

Greening the Urban Environment: An Integrated Approach to Planning Sustainable Cities—The Case of Greater Cairo



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Introduction

Urbanization is a powerful global trend characterized by rapid and often uncontrolled urban growth through excessive emigration of people from the countryside to urban areas leading to the emergence of substantial dispersed and de-compacted cities (Brilhante and Klaas 2018). Rapid urbanization has led to the growth of numerous megacities in developing countries placing increasing pressures on resources and infrastructure while influencing the living conditions and quality of life of its inhabitants. At the outset of the twentieth century, around 12.5% of the world's population (200 million inhabitants) lived in cities (Höjer and Wangel 2014). Today, the twenty-first century has been dubbed as the “urban century” with more than half of the world's population (52% or 3.6 billion people) living in towns (Höjer and Wangel 2014). This surge in urban population is expected to prevail and it is anticipated that by 2050 urban inhabitants will account for 67% of the global population (Höjer and Wangel 2014).

Moreover, cities are facing numerous challenges including economic, social, political, and environmental problems. Floods, heat waves, hurricanes, earthquake, and tsunami hazards are all warning signs of global warming (Keivani 2010). Additionally, cities currently account for some 75% of the world's energy use and are responsible for over 70% of the world's carbon dioxide emissions. Most megacities, especially in developing countries, suffer to different degrees from deterioration of urban environmental performance. Rapid urbanization and sprawl have led to the decline in biodiversity, destruction of urban natural resources and green fields,

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loss of agricultural land, environmental pollution, reduced water quality, population overload, increased pressures on infrastructure, and increased release of greenhouse gases (Höjer and Wangel 2014). This is further pronounced as unsustainable urban morphologies have led to congestion, extensive buildup of transport and other infrastructure, increased dependency on vehicles, and use of fossil fuel, thus increasing the city's carbon footprint (Brilhante and Klaas 2018). These ills represent a prime concern to developing countries primarily because of their institutional inability to implement regulations and manage natural resources (Assadian and Nejati 2013).

During the past 50 years, the urban population in India grew fivefold affecting air quality; this comes as their transport sector contributes ~90% of total emissions in the country (Shrivastava et al. 2019). Loss of agricultural land around cities is another aftereffect of rapid urbanization. It has been estimated that a total of 1.4 million acres of agricultural land around the Greater Cairo Region (GCR) has been lost between 1952 and 2002 (Keivani 2010). Furthermore, according to the FAO, Nigeria's deforestation rate of primary forests is the highest in the world endangering the forest ecosystems (Mfon et al. 2014).

On the social front, cities with high levels of uncontrolled urbanization are prone to social inequalities manifested in terms of relative poverty, crime, and social exclusion of particular sectors of society (migrants, youth, the unemployed, and the disabled). This is clearly witnessed in informal settlements, where access to utilities and infrastructure can be challenging. The illegal status of these settlements impedes governments from providing needed services, thus aggravating environmental pollution while leading to urban inequity and declined community health (Keivani 2010).

Yet, cities are dynamic and complex; they are sources of both environmental opportunities and threats. Cities have an essential economic function; they are the economic engines contributing up to 55% of gross national product in low-income countries, 73% in middle-income countries, and 85% in high-income countries (UN-Habitat 2006). Moreover, cities are places for commercial, cultural, scientific, industrial, and social activities. They are centers of political power and administration, places to enable global economic functions and to offer quality life opportunities. It is but critical that cities adopt environmentally, socially, and economically responsible green growth strategies (OECD 2013).

Sustainable Green Cities

The concept of sustainability emerged in the 1990s tackling social equity, economic growth, and environmental preservation as related to city development. The concept paved the way for interrelated notions such as green urbanism, compact planning, and livable cities (Brilhante and Klaas 2018). Although there is no unique definition for sustainable development, the most widely accepted definition is that declared by the World Commission on Environment and Development in 1987, whereby sustainable development is defined as the "development that meets the needs of the present without compromising the ability of future generations to meet their own

needs” (Assadian and Nejati 2013). In 2006, the UN-HABITAT asserted that sustainable development seeks to strike a dynamic balance among the objectives of economic, environmental, and sociocultural development within the framework of a local government whereby citizens proactively participate in the development process (Assadian and Nejati 2013; Chan and Hun Lee 2019).

One term that emanated from sustainability is “green city” with “green” signifying different things to different people. The term nowadays is widely used by private and public organizations as a brand for sustainability and eco-friendliness (Brilhante and Klaas 2018). Green sustainable cities are an integrated, multi-sector process that covers a broad range of environmental issues while linking these issues to economic and social objectives (EBRD 2016). “Green cities” minimize ecological impact and maximize high environmental performance with the objective of improving and supporting the natural environment while utilizing investments, services, regulation, and other relevant policy instruments. They seek to reduce dependency on nonrenewable energy sources, preserve (air, water, land/soil, and biodiversity), include green and resilient infrastructure and low-carbon transport, mitigate risks deriving from climate change, and deliver improved quality of life (EBRD 2016; Lewis 2015). Adopting green city strategies offers multiple opportunities to create jobs, attract businesses and investment, improve local environmental quality, and address global environmental challenges, particularly climate change (OECD 2013).

