectors 2&3.

Figure 90:Comparison between the Three Sectors of Study area. Source: Author.

As shown in (Figure 90), it is clear that across the Three identified sectors of the selected study area, socio-ecological indicators of Sensory Experience and Biophilia Ratio and Biophilic performances and settings recorded the lowest values compared to physical/functional indicators that included physical character and place identity and connectivity and accessibility with the exception of Sector 1 which recorded the highest value for Biophilia Ratio and Biophilic settings.

Finally, findings reveal that although emotional attachments to the waterfront can be found from users' experiences and perceptions of the river, people still express concerns about some aspects of the waterfront space. Moreover, aesthetic, naturalistic, and moralistic values are the most common values among users of the waterfront.

From the previous analysis of selected study areas, results reveal that the three sectors have some distinctive differences as well as similarities between them and even within the boundaries of the same sector. After the analysis of the three sectors of study area, the following section presents a SWOT analysis using both functional and social analysis in order to investigate opportunities and challenges of utilizing the Nile waterfront as a natural asset for improving human well-being to guide future development decisions

Table 9: SWOT Analysis of all three sectors of study area. Source: Author.

	Sector1		Sector 2		Sector 3	
	East Bank	**West Bank**	**East Bank**	**West Bank**	**East Bank**	**West Bank**
Strengths	- Moderate percentage of green spaces along the river banks. - Abundancy in riparian vegetation in the southern part	- Abundancy in Riparian Vegetation along the river bank. - Natural undeveloped areas that can be utilized to provide access points to the river level.	- Strategic location and good connectivity to main axes and squares. - Number of iconic buildings and landmarks that can act as orientation points. - Good visual and physical accessibility to the River provided by the revitalized pedestrian promenade along the river course.	- Moderate percentage of green spaces along the river banks. - High number of water-dependent uses along the river bank such as floating restaurants.	- Strategic location and good connectivity to main axes and squares. - Number of iconic buildings and landmarks that can act as orientation points. - Good visual and physical accessibility to the River provided by the revitalized pedestrian promenade along the river course.	- Moderate percentage of green spaces along the river banks. - High number of water-dependent uses along the river bank such as floating restaurants.
Weaknesses	- Most green spaces are private and/or inaccessible. - Structures obscure visual access to the river along the promenade. - The pedestrian promenade is on the same level as heavily congested traffic routes.	- The Nile promenade is used as parking lots. - Poor conditions of structures. - Dilapidated metal railings that to safety countermeasures.	- Lack of open green spaces. - Very limited vegetation along the river bank. - Lack of public amenities along the pedestrian promenade on both upper and lower-levels. - Poor conditions of facilities and structures. - Barren and concrete landscape discourage users from exploring. - Activities on the waterfront are very limited.	- Unused developed spaces Infront of fixed barges. - Green spaces are private and/or inaccessible. - Very limited physical and visual connectivity to the river banks.	- Lack of open green spaces. - Very limited vegetation along the river bank. - Lack of public amenities along the pedestrian promenade on both upper and lower-levels.	- Unused developed spaces Infront of fixed barges. - Unused undeveloped spaces Infront of residential areas. - Green spaces are private and/or inaccessible. - Very limited physical and visual connectivity to the river banks.
Opportunities	- Structures obscuring visual access t the river can be relocated. - Wide flat areas on the lower pedestrian levels can provide an opportunity for a continuous pedestrian trail along the river banks, provide physical access to the river and provide a refuge from the noises of traffic on the upper promenade. - Wide sidewalks can be utilized as a pedestrian promenade.					
Threats	- Political unrest and issues of national might hinder development plans. - Economic changes and issues of funding can negatively affect development plans. - Institutional overlaps is a persistent problem in all phases of development process. - The construction of Al-Nahda Dam might affect or limit people’s perceptions of the Nile to a certain degree.					

The results of the study indicate that respondents strongly considered the waterfront place as an attractive and special place. We could infer that users have an emotional connection with the river. Key points include:

- A good number of respondents asserted that the place has an interesting, unique identity and character where the waterfront could offer them a place for social activities, recreation, and a refuge from everyday life routine.
- Poor conditions of facilities, vandalism, and lack of maintenance along the waterfront are the main issues of concern of users.
- Frequency of visits, pattern of engagement and activities also play an important role in defining users' perceptions of the waterfront, and subsequently a significant impact on their experience with the river and its waterfront.
- Another aspect is familiarity, people who visits for purpose of work are more familiar with the place than those who visit it for recreational purposes due to higher frequencies of their visits as well as duration of the visit. It also has a significant influence on place attachment in terms of frequency of visit, duration of visit, locational knowledge and visual recognition.
- The Nile waterfront in selected study area indicated a high level of human intervention along the river edge in terms of usage of the shore, represented in the high number of private uses such as floating restaurants, fixed barges, private boat stations, massive buildings as the backdrop of the river banks and in close proximity to the shore as well as the percentage of independent/not-related water activities compared to other categories.
- While the river has an overwhelming presence in all sectors of the study area, the overwhelming issue of privatization of the river banks indicate a very man-made environment where Nature becomes minimal in effect.
- Users associate elements of built environment, such as the iconic buildings along the waterfront, with the image of the river and their perception of its waterfront.

Conclusion

This chapter was concerned with analysing current conditions of the Nile waterfront in Cairo. An in-depth analysis of the selected study area was carried out to assess the degree of integration of the Nile waterfront within each sector of the study area according to indices of Biophilia, outlined in a previous chapter.The findings indicate that despite significant efforts to reconnect Cairo's residents and dwellers to the Nile waterfront by providing new opportunities for inclusive public access and bringing people close to the river's edge, economic factors remain the main drivers for development decisions along the waterfront. However, there are overwhelming opportunities for the waterfront to be fully realized if looked at beyond being an economic engine or a mere scenic view. The results support the notion that fostering a positive relationship between humans and the natural world requires providing inclusive public access, improving user's sensory experience of the waterfront and stimulating positive feelings towards the river and its waterfront which consequently will raise environmental awareness, increase environmental stewardship and impact people's behaviours and attitudes towards the environment. The next, and final chapter, will discuss the study's conclusions, recommendations, and recommendations for further future research.

CHAPTER 6: Conclusions and Recommendations

"Water is a defining force that models the assets of every place it touches"

(Urban Waterfront Center, 2001)

This end chapter presents the overall conclusions of the study. As such, the chapter begins with a brief summary of the research and then provides an overview of the main objectives and questions of the research and the adopted methodology to obtain answers to the research's questions. The chapter then discusses the main findings of the study and the implications of these findings. Finally, the chapter provides research recommendations for future development policies and decisions to guide interventions in the Central Cairo waterfront, as well as recommendations for further research.

6.1 Conclusions

The research was based on the premise of the human need for contact with Nature within the urban built environment and the emerging conquest for innovative and comprehensive approaches to integrate Nature within the urban fabric of cities and urban areas. The research is situated within the emerging field of Biophilic Urbanism and adopts an urban sociology perspective to explore the biophilic perceptions of urban and urban/natural spaces. As such, the main objective of the study was to first identify valuations of Nature and indicators of "Biophilia" within the Nile waterfront in Central Cairo and then investigate potential opportunities and challenges of applying "Biophilic Urbanism" as a planning and design approach for future urban development along the Nile waterfront in Cairo to harness the potential benefits derived from the river as a natural element, foster positive human-river relations, improve users experience within the waterfront, and ultimately improve human well-being.

Five research questions were posed, including the main question of the research, which were subsequently addressed through the three parts of the study. In parallel, 5 objectives of the research were put forth to reflect on the research questions and obtain answers for them. Each objective was set to be achieved through a specific chapter or chapters. The following section will provide a brief summary of the research's questions and objectives and the adopted methodology to obtain answers to these questions.

6.1.1 Response to the research's Questions

The first research's question addressed in the research was: "**What** are the implications of the process of urbanization and the human-Nature connections, How can the human-Nature relationship be explained, What are the potential range of benefits that human societies can derive from urban Nature?". To answer this question, the research set out to explore the theoretical debate on the relationship between Nature, Urban Eco-systems, biodiversity and human health and wellbeing.

This was addressed in Chapter 2 through an extensive literature review of the theoretical debate on the human-Nature relationship and the theories put forward to explain the current dilemma of the human separation from Nature. As such, prevailing theories and concepts explaining the human-nature connections, on multiple scales, were explored with emphasis on the "Biophilia Theory" as the main theoretical foundation of this research, as well as the human valuations of Nature. Moreover, scientific evidence of the potentially wide range of psychological, physiological, and social benefits that human societies can derive from contact with Nature was showcased to lend validation to the research objectives.

The second question of the research was "**Why** is the approach of "Biophilic Urbanism" considered more convenient and comprehensive as an innovative approach for urban development and what differentiates it from other traditional approaches?". This question was addressed in Chapter 3 through an overview of the emerging field of "biophilic urbanism" to demonstrate integration of urban nature into the urban fabric of the built environment. Within this context, Chapter 3 was split into Two parts; the first part focused on discussing the human conceptions of Nature in modern cities, the spatial configurations of urban nature, and the approach of "Biophilic Urbanism", its definitions, scales, and principles as an emerging approach demonstrating the integration of natural elements and features within the built environment. This found a range of forms and scales in which nature can be synergistically integrated into dense urban environments to contribute to the creation of urban environments that are climate-resilient, adapted to growing resource shortages, and that provide opportunities of human-nature interactions that are beneficial to human health and wellbeing. Finally, that

part of the chapter explored the driving force beyond the emergence of the "Biophilic Urbanism" approach and the reasons that validate mainstreaming this approach in the retrofit of urban areas and cities.

The Third question was **"How** can "Biophilic Urbanism" be applied in urban water-ways and waterfronts development projects to improve human health and well-being? and **what** are the potentialities of integrating these water-ways in the built environment as a tool for improving quality of life?". To answer this question, it was first needed to investigate the current global approaches of integration of urban water-ways as a natural element into the planning process of urban development as a natural tool to improve the built urban environment and to identify indicators of "Biophilia" prevailing in urban water-ways and their environments as well as valuations of Nature relevant to this context.