Benefits of Sustainable Green Cities

Urban form and spatial development have notable consequences on sustainable development encompassing not only environmental issues but also social and economic aspects. Based on studies by diverse scholars (Keivani 2010; Lewis 2015; Keleg 2018) a “sustainable green city” approach facilitates the realization of environmental, social, and economic benefits including but not limited to:

Environmental Benefits:

- Reducing carbon dioxide emissions by utilizing renewable energy sources
- Reducing heat island effects and carbon footprint
- Optimizing natural assets such as sunlight and wind flow
- Providing places for biodiversity in cities
- Creating a quieter and healthier microclimate
- Decreasing air and water pollution
- Reducing reliance on automobiles
- Offering adaptable and resilient urban spaces and infrastructure
- Mitigating hazards
- Producing healthier buildings
- Improving visual amenity

Social Benefits:

- Increasing livability of cities
- Improving quality of life
- Enhancing opportunities for connection with nature and understanding of the natural habitat
- Enhancing physical and mental health and well-being
- Improving community health and decreasing ailment rates

Economic Benefits:

- Enhancing economic vitality
- Increasing marketing potential
- Reducing poverty
- Decreasing operating costs
- Increasing productivity through reduced commutes and travel
- Improving service delivery

Sustainable Green City Strategies

Urban policies could play a significant role in realizing environmental and green growth goals. Cities are responsible for a substantial share of infrastructure investments, which if invested wisely could contribute to national efforts to combine growth with environmental performance leading to sustainable “green cities” (OECD 2013). Establishing a “green city” requires firm policies, a robust regulatory framework, strategic planning, and links to finance (Lewis 2015). By manipulating the built environment and infrastructure, cities could be greener and more sustainable. This involves intervening at various stages of development including design, construction, operation, and maintenance (Lewis 2015). Sustainable green strategies could be summarized to include the following:

Integrated Urban Development

Integrated urban development is crucial to build “green cities” as it enables the planning and development process to consider green sustainable principles while keeping in mind the interaction between sectors, services, and aspired outcomes. It takes into consideration multiple sectors and objectives within a planning and development process while seeking to reconcile conflicting development objectives (Lewis 2015).

Sustainable Land-Use Planning

Urban form and land-use planning could play a key role in reducing environmental impact. Sustainable land-use planning targets energy optimization and integrated transport networks while focusing on enhancing mobility through public transport, cycle routes, and greater social inclusion (Keivani 2010). This is manifested in compact city planning which focuses on mixed land-use development, short commutes, and high residential density.

Sustainable Building Practices

Energy-efficient buildings consider both building and operating phases. The first phase embodies energy required to extract, process, transport, and install building materials. The second phase comprises operating energy to provide services such as heating, cooling, and powering equipment. Sustainable building practices seek to reduce reliance on nonrenewable energy sources, incorporate alternative energy sources, and improve operating efficiency (Lewis 2015). This involves adopting approaches and tactics such as solar access, water capture, treatment, and reuse.

Sustainable Mobility and Transport

A sustainable transport policy seeks to minimize unnecessary trips, encourage behavior change, and improve the operational efficiency of motorized transport (Lewis 2015). A proclaimed approach to achieving sustainable mobility and transport system is through transit-oriented development (TOD). TOD considers mass transit/multimodal transport hubs supported by high-density residential and mixed-use development along corridors and activity nodes. The system represents a low-carbon transport solution stressing nonmotorized transport, thus reducing dependency on petroleum-based modes (Lewis 2015). Increasing the efficiency of the transport system in cities not only benefits the environment and contributes to equitable access, but also enhances the city's attractiveness to investment, skilled human capital, and economic growth (Assadian and Nejadi 2013; OECD 2013).

Greening the Urban Environment

Greening is one strategy cities strive to achieve in order to enhance its livability and quality of life. Urban green open spaces provide many benefits environmentally, socially, and economically. City greening considers the provision of a network of green open space, multifunctional, natural, as well as seminatural areas (Lewis 2015). Urban greening has been an aspiration since Howard's green city movement and has served as the paradigm for such notions as green infrastructure, greenways, green roofs, pocket parks, urban parks, and green corridors (Keleg 2018).

Green Infrastructure

A green infrastructure is an approach that incorporates both the natural environment and engineered systems with the objective of protecting, restoring, and/or mimicking the natural cycles. This involves implementing an urban strategy that considers the infrastructure as a green sustainable network offering to balance natural and man-made systems (Abdou et al. 2016). Green infrastructure is practical and economical, conserves ecosystem values, and enhances community safety and quality of life.

Energy Conservation and Renewable Energy

By and large, energy strategies engage in four aspects: access, security, reliability, and affordability. Green energy strategies consider the same aspects; however it adds alternative energy sources, low-carbon options, and approaches to lower carbon footprint produced by energy consumption while focusing more on renewable sources of energy as well as energy efficiency to serve the rising demand in the built environment, transport, as well as sectors of industry and trade (Assadian and Nejati 2013; Lewis 2015).

Water and Waste Management and Recycling

The water sector comprises three main elements: water supply, wastewater and sanitation, as well as stormwater management and drainage (Lewis 2015). On the one hand, managing water and wastewater networks constitutes the most important domain for building a healthy greener city. Access to safe drinking water and sanitation has an intense effect on increasing public health. Sustainable water policies in “green cities” ensure combating the contamination of surface water in rivers, springs, and underground water. A well-designed sewage system will significantly minimize the pollution of surface water and thus increase water supply. New water consumption techniques should also be considered and could include using smart systems to conserve water (Assadian and Nejati 2013). Collection and reuse of storm as well as gray water should also be considered.

On the other hand, solid waste management involves the collection, transfer, and disposal of waste. The “3R” approach (reduce, reuse, and recycle) represents the core of solid waste management for “green cities” (Lewis 2015). Green industry considers the multiple life cycle of various products and by-products; it encourages recycling where the by-product of an industrial process becomes the inputs for another, thus generating a closed loop to insure reserving the natural resources and managing it in a sustainable matter (Lewis 2015).

Resilient Strategies

Resilient strategies enhance city capacity to respond, adapt, function, and recover from shocks, stresses, disasters, and/or changing climate. It considers both the built form and human elements of a city. In “green cities” the ability of people particularly the poor and vulnerable to live, work, survive, and recover is augmented as part of building up its resilience (Lewis 2015). The concept applies to infrastructure as a part of the built environment in a way that enables such infrastructure to withstand critical events such as flooding, disasters, earthquakes, and climate change.

Greenways: An Approach to Planning Sustainable Green Cities

Greenways are more than just parks or amenities, but a response to the physical and psychological pressures of urbanization (Searns 1995, p. 65). They play a significant role in the development of urban and suburban areas providing much-needed natural corridors in urban settings while establishing the essential counter form to the built environment. Greenways constitute an adaptive response, a way to offset and mitigate the effects of rapid urbanization. They could be considered lines of opportunity, environmental corridors for the purpose of stitching together fragmented sites while providing for environment, ecology, education, and exercise (Bischoff 1995, p. 317). Greenways have been defined by Ahern (Ahern 1995, p. 134) as networks of land planned, designed, and managed for multiple purposes including ecological, recreational, cultural, aesthetic, and/or other purposes compatible with the concept of sustainable land use. Yet, greenways went beyond their initial amenity-oriented objectives of connection, movement, aesthetics, and recreation to address more environmentally sensitive issues including protecting the natural habitat, sustaining threatened ecosystems, preserving and highlighting area culture and heritage, as well as safeguarding against environmental hazards (Searns 1995, p. 72, 73). They represent the platform where much social life and learning take place and are thus educative and informative presenting the relationship of people with natural systems. Greenways could be utilized to help heal the human psyche by providing alternative corridors that offer attractive visual form, greenery, and solace (Searns 1995, p. 72).

Greenways thus constitute an important part of the urban landscape providing an attractive opportunity for stimulation and for offering a wealth of sensual variation. They have the potential to restructure city regions and improve connectivity of open public space, making cities greener and friendlier to pedestrians and cyclists (Abdou et al. 2016; Bousemma et al. 2018). Hence, greenways are a noteworthy tool for conceiving “green cities,” for realizing congruence, safeguarding nature, enhancing economic development, and upholding societal values (Ahern 1995). The articulation of greenways and open-space networks in the planning and

development of sustainable “green cities” is all but common. Globally, the concept has been increasingly used, especially in cities experiencing deindustrialization process (Qu et al. 2015).

Typologies of Greenways

Scale Based

The greenway network could be seen as a framework which varies greatly in scale starting from a national framework right down to the neighborhood and narrow ribbons of green space linking together regional ecological corridors, city parks, community gardens, and pocket parks (Bousemma et al. 2018; Qu et al. 2015).

Function Based

Greenways can serve various functions with multiple goals at national, regional, city, and neighborhood levels. Fabos classified greenways into three categories: recreational, ecological, and heritage greenways (Fabos 2004). The most common typology is that of the recreational greenways, which emphasizes public access and recreational provision. These greenways are usually formed along routes and corridors passing through recreational spaces linking water and landscape resources with high visual value (Bousemma et al. 2018; Fabos 2004). On the other hand, natural corridors of ecological importance are formed by spaces along rivers and valley sides. These corridors facilitate protecting and developing of natural resources and wildlife, migrating of species, sustaining of biological diversity, and natural hiking (Ahern 1995; Bousemma et al. 2018; Fabos 2004). Cultural and heritage greenways have visual and historical value. They link cultural and historic resources attracting tourists, providing economic and educational benefits while affording seasonal accommodation (Ahern 1995; Fabos 2004).

Guiding Principles

Strategically planned and designed, “greenways” should consider the following guiding principles:

- Specify the function, appropriate uses, and activities as well as proposed design of the greenway. In some cases, determining the greenway function can be challenging particularly when proposed functions contradict one another and spatial as well as functional determinants are conflicting.
- Plan the greenway to include an origin, a destination, and significant attractions.

- Balance environmental, social, and economic objectives.
- Make use of vacant lots, unused corridors, and spaces in the urban settings.
- Create a public space network connecting scattered open spaces and destinations.
- Recognize the character and distinctiveness of different sites while ensuring that it is reflected in the programs.
- Seek equity by ensuring accessibility to the entire community, to all socioeconomic classes and neighborhoods (Crawshaw 2009).
- Reflect the needs, demands, aspirations, as well as social and cultural values of regular green open-space users in the design (Qu et al. 2015).
- Avoid spreading invasive species into protected areas (Crawshaw 2009).
- Provide services and amenities including lighting, drinking water, restroom facilities, and parking to encourage use of the greenway (Chen et al. 2017).
- Provide for clarity, safety, security, and visual interest (Chen et al. 2017).
- Connect existing green routes such as waterways and green corridors and slow-traffic routes in linear paths.
- Enhance accessibility to the greenway network through public transportation, allocating transit nodes along existing public transportation routes (e.g., metro lines, bus lines).
- Connect local public facilities including schools, shops, and public transportation nodes to the network.
- Offer multifunctional resources capable of delivering a wide range of environmental and quality-of-life benefits (Abdou et al. 2016).
- Engage key partners and diverse stakeholders in the planning and design process.
- Monitor performance, with funding from government and private partnerships (Abdou et al. 2016).