This was addressed in the second part of Chapter 3. In exploring indicators of "Biophilia" in urban waterfronts, it was essential to first discuss the impacts of the process of urbanization on urban water-ways in modern cities and the contemporary approaches of their management and development, particularly those within dense urban areas. In doing so, many conflicts of planning and management approaches were showcased and discussed. A review of human perceptions of urban waterfronts follows. This found a set of characteristics that constitute the key aspects that influence human perceptions of urban water-ways and their adjacent urban areas, categorized under two main categories; physical dimensions and social dimensions.

In Chapter 4, a review of selected international case studies that demonstrate the application and implementation of the approach of "Biophilic Urbanism" was presented, its guidelines and principles in development projects related to urban water-ways and/or urban waterfronts. An evaluation of these case studies was also included to pinpoint key points that contributed to the success of these projects.

The Fourth research question was "**What** are the current conditions of the Nile's Waterfront in Cairo and to what degree is the waterfront integrated within the urban fabric of the city?". Corresponding to this question, the research set out an objective to analyze the current conditions of the River

Nile waterfront in the selected study area in Central Cairo to explore valuations of Nature and identify biophilic indicators within the area.

In this chapter, the research follows an analytical case study approach. Methods of data collection included an extensive literature review, field survey, on-site observations, concurrent with semi-structured interviews when possible, and an online survey. The survey included questions with multiple choice, binary (yes or no) and 5-point Likert scale (2 answers in agreement with the statement, 1 neutral answer and 2 answers in disagreement with the statement) answers, and finally open-ended questions when needed. This mix of multiple choice, binary, and Likert scale answers provided multiple perspectives.

An in-depth analysis of data was then carried out to assess the degree of integration of the Nile waterfront within the urban fabric of the city, explore valuations of Nature, identify biophilic indicators in the waterfront, and to investigate potential opportunities and challenges of applying "Biophilic Urbanism" in future development plans along the Nile waterfront.

Finally, the main question addressed in this research is: "**What** are the opportunities and challenges of adopting the approach of Biophilic Urbanism in urban development plans along the Nile waterfront in Central Cairo. To answer this question, there was a need to assess the degree of integration of the Nile waterfront within the selected study area in Central Cairo and investigate the potential opportunities and challenges of applying "Biophilic Urbanism" in future urban development along the Nile Waterfront, which represented the main objective of the research and which was addressed in the last chapter of the research.

Chapter 5, addresses the main question of the research as well as the fifth research's question as it provides an in-depth analysis of the current conditions of the Nile waterfront in the selected study area, Central Cairo, identify biophilic indicators within the area and finally provides a SWOT Analysis to investigate potential opportunities and challenges for applying "Biophilic Urbanism" approach in future development decisions along the Nile River course.

Within this context, the key findings of the study can be concluded in the following paragraphs:

Evidence of Biophilia in Modern societies

From the literature, it is clear that the ideas of incorporating natural elements within buildings and urban areas are by no means a new practice, but a deep-rooted one since ancient times. Scientific research continues to support evidence of the many physiological and psychological benefits associated with exposure to Nature. In 1984, Wilson argued for the intrinsic human need to contact with Nature, a notion that, up until recently, was considered a luxury provided for the selected few who can afford it. However, the research would argue that this still prevails in modern societies, manifested in increasing numbers of new residential compounds with marketing strategies that rely mainly on providing future residents with vast spaces of open green areas, blue spaces and the promise of a life away from the hustle of the dense city. The premise of this research is the underlying assumption that people are drawn to natural environments and settings, regardless of whether it's a question of "Nature Vs Nurture".

Within this context, the research concludes that integration of natural elements within the urban fabric of modern cities and urban areas is neither an option nor a luxury for a specific group of users but rather an essential human need for preserving human health and well-being. Therefore, development decisions should seek innovative ways to integrate natural features and elements for urban areas where "grey" isn't the dominant colour.

Urban Water-ways and Waterfronts as Urban Nature

Developing waterfront projects that are not only ecologically sustainable and economically beneficial, but also inclusive, equitable, and reflective of community needs prove challenging to city planners, designers, and city leaders.

Based on data drawn from both the analytical and empirical parts of the study, it is safe to conclude that urban water-ways projects that provide enhanced green space and ecological restoration of water-ways have value into themselves, yet they can also be carried out in ways that serve other goals of raising property values, spurring economic activity, reorienting traffic patterns, and supporting more active and healthy lifestyles. While past decades have witnessed major transformations in planning and design approaches of urban water-ways and waterfronts related projects, most of

these projects were generally economic oriented, rarely designed to reflect the innate human affection for Nature and preference for natural settings. Within such trends, many problems can be identified, as outlined below:

- **Conflicts of planning and development approaches**

As special borders between man-made and natural environments, urban waterfronts have been the subject of many planning conflicts in relation to culture, heritage and identity, land ownerships, social and environmental justice, economic vitality, and environment and ecology. These themes reflect major conflicts of planning and development approaches, stemming from different interests that various stakeholders have in the waterfront.

- **Development and design decisions do not take water as a prerequisite**

Most waterfront projects situate users as passive observers of water with limited opportunities for active bodily engagement when water should be the centerpiece. Water quality, configurations, and water appearances are of equal importance as it is highly improbable that users will be satisfied with a space where debris and trash are scattered.

- **Design content is too stereotyped**

Decision makers often focus very narrowly on the most iconic elements of the design interventions of other cities waterfronts without taking the local social, political, and natural conditions and characteristics into consideration so that the result of the design lack of practice local features and might even fail to deliver its goals. A common issue with many waterside development design interventions is that they are “inspired” by projects with different geographical locations, different topography, and different historical, social, and cultural contexts. In addition, many revenue-oriented development projects capitalizing on proximity to water are not in harmony with the context of such sensitive public spaces, which result in a negative impact on the realization of development goals.

- **Development and design decisions are not “People-Oriented”**

Many waterfront intervention ideas lack active experiences of Nature as they stay only in the form of material changes, therefore, don’t provide users with the full potentials of sensory experience of Nature. City planners and designers need to understand these unique and strategic urban spaces from the "human" perception. However, the realization of "people-oriented" development should be based on full respect and protection of natural ecology. Nature should be perceived and treated as an equal rather than a commodity. Moreover, development decisions should promote inclusive access of diverse user groups.

- **Development Decisions, Design and implementation processes are often one-sided**

Global experiences have shown that a combination of far-sighted political will, support, and collaboration of the private and public sectors can deliver positive urban transformations in a relatively short time. However, experiences also have shown that successful water-ways and waterfront development projects require the support of a public constituency, which is largely dependent on public awareness, which, in turn, depends on people`s values and meanings of the environment. The best way to achieve that is to make the river edge as broadly accessible to the public as possible where people can associate with the river and foster personal attachments and meanings of the space so that they can act as stewards for the waterfront when needed.

- **Designs are too Expensive and Out of-Scale for the Local Context**

Most design concepts require providing vast expanses of urban spaces, expensive infrastructure, and sometimes overpriced iconic buildings that are too costly for local contexts. Escalating costs are one way these projects tend to fail, sometimes even during planning stages, to the point where decision-makers remove some elements, reduce some stages, or abandon them altogether. Ultimately, either resulting in over-designed and underutilized urban spaces or a product that is far from original design visions.

6.1.2 Reflections on The Nile Waterfront in Central Cairo

Like many urban rivers in major cities around the world, the process of urbanization and modernization has degraded the Nile river and severed obvious physical and visual links to its surrounding communities. Evolving investment potentials and leisure and recreation needs have resulted in development decisions along the culturally and ecologically sensitive edge of the Nile river that most often focused on the beautification of the waterfront rather than major physical interventions and transformations.

In accordance with the findings of the analysis of selected study area in the empirical part, the function of the river is not yet clear in the centre of Cairo nowadays. Weak social and ecological factors led up to the loss of river's role in urban and social contexts, ultimately disconnecting the city's residents and dwellers from the river's edge. In comparing foreign projects of riversides revitalization with the case of the Nile waterfront in Central Cairo, it is obvious that the potential of the river here is underutilized and managed insufficiently. It is evident that optimal results are achieved when dimensions of river role (functional, social, ecological, and visual) are developed equally, without overwhelming each other. Reflecting on recent developments of sectors (1&2) of the selected study area in Central Cairo as part of "Ahl Masr Promenade", it is evident that the current realized design remains far from the original vision put forth for the of Nile Waterfront promenade. It can be safely concluded that while phased implementation of development processes allows for flexibility in the event of sociopolitical changes or market downturns, commitment to original development decisions is crucial for an end-product that meets the expectations of original development plans.

The historical hydrologic modification of the Nile as a result of the construction of the High Dam of Aswan, while altering the original ecological conditions of the river, also provides significant opportunities in the context of urban design and planning. The Nile now has a predictable hydrologic regime that allows for modifications along the Nile to occur with far more certainty as to their long-term benefits. Therefore, study findings support development decisions of the Nile waterfront, only if they are in harmony with Nature and don't deny the public physical and visual access to the river.

6.2 Limitations of the Study

The present research had a number of limitations that will be acknowledged in this section and which will suggest avenues for future directions of research. First is the subjective findings of the social analysis conducted in the research. Since the study focused on evaluating users perceptions of the Nile and its waterfront, this focus on self-reported feelings of users of the waterfront also leaves open the question of whether the study findings extend to objective measures of restoration such as improvements in physiological indicators of restoration.

Another limitation of the study was the sample size, which might be considered not representative. Initially, online web survey/ questionnaire was selected as a primary data collection method, along with field survey and interviews, to reach a broader population. However, due to lack of available resources and time frame, only a total of 53 responses were gathered. As such, more representative samples are required in the future.

Another issue identified was potential measurement bias because of the absence of the interviewer when respondents answer online surveys and the presence of the interviewer when field survey participants in interviews respond in person (Heerwegh & Loosveldt, 2008). The author recognizes that the mentioned factors may affect the reliability of making use of statistical data representations. However, as this study is generally qualitative, statistical data were not the main focus of the research.