Global Exemplars and Best Practices

North America is the leading region in implementing the greenway concept and has inspired Europe, Australia, and China to follow in its footsteps. In recent years, attempts have been made to transform derelict sites and open spaces into urban greenways with the objective of improving environmental quality and restructuring the city fabric. The notion has since developed to include numerous success stories globally affording a spectrum of best practices. The following case studies represent a selected sample of exemplars that were chosen based on their positive contribution to social, economic, and ecological functions. They reflect a range of planning levels, from the national to city scale, in addition to highlighting successful planning, design, and implementation processes.

East Coast Greenway

Overview

The East Coast Greenway is one of the most popular greenways in the USA. It represents an exemplar for national scale greenways as it connects 15 states and 450 cities and towns along a 3000-mile stretch from Maine to Florida (see Fig. 1). The greenway is a protected cycling and walking route serving to improve public health, environmental sustainability, economic development, and civic engagement. The trail was created on sewer and riverfront easements, abandoned railways, as well as widened sidewalks. Currently, it accommodates pedestrians, joggers, cyclists, in-line skaters, horseback riders, as well as wheelchair users (see Fig. 2) (Keleg 2018).

Best Practices

A critical review of the East Coast Greenway illustrates a number of guiding principles and best practices. These include the following directives:

- Pursue funding from numerous sources and at different levels. This may include seeking governmental funds, specific programs, private foundations, as well as local funding.

Fig. 1 The East Coast Greenway. Source: East Coast Greenway Alliance (2019)





Fig. 2 The East Cast Greenway design features. Source East Coast Greenway Alliance (2019)

- Use durable, easy-to-maintain materials.
- Minimize and where possible avoid conflict with vehicular traffic.
- Ensure path accessibility and comfort particularly for the physically disabled.
- Ensure high connectivity with no missing links.
- Reduce distances between activities.
- Ensure continuity and cohesion by minimizing distances between parallel and intersecting routes.
- Direct users amidst visually attractive and lively zones.
- Provide unbroken flow by limiting long waits at traffic lights.
- Offer sufficient signage to help identify route directional changes.

The Sauvegarde/Puurs/Baasrode Greenway, Belgium

Overview

The municipality of Puurs in Belgium decided to develop a greenway within its municipal boundary along a derelict railway line connecting Antwerp and Termonde. The regional greenway is planned to cater to both pedestrians and cyclists stretching 6.5 km and continuing eastwards towards Baasrode. The goal is to foster coexistence between different municipalities while facilitating access to schools. However, in 1997 the National Railway Company of Belgium decided to revive the Eastern railway section of Puurs—Antwerp. Measures to ensure safe coexistence between the active railway line and the greenway were thus undertaken (see Fig. 3) (European Greenways Association 1998).

Best Practices

The Puurs Greenway offers a multitude of best practices; among them are the following:

- Lease or expropriate land as a public utility to create greenways.



Fig. 3 The Puurs Greenway represents a good example of coexistence between an active railway line and a greenway. Source: European Greenways Association (1998)

- Coexistence between railway lines and greenways is possible provided that security measures are implemented to safeguard greenway users. These may include among others dividing barriers, safe zones, as well as signal visibility at level crossings.
- Use anti-slip shock-absorbing surfaces for the comfort of pedestrians and cyclists alike.
- Include suitable water drainage to all cycle and pedestrian paths.

Radnor Trail, Pennsylvania, USA

Overview

Located in northern Radnor township, the 2.4-mile Radnor Trail signifies a local recreational trail connecting municipal parks, residential neighborhoods, small businesses, and an art center. This local trail caters to a number of recreational activities including leisure strolls, cycling, jogging, in-line skating, dog walking, and fishing (see Fig. 4) (Township of Radnor 2019).

Best Practices

The Radnor Trail offers the following best practices:

- Reuse derelict rail right-of-way and abandoned sites to create greenways.
- Integrate heritage sites and historical buildings in planning the trail with the aim of educating users about the city history.
- Plan greenways while affording users scenic views and distant vistas.
- Utilize site potentials (fishing spots, etc.) to attract users to the trail.



Fig. 4 The Radnor Trail map. Source: Township of Radnor (2019)

Greenway Planning in the MENA Region

Greenway planning in the MENA region is uncommon and is confronted with numerous challenges. From the limited studies that tackle greenways in the Middle East, Bousemma experiments with the concept of greenway panning in Sousse city, Tunis. His findings reveal that though there is a great potential for adopting greenway planning in Tunis, the notion of greenways and its foundations are absent from Tunisian environmental policy and are nonexistent in town planning strategies (Bousemma et al. 2018). On the other hand, Turk in 2017 developed a strategy for defining, prioritizing, and selecting greenway alternatives utilizing an analytical hierarchy process (AHP) based on an empirical study in the urban region of Trabzon, Turkey. The study concludes that the AHP has a promising capability in prioritizing and selecting the most favorable alternative (Türk 2017).

In Egypt, Fathy focuses on adopting the greenway concept in Historic Cairo, a rich heritage site celebrated with ancient buildings and monuments (Fathy 2006). Additionally, Abdel Salam in 2009 explores the possibility of transforming vacant and neglect spaces within the city of Cairo to open green spaces linked together via an interconnected green network (Abdel Salam 2009). Furthermore, in his study, Hussein investigates planning and management characteristics of green areas in Borg El Arab assessing the potentials and challenges facing the greenway concept. The object of his investigation is to develop a comprehensive vision for the development of green networks in new desert cities (Hussein 2018). In 2010, another study was undertaken by graduate students from Cairo University, the American University in Cairo, and the University of California, Berkeley, under the direction of faculty from all three universities with the objective of developing a vision for reconnecting the city to the river Nile (Kondolf et al. 2011). The study involved four regions in Greater Cairo, namely downtown Cairo (Kedivial Cairo), Old Cairo, Athar El Nabi,

and Maadi. The prime objective of this enquiry was to develop a plan to reconnect local residents with the Nile river through increased access to the waterfront, environmental improvements, pedestrian pathways, and attractive public spaces. On a different scale, Mahmoud and Sayed propose a method of green planning in El Sadat city utilizing GIS. The investigation seeks to enhance connectivity and reduce fragmentation through an integrated greenway system (Mahmoud and El-Sayed 2011). A similar case study by El Adli demonstrates the role of urban greenway systems in planning residential communities in a suburban development west of the city of Cairo. The findings identify a step-by-step approach to integrating natural, recreational, and cultural greenways and corridors in planning future residential developments in Egypt (El Adli 2006).

Furthermore in 2002, the first GCR greenway concept appeared in the Structural Plan of Giza City, yet its recommendations were never realized due to feeble law enforcement and urban development pressures. The plan recommended reclaiming the Nile banks for tourist and recreational activities while connecting new open green space to existing urban parks such as the Orman and the Giza Zoo via an interconnected network of green corridors. It emphasized safeguarding visual corridors to the Nile while enforcing the environment law. In 2012, the strategic “Cairo 2050 Vision” embraced the augmentation of green spaces in the city as part of an interconnected network of open space (see Fig. 5). The vision relied on three cross-cutting pillars that translated into eight strategic actions (Ministry of Housing, Utilities and Urban Development, General Organization of Physical Planning and UN Habitat 2012):

- Developing social equity by improving living conditions for all
- Enhancing the region’s transportation infrastructure
- Revitalizing the inner city

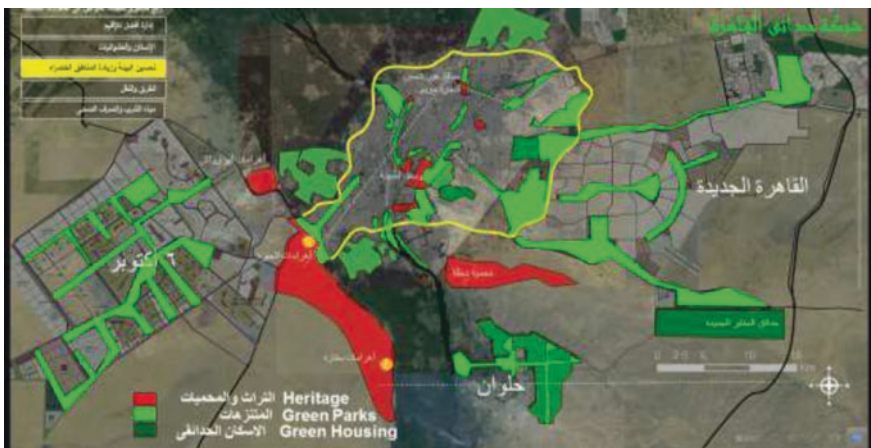


Fig. 5 The proposed green network in Cairo’s 2050 Vision. Source: Ministry of Housing, Utilities and Urban Development, General Organization of Physical Planning and UN Habitat (2012)

- Strengthening new urban communities as vibrant and diverse hubs
- Affording conditions for tourism to flourish
- Providing a competitive environment for a knowledge-based economy
- Adopting more environmentally friendly policies and approaches
- Setting up efficient governance to steer the development

The 2050 Vision resulted in the identification of 22 guiding projects that were meant to facilitate vision realization (Ministry of Housing, Utilities and Urban Development, General Organization of Physical Planning and UN Habitat 2012).

The vision was criticized for being too ambitious and unrealistic, as it is built on relocating concepts unsupported by legislative frameworks. Relocation strategies included transforming cemeteries and unsafe settlements into public parks, relocating all polluting industries to the city outskirts, and converting informal settlements into public open spaces and service hubs (Ministry of Housing, Utilities and Urban Development, General Organization of Physical Planning and UN Habitat 2012). Spatial planning studies for a handful of projects from “Cairo 2050 Vision” have since been developed and include Dahab and El Warraq Islands as well as Cairo’s waterfront and Bolak Abo El Ela development project. Yet, attempts to green the urban environment remain ineffective due to absence of a comprehensive vision to formulate an interconnected green network instead of isolated green islands dispersed within the city.