It is also acknowledged that there are limitations to this research resulting from the geographically limited case studies. However, as mentioned in Chapter 4, criteria for the selection of case studies were based on the premise of demonstrating the application. As such, Sea-front cases were excluded due to the relatively broader scale. Other cases were excluded due to language barriers in available resources of data and the limited available time frame.

6.3 Recommendations

This section will present final study recommendations, based on the analysis of selected study area from the previous chapter. First, it will provide general recommendations. Then, more specific recommendations will follow.

General Recommendations

- Political commitment and governance during all phases of development process are crucial for the success of any development plans. However, it is not sufficient without coordination of all sectors involved in the development process. As such, coordination between all involved actors is important to ensure effectiveness of any development plans.
- User's perceptions of natural environments are multi-faceted and layered. Therefore, it is important to consider that the meanings and values people hold for Nature vary significantly from one local community to another, and even among one community, it may differ from one individual or a group of individuals to another, based on personal experience, beliefs, self-esteem and satisfaction of life in general.
- The development of evaluation criterion for Biophilic indicators in urban waterfronts was based on global practices. Therefore, adopting it to local contexts requires more investigation into the role of cultural perceptions. Hence, taking this into consideration is crucial for any future development of the Nile waterfront.

Recommendations for the Nile Waterfront in Cairo

- It is recommended to establish a network of open green spaces across the area. This network will enhance the visual image of the waterfront, improve user's experience, and provide other services associated with human health and well-being. Quality and maintenance of these spaces should be taken into consideration and people of all user groups should be provided free access to them.
- Although restoring the river to its full ecological integrity is difficult, restoring native riparian vegetation along the river banks will improve the ecological conditions for the river. To achieve this, the research

suggests creating a continuous trail of riparian vegetation along the river banks, removing concrete edges, and stabilizing river banks. Private nurseries along the river banks could be utilized for this purpose by being relocated to a higher level or allocated smaller plot areas to allow a continuous pedestrian promenade along the river banks. In parallel, it is also recommended to activate enacted laws and regulations to protect the river and its tributaries from pollution and wastewater and to preserve its ecological nature and restore natural habitat.

- Improving users' experience of the waterfront as a natural asset is crucial to any future development plans. Within this context, it is highly recommended to limit or decrease traffic access to the waterfront, which will improve air quality, reduce air particulate matter, reduce noise levels, mitigate air temperatures, and create space for pedestrians. Moreover, It is highly recommended to increase the number of ferries stops and water taxi stations by placing them at strategic locations.
- To overcome the dilemma of institutional overlaps, it is recommended that the administration, management, and control of the waterfront should be under the authority of one official organization, with consultations with the public.
- It is recommended to support activities that celebrate proximity to water such as national festivals, shows, art performances, and provide efficient pubic amenities to support intense use of the river banks. This will connect people with the river, help fostering personal attachments and meaning of the river, and ultimately increase their environmental awareness. Activities and uses that require access to water should be accorded due priority. Therefore, it is highly recommended to reallocate water-independent uses and limit private ownership of the river banks.
- It is recommended to create a continuous pedestrian promenade along the Nile Corniche, preferably on the lower-level of the river banks to decrease noise levels and create a relaxing, comfortable and safe settings for users by utilizing the space under bridges structures. It will also bring users closer to the river edge, which could potentially result in increased environmental awareness and stewardship to protect the river from further degradation of its ecological nature.

6.4 Recommendations for future research

- As mentioned in the research's limitations section, more future representative sample size is required. As such, further intercept surveys based on larger samples could give clearer insights into users' values and perceptions of urban water-ways and their environments. Moreover, research that utilizes different research methods and instruments could also reveal other perspectives that weren't covered within the scope of this research.
- Users' values, perceptions, and preference for certain typologies of water-ways and waterfronts may differ based on the scale, shape, and form of the waterway. Thus, further research into shifts in nature valuations for different typologies of water-ways is required.
- Further research is needed to establish stronger links between users' perceptions and values of urban water-ways and their environments and predicting social behavior, actions, and attitudes within these spaces, as well as informing environmental knowledge and stewardship within different cultures.
- The role of social norms, beliefs, and attitudes on influencing people's perceptions of urban development along the Nile River waterfront within different local communities across country needs more holistic understanding and investigation.
- Finally, perceptions of environmental aesthetics in the Nile waterfront in Central Cairo in relation to recent developments need more investigation to identify preferred types of design interventions.

References

- Abd Alaziz, N. A. (2017). Nile River: A Fitness Trail Promoting Physical Activity In Cairo City. *International Journal of Engineering Research and Development*, *13*(5), 59–69.
- Abdel-Satar, A. M., Ali, M. H., & Goher, M. E. (2017). Indices of water quality and metal pollution of Nile River, Egypt. *Egyptian Journal of Aquatic Research*, *43*(1), 21–29.
- Abdelmonem, M. . (2016). Chase over the Nile: The Social Evolution of the Riverine Landscape in Urban Egypt. In C. Silva (Ed.), *Urban Planning in North Africa* (1 st, pp. 161–170). Routledge.
- AbdelRaheam, A., Mohamed, U., AbdElhafez, A., & Osman, A. (2020). Characteristics' Analysis of Urban System in Northern Upper Egypt Region (NUE) Size Distribution Analysis of Urban Settlements; 1976~2016. *Journal of Modern Research*, *2*, 84–96.
- Aboukorin, A. A. (2018). Spatial analysis of the urban system in the Nile Valley of Egypt. *Ain Shams Engineering Journal*, *9*, 1819–1829.
- Abu-Lughod, J. (1971). *Cairo: 1001 Years of the City Victorious*. Princeton University Press.
- Al-Afify, A. D. G., Othman, A. A., & Ramadan, M. F. (2018). Characterization of chemical and microbiological quality of Nile River surface water at Cairo (Egypt). *Rendiconti Lincei*, *29*(3), 725–736.
- Alexander, C., Silverstein, M., & Ishikawa, S. (1977). *A Pattern Language: Towns, Buildings, Construction*. Oxford University Press.
- AlSayyad, N. (2011). *Cairo: Histories of a city* (1st Edition). Belknap Press of Harvard University Press.
- Aly, D. G. (2017). *Multifunctional Landscape Design: An Analytical Framework for Urban Waterfronts in Cairo*(Master's thesis). Ain Shams University.
- Amirtahmasebi, R., Orloff, M., Wahba, S., & Altman, A. (2013). *Regenerating Urban Land: A Practitioner's Guide to Leveraging Private Investment*. World Bank Group.
- Andersson, E., Tengö, M., McPhearson, T., & Kremer, P. (2015). Cultural Ecosystem Services as a Gateway for improving Urban Sustainability. *Ecosystem Services*, *12*, 165–168.

- Ansari, F. Al. (2009). *Public Open Space on the Transforming Urban Waterfronts of Bahrain – The Case of Manama City*. Newcastle University.
- Appleton, J. (1975). *The Experience of Landscape*. John Wiley & Sons.
- Artell, J., Ahtiainen, H., & Pouta, E. (2013). Subjective vs. objective measures in the valuation of water quality. *Journal of Environmental Management*, *130*, 288–296.
- Avni, N., & Teschner, N. (2019). Urban Waterfronts: Contemporary Streams of Planning Conflicts. *Journal of Planning Literature*, *34*(4), 408–420.
- Bagan, H., & Yamagata, Y. (2014). Land-cover change analysis in 50 global cities by using a combination of Landsat data and analysis of grid cells. *Environmental Research Letters*, *9*, 1–13.
- Barton, J., & Pretty, J. (2010). What is the Best Dose of Nature and Green Exercise for Improving Mental Health? A Multi-Study Analysis. *Environ. Sci. Technol.*, *44*(10), 3947–3955.
- Beatley, T. (2011). *Biophilic Cities: Integrating Nature into Urban Design and Planning*. Island Press.
- Beatley, T. (2017). Handbook of biophilic city planning and design. In *Handbook of Biophilic City Planning and Design*. Island Press.
- Beery, T., Ingemar Jönsson, K., & Elmberg, J. (2015). From environmental connectedness to sustainable futures: Topophilia and human affiliation with nature. *Sustainability*, *7*(7), 8837–8854.
- Bell, Siân De, Graham, H., Jarvis, S., & White, P. (2017). The importance of nature in mediating social and psychological benefits associated with visits to freshwater blue space. *Landscape and Urban Planning*, *167*, 118–127.
- Bell, Simon. (2004). *Elements of Visual Design in the Landscape.* (2nd Edition). Spon Press.
- Benton-short, L., & Short, J. R. (2013). *Cities and Nature (Routledge Critical Introductions to Urbanism and the City)* (2nd Edition). Routledge.
- Berry, W. (1972). *A Continuous Harmony: Essays Cultural and Agricultural*. Harcourt.

- Berto, R., Barbiero, G., Barbiero, P., & Senes, G. (2018). An individual's connection to nature can affect perceived restorativeness of natural environments. some observations about biophilia. *Behavioral Sciences*, *8*(3).
- Birkeland, J. L. (2016). Net positive biophilic urbanism. *Smart and Sustainable Built Environment*, *5*(1), 9–14.
- Blair, K. (2015). Making Places: Public Spaces in Chicago. *Architectural Record*, *203*(10), 78–84.
- Bossen, A. (2010). The importance of getting back to nature for people with dementia. *Gerontological Nursing*, *36*(2), 17–22.
- Bowler, D. E., Buyung-Ali, L., Knight, T. M., & Pullin, A. S. (2010). Urban greening to cool towns and cities: A systematic review of the empirical evidence. *Landscape and Urban Planning*, *97*(3), 147–155.
- Brand, P., & Thomas, M. J. (2005). *Urban Environmentalism: Global change and the mediation of local conflict*. Routledge.
- Britton, E., Kindermann, G., Domegan, C., & Carlin, C. (2020). Blue care: A systematic review of blue space interventions for health and wellbeing. *Health Promotion International*, *35*(1), 50–69.
- Bruttomesso, R. (2001). Comlexity on the Urban Waterfront. In R. Marshall (Ed.), *Waterfronts in Post-industrial Cities* (pp. 39–49). Spon Press.
- Byun, M., Hwang, K., Lah, T., & Lee, S. (2016). *Cheonggyecheon Restoration Project : Conflict Management Strategies* (Issue 22).
- CAPMAS. (2020). *Population numbers*. Accessed on February 26, 2020, https://www.capmas.gov.eg/Pages/populationClock.aspx.
- Castree, N., & Braun, B. (2005). The construction of Nature and the Nature of Construction: Analytical and political tools for building survivable futures. In N. Castree & B. Braun (Eds.), *Remaking Reality: Nature at the millenium* (pp. 3–41). Routledge.
- Cervero, R. (2010). Urban Reclamation and Regeneration in Seoul, South Korea. In W. Ascher & C. Krupp (Eds.), *Physical Infrastructure Development: Balancing the Growth, Equity, and Environmental Imperatives* (pp. 187–201). Pacific Basin Research Center.
- Chan, V., & Kiang, H. C. (2004). The " Night Zone " Storyline : Boat Quay , Clarke Quay and Robertson Quay. *Raditional Dwelling and Settlement Review*, *11*(2), 41–49.