The Greater Cairo Region (GCR): A Case Study

As a metropolitan city, the Greater Cairo Region (GCR) faces tremendous urban pressures as a result of its phenomenal growth since the turn of the twentieth century. Encompassing three governorates, Cairo, Giza, and Qalyubia, the GCR suffers from high population (up to 24.7 million and a density of 38,247 inhabitants/km²) (Central Agency for Public Mobilization and Statistics 2019). Hence, despite the concentration of services and job opportunities, the city ranks relatively low on the livability index rank (121 from 140 countries in 2015) (The Economist Intelligence 2015). Ills of rapid urbanization are manifested in environmental pollution, congestion, pressures on infrastructure, and loss of agricultural land. This is further pronounced due to the acute shortage, degradation, and inequitable distribution of public open space in general and that of green open space in specific. Unbalanced distribution of open space coupled by their disconnection within the larger network fails to contribute to social equity (Keleg 2018). Nowadays, Cairo’s share per capita of green spaces stands at 0.5 m²/capita remaining relatively lower than that of international standards, even when compared to other cities in the MENA and Gulf region (Keleg 2018). To further exacerbate this predicament, much of the green open space and promenades along the banks of the river Nile have been in recent years and continue in the present day to be consumed by development. Trees are being cut off and open land is appropriated to the benefit of public services and

infrastructure including water treatment facilities, cafeterias, social clubs, floating restaurants, and plant nurseries (see Fig. 6). As a result, a considerable percentage of city dwellers are deprived from direct contact with nature lacking access to natural environments, recreational opportunities, and a learning experience (Keleg 2018).

Nevertheless, the GCR possesses promising potentials for developing greenway networks as riparian greenways, parkways, and farmland greenways owing to its diverse natural features. The most prominent feature is the river Nile that represents an ecological blueway and an environmental corridor affording multiple opportunities for tourism, leisure, and education (Abdou et al. 2016). This articulated ecological corridor could serve as the green spine that links urban districts via an interconnected network of smaller greenways. Additionally, the GCR is rich in heritage sites, such as the pyramids and the citadel; green open spaces as El Kanater park, one of the largest regional parks in Egypt; and natural reserves such as Wadi Degla. Moreover, desolate sites including derelict railways, abandoned storage sites, deserted areas, and open spaces could potentially be linked to one another via green corridors forming an interconnected network of greenways.

Furthermore, the Nile's riverbanks have the potential of becoming recreational green corridors, affording residents and visitors alike a wealth of experiences. As an ecological corridor, the Nile could represent the spine of an interconnected green network linking heritage sites to leisure hubs via an intricate system of greenways. In recent years, numerous proposals and project schemes have suggested the development of the river Nile and its banks to include new activities and land uses while advocating expanding the role of the river as a connecting corridor linking the city with its peripheries.



Fig. 6 The Nile riverbanks are consumed by development. Source: Barada et al. (2005)

The potential of integrating greenway planning in the Greater Cairo Region (GCR) is thus nothing less than promising. Yet, prospects of successful implementation are confronted with numerous challenges and impediments. A key challenge involves dealing with competing land uses in high-density urban environments.

Greening the Greater Cairo Region (GCR)

A recent undertaking by urban specialists from Cairo University in 2005–2006 proposes a comprehensive approach to dealing with the river Nile in the GCR while offering a strategic vision towards creating an interconnected network of greenways along the river (see Fig. 7) (Barada et al. 2005). The study's prime objective is to safeguard the river Nile as an ecological corridor while affording multiple opportunities for tourism, education, recreation, social interaction, and economic development.

Divided into three sections, the study illustrates the existing conditions and challenges facing the development of the Nile riverbanks, establishes the needs and aspirations of the local community, and concludes with a strategic vision and a greenway master plan for the GCR. The plan emphasizes the connection to nature, vegetation, and abundant wildlife as epitomized in the Nile river; underlines economic vitality as highlighted in recreational and commercial functions; promotes accessibility and mobility via an articulated transport system including BRT, cycling, and water taxi; and highlights sociocultural values via linkages connecting multifunctional green spaces to heritage sites. The planned greenway network connects the city to the Nile and its differentiated districts while advocating interventions to resolve traffic congestion and enhance the visual image of the GCR (Keleg 2018).



Fig. 7 Nile river master plan. Source: Barada et al. (2005)

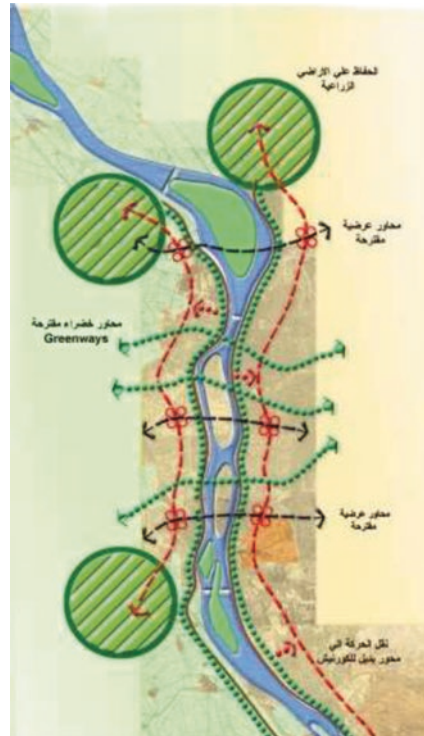
Proposed Strategy

The strategic vision for the Nile riverbanks was formulated upon a critical review of international greenway case studies in the USA, France, China, Tokyo, Canada, and the UK, in addition to a detailed appraisal of local legislation as well as national structural and transport plans. The vision ensured integrating transport and mobility goals, environmental and recreational goals, as well as social and economic goals. The goals include the following (Barada et al. 2005):

Transport and Mobility Goals

- Transfer traffic along the Cornish Boulevard (adjacent to the river) to substitute trajectories.
- Introduce an integrated multimodal transport system.
- Ensure connectivity and continuity of the Cornish promenade (see Fig. 8).
- Safeguard pedestrians from vehicular traffic.
- Reduce the density of activities along the riverfront.

Fig. 8 Connecting the city to the river Nile. Source: Barada et al. (2005)



Environmental, Recreational, and Visual Goals

- Safeguard ecological, recreational, and aesthetic attributes of the river Nile corridor.
- Protect and preserve agricultural land in and around the city and along the Nile corridor.
- Transform the Cornish Boulevard into a recreational corridor with ample opportunities for recreation, social interaction, and learning.
- Connect the Cornish and river trail with the city, its heritage sites, and recreational, retail, and touristic nodes.
- Increase the per capita share of green open space.
- Safeguard and enhance visual corridors.

Social and Economic Goals

- Offer opportunities for social interaction, recreation, and education.
- Provide for and boost the economic vitality of the greenway network.
- Introduce new activities along the river Nile corridor and attract tourism.

The Greenway Master Plan

The green network in GCR was formulated by replanning streets and paths within the city with the objective of expanding green open spaces and introducing new functions without compromising accessibility. Figure 9 illustrates proposed linkages radiating from the heart of the region connecting urban parks, public spaces, natural and cultural resources, historical sites, and tourist destinations in an articulated green network. The proposed plan establishes four categories of hubs and two categories of links. Proposed hubs incorporate:

- Ecological hubs including natural reserves such as Wadi Degla, Mokattam Hills, as well as water canals.
- Recreational hubs including touristic, sports, and recreational uses: These embrace among others urban parks, Ain El Sira pond, garden palaces, heritage parks, as well as Cairo stadium.
- Cultural and educational hubs including historic and cultural sites such as Giza Pyramid, Sakkara Pyramid, Megra El Eion historic wall, Salah El-Din Citadel, Opera House, religious complexes, the Egyptian museum, and Cairo University.
- Central and commercial hubs including such sites as the Khedivial city center, Tahrir Square, and Opera Square.

Proposed links include:

- The Nile river including the riverbanks, as the main spine and blueway.
- Gray-ways including transportation corridors which could be utilized as parkways including such streets as Haram street, Salah Salem street, the Auto-strad, Gesr El-Suez street, El Orouba street, Ramsis street, and Port Said street.



Fig. 9 Proposed greenway network in GCR. Source: Barada et al. (2005)

The master plan suggests six specific greenways, the Nile recreational greenway, four historical greenways, and one commercial greenway connecting the downtown with the waterfront. It focuses on connecting the banks to the surrounding neighborhoods by diverting traffic to alternative routes while affording the public accessibility to linear green recreational corridor along the river Nile. The study presented some solutions to maximize the use of riverbank slopes (see Figs. 10, 11, 12, and 13).

Implementation Challenges

Planning greenways in a condensed urban center such as in the GCR often encounters numerous hurdles. The most obvious are the scarcity of vacant land and conflict with existing physical barriers such as major roads, railroads, buildings, and residential/

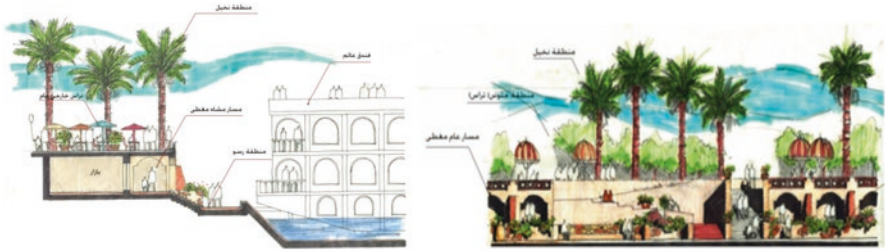


Fig. 10 Utilizing elevation differences to accommodate services and amenities while preserving scenic views of the Nile. Source: Barada et al. (2005)



Fig. 11 Creating attractive settings for recreation. Source: Barada et al. (2005)



Fig. 12 Connections between the riverbanks and the surrounding environments. Source: Barada et al. (2005)



Fig. 13 Creating parks along the riverbanks and connecting them with the city. Source: Barada et al. (2005)

commercial areas. Yet, such stumbling blocks could readily be overcome by employing strategic and master greenway plans. Greenway plans should thus be accurate and applicable if they are to be translated to reality. They should identify prevailing difficulties and impediments in both the planning and implementation stages. The following illustrates the most common challenges encountered during both stages.