- Chang, T. C., & Huang, S. (2005). Recreating place , replacing memory : Creative destruction at the Singapore River. *Asia Pacific Viewpoint*, *46*(3), 267–280.
- Chang, T. C., & Huang, S. (2011). Reclaiming the city: Waterfront development in Singapore. *Urban Studies*, *48*(10), 2085–2100.
- Chang, T. C., Huang, S., & Savage, V. R. (2004). On the waterfront: Globalization and urbanization in singapore. *Urban Geography*, *25*(5), 413–436. 3
- Chen, Y. (2017). *The Impact Of Biophilic Design On Health And Wellbeing Of Residents Through Raising Environmental Awareness And Nature Connectedness* (Master's thesis). University of Georgia.
- Chesla, E. (2017). *Investing in Urban Infrastructure: Chicago Riverwalk Phase 2 & 3*. Bruner Foundation.
- Chester, M., & Grant, A. (2015). *The Nature of Cities*. Accessed on September18, 2020, https://www.thenatureofcities.com/2015/01/06.
- Chicago Department of Zoning and Planning, & Chicago Department of Transportation. (2009). *Chicago Riverwalk: Main Branch Framewrok Plan*. Available online on https://www.chicago.gov/city/en/depts/dcd/supp_info/chicago_river_mainbranchframeworkplan.html.
- Cho, M.R. (2010). The politics of urban nature restoration: The case of Cheonggyecheon restoration in Seoul, Korea. *International Development Planning Review*, *32*(2), 145–165.
- Church, S. P. (2018). From street trees to natural areas : retrofitting cities for human connectedness to nature. *Journal of Environmental Planning and Management*, *0*(0), 1–26.
- City of Chicago. (2018). *Chicago Riverwalk: Project History*. Retrieved March 13, 2020, from https://www.chicagoriverwalk.us/projecthistory.
- Cleveland, A. C. (2014). *Symbiosis Between Biophilic Design And Restorative Healing Environments: The Impact On Overall Well-Being Of Urban Dwellers* (Master's thesis). Florida State University College.
- Coon, J. T., Boddy, K., Stein, K., Barton, J., Depledge, M. ., & Whear, R. (2011). Does participating in physical activity in out door natural environments have a greater effecton physical and mental well being than physical activity indoors? A systematic review. *Environ. Sci. Technol.*, *45*(5), 1761–1772.

- Cronon, W. J. (1995). *Uncommon Ground: Rethinking the Human Place in Nature*. W. W. Norton & Company, Inc.
- Daily, G. C. (1997). *Natures Services: Societal Dependence on Natural Ecosystems*. ISLAND PRESS.
- Desha, C., Reeve, A., Hargroves, C., & Hargreaves, D. (2015). Biophilic Urbanism: Contributions to holistic urban greening for urban renewal. *Smart and Sustainable Built Environment*, *4*(2), 215–233.
- Dias, B. D. (2015). Beyond Sustainability – Biophilic and Regenerative Design in Architecture. *European Scientific Journal*, *7881*(March), 1857–7881.
- Diener, E., Suh, E. M., Lucas, R. E., & Smith, H. L. (1999). Subjective well-being:three decades of progress. *Psychological Bulletin*, *125*(2), 276–302.
- Dizdaroglu, D. (2020). Possible Indicators for the Evaluation of the Performance of a Biophilic Urban Ecosystem. *International Congress of Architecture and Planning*.
- Douglas, I. (2011). The analysis of cities as ecosystems. In D. Goode, I. Douglas, R. Wang, & M. Houck (Eds.), *The Routledge Handbook of Urban Ecology* (pp. 17–25). Routledge.
- Dustin, D. L., Bricker, K. S., & Schwab, K. A. (2009). People and Nature : Toward an Ecological Model of Health Promotion. *Leisure Sciences: An Interdisciplinary Journal*, *32*(1), 3–14.
- Dutta, S., & Sarkar, S. (2020). Contextualizing and analyzing the urban design parameters for a successful Canal-Oriented Development in an urban context. *High Technology Letters*, *26*, 122–129.
- Dyson, K., & Yocom, K. (2015). Ecological design for urban waterfronts. *Urban Ecosystem*, *18*, 189–208.
- Ebrahimpour, M., Majedi, H., & Zabihi, H. (2017). " Biophilic " planning , a new approach in achieving liveable cities in Iranian new towns – Hashtgerd case study. *Stads- En Streeksbeplanning = Town and Regional Planning*, *70*, 1–13.
- Echols, S. P., & Nassar, H. F. (2006). Canals and lakes of Cairo: Influence of traditional water system on the development of urban form. *Urban Design International*, *11*(3–4), 203–212.

- Edgeworth, M. (2011). Rivers as Entanglements of nature and culture. In *Fluid Pasts: Archaeology Of Flow (Debates in Archaeology)* (pp. 11–32). Bristol Classical Press.
- El-Sheekh, M. M. (2016). Impact of Water Quality on Ecosystems of the Nile River. In *The Handbook of Environmental Chemistry* (pp. 357–385).
- Everard, M., & Moggridge, H. L. (2012). Rediscovering the value of urban rivers. *Urban Ecosystem*, *15*(2), 293–314.
- Ewert, A., Mitten, D., & Overholt, J. (2014). *Natural Environments and Human Health*. CAB International.
- Faggi, A., Breuste, J., Madanes, N., Gropper, C., & Perelman, P. (2013). Water as an appreciated feature in the landscape: A comparison of residents' and visitors' preferences in buenos aires. *Journal of Cleaner Production*, *60*, 182–187.
- Falk, J. H., & Balling, J. D. (2010). Evolutionary influence on human landscape preference. *Environment and Behavior*, *42*(4), 479–493.
- Feng, Y., & Tan, P. Y. (2017). Imperatives for Greening Cities. A Historical Perspective. In P. Y. Tan & C. yung Jim (Eds.), *Greening Cities: Advances in 21st Century Human Settlements* (pp. 41–70). Springer.
- Fisher, B. (2004). Waterfront Design. In *Remaking the Urban Waterfront* (pp. 46–63). Urban Land Institute.
- Flotemersch, J., & Aho, K. (2021). Factors influencing perceptions of aquatic ecosystems. *Ambio*, *50*, 425–435.
- Fouad, H., Aly, M., & Redeker, C. (2013). Egypt; Nile Island Heterotopias. *Democratic Transition and Sustainable Communities-Overcoming Challenges Innovative Practical Solutions*, 316–328.
- Frumkin, H., Bratman, G. N., Breslow, S. J., Cochran, B., Kahn, P. H., Lawler, J. J., Levin, P. S., Tandon, P. S., Varanasi, U., Wolf, K. L., & Wood, S. A. (2017). Nature contact and human health: A research agenda. *Environmental Health Perspectives*, *125*(7), 1–18.
- Gabr, H. S. (2004). Perception of Urban Waterfront Aesthetics Along the Nile in Cairo, Egypt. *Coastal Management*, *32*(2), 155–171.
- Gandy, M. (2004). Rethinking urban metabolism: water, space and the modern city. *City: Analysis of Urban Trends, Culture, Theory, Policy, Action*, *8*(3), 371–387.

- Gandy, M. (2006). Urban nature and the ecological imaginary. In N. Heynen, M. Kaika, & E. Swyngedouw (Eds.), *In the Nature of Cities: Urban political ecology and the politics of urban metabolism* (pp. 62–72). Routledge.
- Gardner, H. (2000). *Intelligence Reframed: Multiple Intelligences for the 21st Century*. Basic Books.
- Gillis, K., & Gatersleben, B. (2015). A Review of Psychological Literature on the Health and Wellbeing Benefits of Biophilic Design. *Buildings*, *5*, 948–963.
- GIZ. (2011). *Reviving the Soul in Seoul : Seoul's Experience in Demolishing Road Infrastructure and Improving Public Transport*. Retrieved October 23, 2018, from http://www.sutp.org/files/contents/documents/resources/C_Case-Studies/GIZ_SUTP_CS_Reviving-the-Soul-in-Seoul_EN.pdf.
- Gobster, P. H., & Westphal, L. M. (2004). The human dimensions of urban greenways: Planning for recreation and related experiences. *Landscape and Urban Planning*, *68*(2–3), 147–165.
- Golubiewski, N. (2012). Is There a Metabolism of an Urban Ecosystem ? An Ecological Critique. *Ambio*, *41*(7), 751–764.
- Grimm, N. B., & Schindler, S. (2018). Nature of Cities and Nature in Cities Prospects for Conservation and Design of Urban Nature in Human Habitat. In E. S. Brondizio, J. Byrne, G. M. Mace, S. Lele, & J. Martinez-Alier (Eds.), *Rethinking Environmentalism: Linking Justice, Sustainability, and Diversity* (pp. 99–125). MIT Press.
- Groenewegen, P. P., De Vries, S., van Dillen, S. M. E., & Spreeuwenberg, P. (2013). Streetscape greenery and health: Stress, social cohesion and physical activity as mediators. *Social Science and Medicine*, *94*, 26–33.
- Groot, R. S. De, Wilson, M. A., & Boumans, R. M. J. (2002). A typology for the classification , description and valuation of ecosystem functions , goods and services. *Ecological Economics*, *41*, 393–408.
- Gullone, E. (2000). The Biophilia Hypothesis and Life in the 21st Century: Increasing Mental Health or Increasing Pathology? *Journal of Happiness Studies*, *1*(3), 293–322.
- Hae, M., Jackson-smith, D., Buchert, M., & Risley, J. (2017). Accessing blue spaces : Social and geographic factors structuring familiarity with , use of , and appreciation of urban water-ways. *Landscape and Urban Planning*, *167*, 136–146.