Challenges in the Planning Process

As practitioners, we endure numerous adversities to produce accurate, applicable, and at the same time flexible plans. Overcoming these challenges is a must to move from the planning stage to the implementation and execution stages. The most common challenges facing the planning process include¹:

- **Competence and experience of the planning team.** The General Authority for Urban Planning commissions experts or consulting firms to provide strategic plans; yet, occasionally the quality of the product prevents the execution of the plan due to imprecise or irrelevant data (El Said 2015).
- **Insufficient/accurate database.** This is a common problem in the Egyptian planning process. Performing robust analysis and taking informed decisions warrant the availability of up-to-date data, which is not necessarily always the case (El Said 2015). Such shortcomings reflect negatively on the applicability of both the strategic and master plans limiting implementation procedures.
- **Ignoring land ownership.** Occasionally, strategic plans ignore land tenure, thus delivering unrealistic strategies, especially when monetary compensations are required for land acquisition (Ibrahim 2016). Private property may thus halt implementation of a greenway plan due to concerns relating to loss of privacy, liability, illegal parking, access, and pollution.
- **Poor representation and involvement of stakeholders.** Though expert opinion is greatly valued in developing strategic and master plans, public and stakeholder involvement is equally crucial (Ibrahim 2016). Nevertheless, seldom is the local community efficiently represented—only a limited sample of the general public is heard. Yet, local knowledge and expertise is fundamental in ensuring that proposed strategies reflect local conditions and values.
- **Lack of coordination between planning organizations.** In the GCR numerous governmental bodies are mandated with green open spaces, including but not limited to the General Organization for Physical Planning, New Urban Communities Authority, the Cairo Governorate, Giza Governorate, Qalyubia Governorate, the General Authority for Tourism Development, and the National Organization of

¹The GCR greenway master plan encountered several of these problems.

Urban Harmony. This is further exacerbated due to the lack of coordination among these bodies, with each advocating different goals and strategies.

- **Poor connection with other plans.** A critical criterion for the lack of effectiveness of greenway master plans is its disengagement and disconnection with other plans such as economic, infrastructure, and utility plans.

Challenges in the Implementation and Execution Process

While implementing an approved plan issues arise that could hamper implementation. These include:

- **Multiple jurisdictions.** The implementing of greenways, especially across multi-jurisdictional boundaries, can be challenging if not impossible. Implementing an urban greenway plan in the GCR across three governorates involves numerous stakeholders and implementing authorities. This could include several ministries, governorates, local authorities, city councils, as well as local community groups, residents, and landlords. Coordinating among the different units and stakeholders is a bewildering task especially if they hold conflicting agendas or inconsistencies in their planning policies and information systems.
- **Absence of an action plan.** Many strategic plans are not translated into detailed plans that are applicable, and thus they remain in the conceptual phase.
- **Poor law enforcement.** Weak enforcement of bylaws and regulations on the local level is critical in crippling the implementation of urban plans particularly when it involves relocating or changing land uses as a part of the plan (Ibrahim 2016).
- **Lagging behind schedule.** Due to rapid change in land uses, densities, utilities, and other related urban environments, diverting away from the set schedule could hinder the implementation process.
- **Limited awareness of green cities.** Governmental institutions lack the resources to plan, implement, and manage greenways solely. Instigating legitimate channels to embrace the involvement and the support of both the public and NGOs should thus be undertaken for conceptual planning, detailed design, maintenance, and monitoring of greenway systems. Yet, ignorance of the holistic importance of greenways to sustainable green cities contributes to unproductive public participation, unsatisfied decision makers, and limited political support.
- **Insufficient funding.** Project funding is possibly the most crucial challenge for greenway projects. Funds should be secured beforehand for construction and maintenance. Currently, funding for greenways predominantly comes from the local government (Ibrahim 2016); however it could be thought from both private businesses and nonprofit organizations.

Conclusion and Recommendation

Greenways are linear corridors found in rural and urban contexts serving both pedestrians and cyclists. They function at a range of scales from the regional to the neighborhood, facilitating access to nature. Greenways are connectors linking parks, natural reserves, and historical and recreational sites and are able to tackle economic, social, and environmental concerns simultaneously. They seek to boost the quality of life and mitigate exacerbated conditions in cities where rapid urbanization and large concentrations of people and activities have created a myriad of complex socioeconomic challenges with often severe environmental consequences. Due to their varied benefits, greenways are a successful tool for sustaining green cities. Yet, and though the greenway concept is well acknowledged, its implementation is limited and inadequate.

It is thus highly recommended that innovative practical approaches be considered to foster the likelihoods of greenway implementation. On the one hand, targeting a greener national framework would facilitate addressing city-specific challenges and ensure coherence and consistency between national and local policies while integrating greenway opportunities into planning policies. Providing effective planning legislation system is necessary to coordinate all levels of the planning process, through a combination of enforcement and incentives to ensure compliance and inter-municipal cooperation to manage urban development. On the other hand, measuring and monitoring tools that cross administrative boundaries should also be made available, as well as a body to collect and disseminate cross-sector data at the microscale. A detailed local plan is crucial to translate greenway strategies while allowing different stakeholders besides professional planners, to partake in the planning process from start to implementation and management.

Furthermore, it is fundamental to establish sustainable financing options and to diversify domestic funding sources. A well-designed property tax and development fee could tackle urban sprawl and raise money for funding greenways. Real estate developers could be charged to link their new projects to existing greenway networks. Local governments could also seize part of the value increases of real estate dues benefiting from greenway networks to maintain existing trails. Another alternative is to adopt public-private partnerships (PPPs), whose success in similar projects has been substantiated.

Moreover, green strategies should capitalize on the great potential for NGOs, private sector, and investors to change the current status of green spaces in the GCR. Trained professionals and leadership with clear mechanisms for gathering and updating physical, social, economic, and environmental data could cause a colossal uplift in the quality of urban plans. To conclude, further endeavors are essential to create a comprehensive and pertinent vision for greenways in the GCR with huge prospects for enhancing the quality of life for millions of residents and visitors alike.

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