- Han, K. (2007). Responses to Six Major Terrestrial Biomes in Terms of Scenic Beauty , Preference , and Restorativeness. *Environment and Behavior*, *39*(4), 529–556.
- Hanson, S., Callone, M., & Walz, S. (2019). *Chicago Riverwalk, Phases 2 & 3 Methods*. Landscape Performance Series, Landscape Architecture Foundation. Retrieved March 13, 2020, from https://doi.org/10.31353/cs1501.
- Hartig, T., Mitchell, R., Vries, S. De, & Frumkin, H. (2014). Nature and Health. *Annual Review of Public Health*, *35*, 207–228.
- Hartig, T., Van-den-Berg, A. E., Hagerhall, C. M., Tomalak, M., Ann, O., Hansmann, R., Bauer, N., Bell, S., Waaseth, G., & Carrus, G. (2011). Health benefits and nature experiences: psychological, social and cultural processes. In K. Nilsson, M. Sangster, C. Gallis, T. Hartig, S. Vries, K. Seeland, & J. Schipperijn (Eds.), *Forests, Trees and Human Health* (pp. 127–168). Springer, Dordrechtr.
- Hassan, R., Scholes, R., & Ash, N. (Eds.). (2005). *Ecosystems and Human Well-being : Current State and Trends*. Island Press.
- Heerwagen, J., Kellert, S., & Mador, M. L. (2008). *Biophilic Design: The Theory, Science, and Practice of Bringing Buildings to Life*. John Wiley & Sons.
- Heerwagen, J., & Orians, G. . (1992). Evolved responses to landscapes. In J. H. Baekow, J. Tooby, & L. Cosmides (Eds.), *The adapted mind: evolutionary psychology and the generation of culture* (pp. 555–579). Oxford University Press.
- Heerwegh, D., & Loosveldt, G. (2008). Face-to-face versus web surveying in a high-internet-coverage population: Differences in response quality. *Public Opinion Quarterly*, *72*(5), 836–846.
- Hellenthal, M. F., & Gross, D. M. (2016). Design and Construction of the Chicago Riverwalk. *Geotechnical Special Publication*, *2016-Janua*(269 GSP), 643–652.
- Hermida, M. A., Cabrera-Jara, N., Osorio, P., & Cabrera, S. (2019). Methodology for the assessment of connectivity and comfort of urban rivers. *Cities*, *95*(102376).
- Herzog, T. ., Crooks, C. ., Herbert, E. ., & Kaplan, R. (2000). Cultural and developmental comparisons of landscape perceptions and preferences. *Environment and Behavior*, *32*, 323-346.

- Heynen, N., Kaika, M., & Swyngedouw, E. (2006). Urban political ecology. In N. Heynen, M. Kaika, & E. Swyngedouw (Eds.), *In the Nature of Cities: Urban political ecology and the politics of urban metabolism*. Routledge.
- Higgins, S. L., Thomas, F., Goldsmith, B., Brooks, S. J., Hassall, C., Harlow, J., Stone, D., Völker, S., & White, P. (2019). Urban freshwaters, biodiversity, and human health and well-being: Setting an interdisciplinary research agenda. *Wiley Interdisciplinary Reviews: Water*, *6*(2), 1339.
- Hong, C. Y., Chang, H., & Chung, E. S. (2019). Comparing the functional recognition of aesthetics, hydrology, and quality in urban stream restoration through the framework of environmental perception. *River Research and Applications*, *35*(6), 543–552.
- Hopkins, K. S. (2014). *A Biophilic Landscape Design in Shanghai, China* (Master's Thesis). University of Colorado.
- Hough, R. L. (2014). Biodiversity and human health : evidence for causality ? *Biodiverity Conservation*, *23*(2), 267–288.
- House, B. M. A., & Sangster, E. K. (1991). Public Perception of River-Corridor Management. *Journal of the Institution of Water and Environmental Management*, *5*, 312–317.
- Hsieh, H., Li, X., Wang, S., & Wu, Y. (2018). *Post-occupancy Evaluation of the Chicago Riverwalk Final Report*. University of Michigan.
- Hwang, K. (2005). *Restoring Cheonggyecheon Stream in the Downtown Seoul*.
- Iolin, C. H. R. V, Ada, P. E. C., Udduth, E. L. B. S., Assett, B. R. A. H., & Enrose, D. A. L. P. (2011). Effects of urbanization and urban stream restoration on the physical and biological structure of stream ecosystems. *Ecological Applications*, *21*(6), 1932–1949.
- Irvine, K. N., & Fuller, R. A. (2010). Interactions between people and nature in urban environments. In K. Gatson (Ed.), *Urban Ecology* (pp. 134–171). Cambridge University Press.
- Jeon, C., & Kang, Y. (2019). Restoring and Re-Restoring the Cheonggyecheon: Nature, Technology, and History in Seoul, South Korea. *Environmental History*, *24*, 736–765.

- Jingyao, W. (2010). *Urban Waterfront Redevelopment: Urban Redevelopment And Urban Politics, A Comparison Study Of Singapore And Shanghai* (Master's Thesis). National University Of Singapore.
- Jones, N. A., Ross, H., Shaw, S., Witt, K., Pinner, B., & Rissik, D. (2016). Values towards water-ways in south east Queensland: Why people care. *Marine Policy*, *71*, 121–131.
- Jung, Y. J., & Yi, C. (2017). *Role of Governance in Urban Transormation in Seoul : Best Practices*. The Seoul Institute. Available online from https://seoulsolution.kr/sites/default/files/gettoknowus/Role%20of%20Governance%20in%20Urban%20Transformation%20of%20Seoul_Chang%20Yi_2017-BR-04.pdf.
- Kahn, P. H. (1997). Developmental Psychology and the Biophilia Hypothesis : Children ' s Affiliation with Nature. *Developmental Review*, *61*(17), 1–61.
- Kaika, M. (2005). *City of Flows: Modernity, Nature, And The City*. Routledge.
- Kang, C. D., & Cervero, R. (2009). From Elevated Freeway to Urban Greenway : Land Value Impacts of the CGC Project in Seoul , Korea. *Urban Studies*, *46*(13), 2771–2794.
- Kaplan, S. (1995). The restorative benefits of nature: toward an integrative framework. *Environmental Psycology*, *15*(3), 169–182.
- Kaplan, S., & Kaplan, R. (1989). *The experience of nature : a psychological perspective*. Cambridge University Press.
- Keil, R., & Graham, J. (2005). Reasserting Nature: Constructing urban environments after Fordism. In N. Castree & B. Braun (Eds.), *REMAKING REALITY: Nature at the millenium* (pp. 98–124). Routledge.
- Kellert, S. (2005). *Building for life : designing and understanding the human-nature connection*. Island Press.
- Kellert, S. (2016). Biophilic urbanism : the potential to transform. *Smart and Sustainable Built Environment*, *5*(1), 4–8.
- Kellert, S., & Wilson, E. O. (1993). Biophilia and the conservation ethic. In S. Kellert & E. O. Wilson (Eds.), *The Biophilia Hypothesis* (pp. 31–40). Shearwater Books.
- Keniger, L. E., Gaston, K. J., Irvine, K. N., & Fuller, R. A. (2013). What are the Benefits of Interacting with Nature ? *International Journal of Environmental Research and Public Health*, *10*, 913–935.

- Kenwick, R. A., Shammin, M. R., & Sullivan, W. C. (2009). Preferences for riparian buffers. *Landscape and Urban Planning*, *91*(2), 88–96.
- Kim, H., Koh, T., & Kwon, K. (2009). *The Cheonggyecheon (Stream) Restoration Project - Effects of the restoration work*. Seoul Metropolitan Facilities Management Corporation.
- Kim, H. M., & Han, S. S. (2012). Seoul. *Cities*, *29*(2), 142–154.
- Kim, W. (2017). *Restoration Plans for Cheonggye Stream & the City Center (2002 – 2006)*. The Seoul Developmentl Institute. Retrieved March 12, 2019, from https://seoulsolution.kr/en/content/3519.
- Klein, W., Dove, M. R., & Felson, A. J. (2021). Engaging the unengaged: Understanding residents' perceptions of social access to urban public space. *Urban Forestry and Urban Greening*, *59*(March 2020).
- Kondolf, G. M., Gohar, A., Marizon, R., Mozingo, L., Balakrishnan, K., & Krishnachandran. (2011). *Connecting Cairo to the Nile: Renewing Life and Heritage on the River* (WP-2011-06).
- Kondolf, G. M., & Pinto, P. J. (2016). The social connectivity of urban rivers. *Geomorphology*, *277*, 182–196.
- Kostof, S. (1992). *The City Assembled: The Elements of Urban Form Through History*. Thames & Hudson Ltd.
- Kothencz, G., & Blaschke, T. (2017). Urban parks: Visitors' perceptions versus spatial indicators. *Land Use Policy*, *64*, 233–244.
- Kovel, J. (2007). *The Enemy of Nature. The end of capitalism or the end of the world?* (Second Edi). Zed Books Ltd.
- Krieger, A. (2004). The Transformation of the Urban Waterfront. In *Remaking the Urban Waterfront* (pp. 22–45). Urban Land Institute.
- Krieger, A. (2014). Transformations Along Urban Waterfronts. *International Planning Congress Urban Transformations- Cities and Water*, 1–91.
- Lamb, R. ., & Purcell, A. . (1984). Landscape perception: an examination and empirical investigation of two central issues in the area. *Environmental Management*, *13*, 31–63.
- Lasiewicz, S. . (2019). Urban waterfronts' wilderness as a space of engagement. *Technical Transactions*, *2*, 41–56.
- Lee, I. (2006). *Cheong Gye Cheon Restoration Project, A revolution in Seoul*. Seoul Metropolitan Government. Available online on

https://www.seoulsolution.kr/sites/default/files/policy/%5BEN%5DCheong%20Gye%20Cheon%20Restoration%20Project.pdf.

- Lee, J., & Anderson, C. (2014). The Restored Cheonggyecheon and the Quality of Life in Seoul. *Journal of Urban Technology*, *20*(4), 3–22.
- Lee, Y., Lee, C., Choi, J., Yoon, S., & Hart, R. . (2014). Tourism ' s role in urban regeneration : examining the impact of environmental cues on emotion , satisfaction , loyalty , and support for Seoul ' s revitalized Cheonggyecheon stream district. *Journal of Sustainable Tourism*, *22*(5), 726–749.
- Lim, H., Kim, J., Potter, C., & Bae, W. (2013). Urban regeneration and gentrification: Land use impacts of the Cheonggye Stream Restoration Project on the Seoul's central business district. *Habitat International*, *39*, 192–200.
- Littke, H. (2016). Becoming biophilic:Challenges and opportunities for biophilic urbanism in urban planning policy. *Smart and Sustainable Built Environment*, *5*(1), 15–24.
- Louv, R. (2008). *Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder*. Algonquin Books of Chapel Hill.
- Low, C.-L. (2008). Singapore River: Six Strategies for Sustainability. In T. Wong, B. Yuen, & C. Goldblum (Eds.), *Spatial Planning for a Sustainable Singapore* (pp. 79–92). Springer.
- Ma, X. (2016). *Assessing Residents' Perceptions Of Waterfront Landscapes In Las Colinas Urban Center, Irving, Texas* (Master's Thesis). The University of Texas at Arlington.
- Mačiukėnaitė, J., & Povilaitienė, I. (2013). The Role of the River in the City Centre and its Identity. *Journal of Sustainable Architecture and Civil Engineering*, *4*(5), 33–41.
- Maller, C., Townsend, M., Pryor, A., Brown, P., & Leger, L. S. T. (2005). Healthy nature healthy people : ' contact with nature ' as an upstream health promotion intervention for populations. *Health Promotion International*, *21*(1).
- Marten, G. G. (2001). *Human Ecology: Basic Concepts for Sustainable Development*. Earthscan Publications Ltd.
- Marx, K. (1988). *The Economic and Philosophic Manuscript of 1844*. Prometheus Books.

- Maxwell, S., & Lovell, R. (2017). *Evidence Statement on the links between natural environments and human health*. The European Centre for Environment and Human Health.
- May, R. (2006). “Connectivity” in urban rivers: Conflict and convergence between ecology and design. *Technology in Society*, *28*(4), 477–488.
- Mcharg, I. L. (1969). *Desing With Nature*. The Natural History Press.
- Mendler, S., Lazarus, M., & O`dell, W. (2006). *The HOK Guidebook to Sustainable Design* (Second Edi). John Wiley & Sons.
- Millennium Ecosystem Assessment. (2005). Ecosystems and Human Well-being: Synthesis. *Island Press*.
- Mishra, H. S., Bell, S., Vassiljev, P., Kuhlmann, F., Niin, G., & Grellier, J. (2020). The development of a tool for assessing the environmental qualities of urban blue spaces. *Urban Forestry and Urban Greening*, *49*.
- Mitchell, R. (2013). Is physical activity in natural environments better for mental health than physical activity in other environments? *Social Science and Medicine*, *91*, 130–134.
- Mitchell, R., & Popham, F. (2008). Effect of exposure to natural environment on health inequalities: an observational population study. *The Lancet*, *372*(9650), 1655–1660.
- Morley, S. A., & Karr, J. R. (2002). Assessing and Restoring the Health of Urban Streams in the Puget Sound Basin. *Conservation Biology*, *16*(6), 1498–1509.
- Mosler, S. (2021). The transformative role of rivers in the evolution of urban landscapes: a case study from urban rivers of Chelmsford in Essex. *Journal of Urban Design*, *26*(1), 95–116.
- Mouad, A. (2013). *Multi-Functional Urban Waterfronts Case study – The Nile River in Central Cairo* (Master's Thesis). Ain Shams Univeristy.
- Nayan, N. M., Jones, D. S., Bahaluddin, A., Ghani, I., & Rahman, N. A. (2020). Designating Urban Rivers as National Heritage: A case study of Sungai Kelang and Sungai Gombak, Kuala Lumpur, Malaysia. *IOP Conference Series: Earth and Environmental Science*, *409*.
- Newman, P., Beatley, T., & Boyer, H. (2017). *Resilient Cities: Overcoming Fossil Fuel Dependence* (2nd Edition). Island Press.

- Niemann, B., & Weber, S. (2013). The particular case of urban waterfronts. *WIT Transactions on Ecology and the Environment*, *179*, 561–566.
- Olivier, B. (2013). Nature , Capitalism , and the Future of Humankind. *South African Journal of Philosophy*, 37–41.
- Orians, G. . (1986). An ecological and evolutionary approach to landscape aesthetics. In E. Penning-Rowsell & D. Lowenthal (Eds.), *Landscape meanings and values* (pp. 4–25). Allen and Unwin.
- Panagopoulos, T. (2019). Special Issue : Landscape Urbanism and Green Infrastructure. *Land*, *8*(112).
- Pitt, H. (2018). Muddying the waters: What urban water-ways reveal about bluespaces and wellbeing. *Geoforum*, *92*, 161–170.
- Pitt, H. (2019). What prevents people accessing urban bluespaces? A qualitative study. *Forestry and Urban Greening*, *39*, 89–97.
- Proctor, J. D. (2004). Resolving Multiple Visions of Nature, Science, and Religion. *Zygon*, *39*(3), 637–653.
- Pyle, R. (1993). *The thunder tree: lessons from an urban wildland*. Houghton Mifflin.
- Qutb, K., & Shalaby, A. (2016). Constructing a Conceptual Framework towards Understanding Urban Transformations of Waterfronts. *Journal of Urban Research*, *21*, 1–23.
- Raslan, Y. M. (2006). Economical and Environmental Aspects of. *Sixth International Water Technology Conference*, 319–328.
- Raymond, A. (2000). *Cairo* (W. Wood (Ed.)). Harvard University Press.
- Reed, B. (2007). Shifting from ‘ sustainability ’ to regeneration Forum Shifting from ‘ sustainability ’ to regeneration. *Building Research & Information*, *35*(6), 674–680.
- Reeve, A. (2014). *Mainstreaming biophilic urbanism in Australian cities: A response to climate change, resource shortages and population pressures* (Doctoral Dissertation). Queensland University of Technology.
- Reeve, A., Desha, C., Hargroves, C., & Newman, P. (2013). A Basis for Inquiry into Policy Considerations for Increasing the Application of Biophilic Urbanism. In G. Morrison, S. Rauch, S. Norra, & N. Schleicher (Eds.), *Urban Environment: Proceedings of the 11th Urban Environment Symposium (UES)* (pp. 143–151). Springer.

- Rowe, P. ., & Hee, L. (2018). *A City in Blue and Green*. Springer Na.
- Ryu, C., & Kwon, Y. (2016). How do mega projects alter the city to be more sustainable? Spatial changes following the Seoul Cheonggyecheon Restoration Project in South Korea. *Sustainability (Switzerland)*, *8*(11).
- Sami, A. (2011). *Urban Redevelopment for the Waterfronts of Metropolitan Cities* (Doctoral Dissertation). Ain Shams University.
- Sandifer, P. A., Sutton-grier, A. E., & Ward, B. P. (2015). Exploring connections among nature , biodiversity , ecosystem services , and human health and well-being : Opportunities to enhance health and biodiversity conservation $. *Ecosystem Services*, *12*, 1–15.
- Sayyid, A. F. (2015). The Historical Development of Cairo. In *The Topography and Urban Evolution of Cairo* (pp. 5–27). Genral Egyptian Book Organization.
- SBEnrc. (2012). *Can biophilic urbanism deliver strong economic and social benefits in cities? An economic and policy investigation into the increased use of natural elements in urban design*.
- Schacter, D. ., Gilbert, D. ., & Wegner, D. . (2011). *Sensation and Perception in Psychology* (2nd Editio). Worth Publishers.
- Schultz, P. W. (2000). Empathizing With Nature: The Effects ofPerspective Taking on Concern for Environmental Issues. *Journal of Social Issues*, *56*(3), 391–406.
- Schultz, P. W., Shriver, C., Tabanico, J. J., & Khazian, A. M. (2004). Implicit connections with nature. *Journal of Environmental Psychology*, *24*(1), 31–42.
- Seoul Development Institute. (2014). *Seoul Urban Regeneration: Cheonggyecheon Restoration and Downtown Revitalization*. Seoul Metropolitan Government. Retrieved February 02, 2019, from https://www.seoulsolution.kr/node/2374?language=en
- Seoul Metropolitan Government (SMG). (2009). *UNESCO city of design: Seoul*.
- Seymour, V. (2016). The Human – Nature Relationship and its impact on Health : A Critical Review. *Fontiers in Public Health*, *4*(260), 1–12.
- Silva, J., Serdoura, F., & Pinto, P. J. (2006). Urban Rivers as Factors of Urban (Dis) integration. *42nd ISOCARP Congress*, 14–18.

- Simaika, J. P., & Samways, M. J. (2010). Biophilia as a Universal Ethic for Conserving Biodiversity. *Conservation Biology*, *24*(3), 903–906.
- Sims, D. (2012). *Understanding Cairo: The Logic of A City out of Control*. The American University in Cairo Press.
- Smardon, R. (2018). Urban waterway history and planning context. In S. Moran, R. Smardon, & A.-K. Baptiste (Eds.), *Revitalizing Urban Waterway Communities* (pp. 1–27). Routledge.
- Smith, D. G., Croker, G. F., & McFarlane, K. (1995). Human perception of water appearance: 1. Clarity and colour for bathing and aesthetics. *New Zealand Journal of Marine and Freshwater Research*, *29*(1), 29–43.
- Soga, M., & Gaston, K. J. (2016). Extinction of experience: The loss of human-nature interactions. *Frontiers in Ecology and the Environment*, *14*(2), 94–101.
- Song, Y. (2011). Ecological city and urban sustainable development. *Procedia Engineering*, *21*, 142–146.
- Srinivasan, V. (2014). *The Separation of Humans and Nature as it Relates to Environmental Degradation*. 2014 Claremont Colleges Library Undergraduate Research Award.
- Stevens, Q. (2009). Artificial waterfronts. *Urban Design International*, *14*, 3–21.
- Strain, E. M. A., Alexander, K. A., Kienker, S., Morris, R., Jarvis, R., Coleman, R., Bollard, B., Firth, L. B., Knights, A. M., Grabowski, J. H., Airoldi, L., Chan, B. K. K., Chee, S. Y., Cheng, Z., Coutinho, R., de Menezes, R. G., Ding, M., Dong, Y., Fraser, C. M. L., … Bishop, M. J. (2019). Urban blue: A global analysis of the factors shaping people's perceptions of the marine environment and ecological engineering in harbours. *Science of the Total Environment*, *658*, 1293–1305.
- Taylor, A. F., Kuo, F. E., & Sullivan, W. C. (2001). *Copping with ADD: The Surprising Connection to Green Play Settings*. *33*(1), 54–77.
- Timur, U. P. (2013). Urban Waterfront Regenerations. In M. Ozyavuz (Ed.), *Advances in Landscape Architecture* (pp. 169–206). IntechOpen.
- Tokhmehchian, A., & Gharehbaglou, M. (2019). Biophilic perception in urban green spaces (Case study : El Gölü Park , Tabriz) Biophilic perception in urban green spaces (Case study : El. *International Journal of Urban Sciences*, *0*(0), 1–18.

- Totaforti, S. (2020). Emerging biophilic urbanism: The value of the human-nature relationship in the urban space. *Sustainability (Switzerland)*, *12*(13).
- Tuan, Y.-F. (1974). *Topophilia: A Study of Environmental Perceptions, Attitudes, and Values*. Prentice Hall Inc.
- Turner, W. R., Nakamura, T., & Dinetti, M. (2004). Global Urbanization and the Separation of Humans from Nature. *BioScience*, *54*(6), 585–590.
- Ulrich, R. S. (1983). Aesthetic and affective response to natural environment: Behavior and the natural environment. In J. F. Wohlwill & I. Altman (Eds.), *Behavior and the Natural Environment* (pp. 85–125). Plenum.
- Ulrich, R. S. (1999). Effects of gardens on health outcomes: theory and research. In C. C. Marcus & M. Barnes (Eds.), *Healing Gardens: Therapeutic Benefits and Design Recommendations* (pp. 27–86). John Wiley & Sons.
- UN-Habitat. (2016). *Urbanization and Development : Emerging Futures*.
- UN-HABITAT. (2015). *Issue Paper On Urban Ecosystems And Resource Management*.
- Unema, P., Pasini, M., Barbiero, G., & Berto, R. (2015). Biophilic Design Triggers Fascination and Enhances Psychological Restoration in the Urban Environment. *Journal Of Biourbanism*, *Volume III*(1–2), 28–34.
- United Nations. (2017). *The World Population Prospects: The 2017 Revision*.
- Urban Redevelopment Authority. (2019). *Singapore River: Urban Design Guidelines & Plans*. Retrieved January 01, 2020, from https://www.ura.gov.sg/Corporate/Guidelines/Urban-Design/Singapore-River
- Vining, J., Merrick, M. S., & Price, E. A. (2008). The distinction between humans and nature: Human perceptions of connectedness to Nature and elements of the natural and unnatural. *Human Ecology Review*, *15*(1), 1–11.
- Völker, S., & Kistemann, T. (2011). The impact of blue space on human health and well-being - Salutogenetic health effects of inland surface waters: A review. *International Journal of Hygiene and Environmental Health*, *214*(6), 449–460.

- Völker, S., & Kistemann, T. (2013). “I’m always entirely happy when I’m here!” Urban blue enhancing human health and well-being in Cologne and Düsseldorf, Germany. *Social Science and Medicine*, *78*(1), 113–124.
- Vollmer, D. (2009). Urban waterfront rehabilitation: Can it contribute to environmental improvements in the developing world? *Environmental Research Letters*, *4*(2).
- Wantzen, K. M., Ballouche, A., Longuet, I., Bao, I., Bocoum, H., Cissé, L., Chauhan, M., Girard, P., Gopal, B., Kane, A., Marchese, M. R., Nautiyal, P., Teixeira, P., & Zalewski, M. (2016). River Culture: An eco-social approach to mitigate the biological and cultural diversity crisis in riverscapes. *Ecohydrology and Hydrobiology*, *16*(1), 7–18.
- Washington, H. (2013). *Human Dependence on Nature How to help solve the environmental crisis*. Routledge.
- Wessells, A. T., & Lejano, R. P. (2017). Urban water-ways and waterfront spaces: Social construction of a common good. *Journal of the Southwest*, *59*(1–2), 106–132.
- West, A. O., Nolan, J. M., & Scott, J. T. (2016). Optical water quality and human perceptions: a synthesis. *Wiley Interdisciplinary Reviews: Water*, *3*(2), 167–180.
- White, L. (1967). The Historical Roots of Our Ecologic Crisis. *SCIENCE*, *155*(3767), 1203–1207.
- White, M., Smith, A., Humphryes, K., Pahl, S., Snelling, D., & Depledge, M. (2010). Blue space: The importance of water for preference, affect, and restorativeness ratings of natural and built scenes. *Journal of Environmental Psychology*, *30*(4), 482–493.
- Wilson, E. O. (1984). *Biophilia*. Harvard University Press.
- Wohl, E. (2011). *A world of rivers: environmental change on ten of the world’s great rivers*. The University of Chicago Press.
- Wohlwill, J. F. (1983). The concept of nature: A psychologist’s view. In I. Altman & J. F. Wohlwill (Eds.), *Behavior and the Natural Environment*. Plenum Press.
- Woodward, R. (2001). Water in landscape. In D. Grau & H. Dreiseitl (Eds.), *New Waterscapes: Planning, Building and Designing with Water* (pp. 10–41). Birkhäuser Basel.

- World Bank. (2015a). *Urban Regeneration case studies: Seoul*. World Bank. Retrieved April 10, 2019, from <https://urbanregeneration.worldbank.org/Seoul>
- World Bank. (2015b). *Urban Regeneration case studies: Singapore*. World Bank. Retrieved February 05, 2019, from <https://urban-regeneration.worldbank.org/node/72>
- World Health Organization, & Convention on Biological Diversity. (2015). *Connecting Global Priorities : Review, Knowledge*.
- Wrenn, D., Casazza, J. ., & Smart, E. (1983). *Urban Waterfront Development*. Urban Land Institute.
- Yocom, K., Andrews, L., Faghin, N., Dyson, K., Leschine, T., & Nam, J. (2016). Revitalizing urban waterfronts: identifying indicators for human. *Environmental Science*, *3*(3), 456–473.
- Yuen, B. (2013). Urban regeneration in Asia: mega-projects and heritage conservation. In J. McCarthy & M. E. Leary (Eds.), *The Routledge Companion To Urban Regeneration* (pp. 127–137). Routledge.
- Zari, P. M. (2019). Understanding and designing nature experiences in cities: a framework for biophilic urbanism. *Cities & Health*, *00*(00), 1–12.
- Zheng, T., Yan, Y., Lu, H., Pan, Q., Zhu, J., Wang, C., Zhang, W., Rong, Y., & Zhan, Y. (2020). Visitors' perception based on five physical senses on ecosystem services of urban parks from the perspective of landsenses ecology. *International Journal of Sustainable Development and World Ecology*, *27*(3), 214–223.
- Zube, E. ., Taylor, J., & Sell, J. (1982). Landscape perception: research, application, theory. *Landscape and Urban Planning*, *9*, 1–33.

الملخص

نتيجة لتكدس السكان في المدن والماطق الحضرية، تبحث المدن عن طرق جديدة لدمج الطبيعة مع نسيجها العمراني؛ سعياً إلى تحسين جودة حياة الإنسان والبيئة التي يعيش فيها. وتشمل المناطق الطبيعية: الحدائق العامة والمساحات الخضراء وسواحل البحار وضفاف الأنهار، وتتضمن الأخيرة الممرات و المجاري المائية بالمناطق الحضرية. المجارى المائية الموجودة داخل المدن هى جزء لا يتجزأ من النسيج العمرانى لها. تاريخيا، لعبت هذه المسطحات المائية دورا هاما فى بناء المستوطنات البشرية منذ العصور القديمة. حيث مثلت هذه المسطحات المائية، باختلاف احجامها، مصدرا للماء و الطعام كما تم استخدامها كممرات حركة و ممرات تجارية. ومنذ عصور الحضارات القديمة، كان يتم اختيار المناطق المحاذية للمسطحات المائية بسبب الموقع المتميز. ومع التزايد المستمر لعملية التنمية العمرانية فان ذلك كان له تأثير سلبى على هذه المجارى المائية حيث تعرضت هذه المسطحات الى التلوث وسوء الأستخدام. فى مصر، نهر النيل ، وكالعديد من انهار العالم ، مثل مصدرا للحياه منذ عصور الحضارة المصرية القديمة التى نشأت على ضفاف هذا النهر، معتمدة علية كمصدر للمياه و الطعام وكممر للحركة و التجارة و كمصدر حياه للأراضى الخصبة المحيطة بالنهر. يعانى من تدهور فى الطبيعة الخاصة بالنهر والبيئة الطبيعية المحيطة الى جانب ان ضفاف النهر اصبحت مكتظة بانشطة غير ملائمة لطبيعة النهر و انفصال بين النهر و البيئة العمرانية المحيطة بالإضافة الى عدم قدرة مستخدمى النهر على الاتصال المباشر به ، بصريا و جسديا. بالإضافة لذلك فإن هناك عدم ادراك باهمية نهر النيل كعنصر طبيعى أو كجزء جلى من البيئة الطبيعية وكعنصر اتصال قوى بين النسيج العمرانى للمدن المصرية.

وبالرغم من الأهتمام الذى تحظى به حاليا المناطق المحاذية للمجارى المائية كمناطق متميزة و غنية طبيعيا الا ان المشكلة تكمن فى ان الكثير من المدن لازالت غير قادرة على استيعاب الإمكانيات المتاحة و التى تكمن فى الاستغلال الأمثل لهذه المجارى المائية فى عملية التنمية العمرانية على ضفافها حيث تمثل هذة معضلة للمعماريين والمخططين المختصين لتحقيق اقصى استفادة ممكنة بدون اللجوء الى مقايضات بين العوامل الأجتماعية و الأقتصادية و البيئية المختلفة.

فى هذا السياق , بدأ ظهور اتجاه " العمران البيوفيلى" كاتجاه عمرانى جديد فى تصميم المناطق العمرانية الحضرية. يعتبر اتجاه " العمران البيوفيلى " تطبيق على نظرية او فرضية " البيوفيليا" و التى تم استخدامها من قبل إدوارد أوسبورن ويلسون ، الذي ألف كتاب يحمل نفس الاسم ونشره في جامعة هارفارد ، عام ١٩٨٤.فى هذا الكتاب يصف ويلسون البيوفيليا "*بالميل الطبيعي لدى الانسان لكل الكائنات الحية الوجودة بالبيئة الطبيعية المحيطة*". حيث يستند ويلسون فى هذه الفرضية الى ان عملية التطور لدى الانسان بدأت فعلا من البيئة الطبيعية المحيطه به.اثبت الدراسات العلمية الحديثة

الى حد كبير صـــحة فرضـــية "البيوفيليا" حيث ايدت نتائج هذه الدراســـات فرضـــية ويلســـون فيما يخص فوائد اتصـــال الإنســـان بالبيئة الطبيعية والتى تتفاوت بين فوائد اجتماعية و نفسية و ثقافية وفيزيولوجية متعددة.

الهدف الرئيسى من هذه الدراسة هو البحث فى الإمكانيات و المحددات الممكنةوالمتوقعة لتطبيق اتجاه" العمران البيوفيلى" فى خطط التنمية العمرانية المستقبلية على ضفاف نهر النيل و محاولة تحقيق استفادة عامة من النهر كعنصر طبيعى دائم و مؤثر فى النسيج العمرانى للبيئة العمرانية المحيطة . كما ان البحث سيناقش من خلال دراسة تحليلة للوضع الراهن لضفاف النهر الأسباب الرئيسية وراء ما وصلت اليه ضفاف النهر والبيئة العمرانية المحيطة من تراجع فى طبيعة مياه النهر و انفصال بين النهر ومستخدميه.

البحث سوف ينقسم الى ثلاث اجزاء رئيسية: الجزء الأول هو الجزء النظرى والذي سيتبع منهج وصفى حول العلاقة النظرية بين البيئة الطبيعية و تأثيرها على صحة الإنسان، ذهنيا و جسديا. كذلك سيتناول هذا الجزء النظريات السائدة حول هذة العلاقة مع التركيز على نظرية " البيوفيليا" و التطبيق العملى على هذه النظرية فى دمج العناصر الطبيعية فى البيئة العمرانية المشيدة كوسيلة لتطويرها لصالح الإنسان. الجزء الثانى من البحث هو الجزء التحليلى و فيه سيتناول البحث الطرق و الانجاهات العالمية الحديثة للتعامل مع المجارى المائية والتنمية العمرانية على ضفافها. هذا الجزء سيتبع منهج استقرائي/ استنباطى عن طريق دراسة تحليلية لأمثلة عالمية تبنت اتجاه" العمران البيوفيلى" فى التنمية العمرانية على ضفاف المجارى المائية. هذا الجزء من البحث سيهدف الى محاولة الوصول الى مجموعة من الأعتبارات للتمنية العمرانية لضفاف المجارى المائية باتباع اتجاه " العمران البيوفيلى" بحيث يمكن استخدامها كمعايير للقياس فى الجزء التطبيقى الخاص بدراسة حالة نهر النيل. بينما الجزء الثالث من البحث سيتناول دراسة تحليلية مفصلة للمنطقة محل الدراسة بمدينة القاهرة تحديد مؤشرات البيوفيليا في المنطقة محل الدراسة والوقوف على مدى الإدراك المجتمعى لمستخدمى نهر النيل باستخدام مجموعة الإعتبارات التى تم الوصول اليها خلال الجزء الثاني ، وتقييم مدى تكامل المناطق ذات الواجهة النيلية مع النسيج العمراني للمدينة، وكذلك البحث في إمكانية استخدام النيل في وسط القاهرة كعامل محفز لتحسين جودة حياة الإنسان وجودة الحياة في المناطق الحضرية.

ويتبع البحث نهجاً تحليلياً لدراســة الحالة. وشــملت أســاليب جمع البيانات اســتعراضــاً مســتفيضــاً للمطبوعات و الاعمال الادبية ، ودراســة اســتقصــائية ميدانية ، بالتزامن مع مقابلات مع مستخدمي الواجهة المائية لنهر النيل بالمنطقة محل الدراسة كلما أمكن ذلك، ودراسة استقصائية تم توزيعها علي شبكة الإنترنت. ثم تم إجراء تحليلي للبيانات لتقييم درجة تكامل الواجهة البحرية لنهر النيل داخل النسيج الحضري للمدينة لتحديد مؤشرات البيوفيليا في الواجهة المائية بالمنطقة محل الدراســة والتحقيق في الفرص والتحديات المحتملة لتطبيق اتجاه "العمران البيوفيلي" في خطط التنمية المســتقبلية على طول الواجهة البحرية للنيل. وتبين النتائج أن مســتخدمي الواجهة البحرية لنهر النيل نادرا ما

يُسـمح لهم بالوصـول المادي إلى المياه. يتم توفير الوصـول البصـري في الغالب، مع اسـتثناءات طفيفة. وتشـير اهم النتائج الشـاملة الاخرى إلى عدم وجود اتصـال اجتماعي طولي واتّصـالي إلى الواجهة البحرية، وعدم وجود مسـارات مناسـبة مسـتمرة للمشـاة، ونقص عام في المساحات الخضراء والمرافق العامة.

الكلمات المفتاحية: بيوفيليا – العمران البيوفيلى – البيئة الطبيعية – البيئة العمرانية – المجارى المائية فى المناطق الحضرية – الواجهات المائية الحضرية – التنمية العمرانية للواجهات المائية.

تعريف بمقدم الرسالة

الاسم : سارة عيد حنيدق محمد علي

تاريخ الميلاد : ٠٨-١٠-١٩٨٩

محل الميلاد : القاهرة

اخر درجة جامعية : بكالريوس العلوم بالهندسة المعمارية- تخطيط عمراني

الجهة المانحة : كلية الهندسة – جامعة عين شمس

تاريخ المنح : ٢٠١٢

الوظيفه الحالية : مهندسة معمارية بمكتب لاند للاستشارات الهندسية

جامعة عين شمس
كلية الهندسة
قسم التخطيط العمرانى

رسالة الماجستير:

اسم الطالب : سارة عيد حنيدق محمد علي

عنوان الرسالة : **العمران البيوفيلي: المجارى المائية فى المناطق الحضرية من العزل الى التكامل**
دراسة حالة نهر النيل فى مصر

اسم الدرجة : ماجستير العلوم في الهندسة

لجنة الاشراف:

أ.د/ مروة ابو الفتوح السيد خليفة

أ.د/ أحمد سامي عبد الرحمن

تاريخ البحث : ...../...../.....

الدراسات العليا:

ختم الإجازة: اجيزت الرسالة بتاريخ :
...../...../.....

موافقة مجلس الكلية : ...../...../.....

موافقة مجلس الجامعة : ...../...../.....

القاهرة
٢٠٢١

جامعة عين شمس
كلية الهندسة
قسم التخطيط العمرانى

العمران البيوفيلي: المجارى المائية فى المناطق الحضرية من العزل الى التكامل دراسة حالة نهر النيل فى مصر

إعداد

سارة عيد حنيدق محمد علي

لجنة الحكم

الاسم	التوقيع
أ.د/ ايمن حسان احمد محمود كلية الهندسة – جامعة القاهرة	.....
أ.د/ مروة ابو الفتوح السيد خليفة كلية الهندسة – جامعة عين شمس	.....
أ.د/ عبير محمد رضا الشاطر كلية الهندسة – جامعة عين شمس	.....
أ.د/ أحمد سامي عبد الرحمن كلية الهندسة – جامعة عين شمس	.....

٢٠٢١/٠٣/١١

جامعة عين شمس
كلية الهندسة
قسم التخطيط العمرانى

العمران البيوفيلي: المجارى المائية فى المناطق الحضرية من العزل الى التكامل
دراسة حالة نهر النيل فى مصر

رسالة مقدمة للحصول على درجة ماجستير العلوم
فى الهندسة المعمارية
(التخطيط العمرانى)

اعداد
سارة عيد حنيدق محمد علي
حاصل على بكالوريوس العلوم
فى الهندسة المعمارية
(التخطيط العمرانى)
كلية الهندسة,جامعة عين شمس ,
٢٠١٢

المشرفون

أ.د/ مروة ابو الفتوح السيد خليفة
استاذ دكتور
قسم التخطيط و التصميم العمرانى
جامعة عين شمس

أ.د/ احمد سامي عبد الرحمن
استاذ دكتور
قسم التخطيط و التصميم العمرانى
جامعة عين شمس

القاهرة
٢٠٢١