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AN ECOLOGICAL APPROACH TO URBAN GREEN SPACE PLANNING  
CASE OF BENGHAZI'S COASTAL LANDSCAPE

A THESIS

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by

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## ABSTRACT

### AN ECOLOGICAL APPROACH TO URBAN GREEN SPACE PLANNING CASE OF BENGHAZI'S COASTAL LANDSCAPE

The marginal area of waterscapes, lakes and urban coastal areas are important aspects of urban landscapes of today cities. With the application of the ecological approach to green space planning, we can protect nature, create a sense of place with a natural identity and support the quality of life and health of these cities. The ecological approach to green system planning as a dimension of ecological planning is the main subject of this research. In this research, the focus will be on Benghazi as a case study in order to understand the possibilities of ecological planning of green spaces. The main aim of the research is to show applying environmental methods and ecological planning idea in the planning of green spaces will protect and provide existing green space network in the city. Also, the study will investigate different experimental studies in different cities. In the thesis, the study area was divided into 5 regions showing the diagnosis of each zone of possibilities, problems, and threats in the specific area. Then, in the assessment matrix, each region was classified according to the environmental potential and recreational facilities that the region could perform. In the final part, the proposed decision-making matrix aims to guide planners and decision makers in terms of eligibility in any land use decision around the potential green space network in the coastal landscapes of Benghazi.

A number of recommendations emphasizing the multiple roles of ecological planning for the improvement of urban green spaces were confirmed and take into account a certain level of qualitative improvement and their distribution in urban areas and their effective integration into urban planning.

**Keywords:** Urban Green Space, Ecological Planning, Ecological Networks, Coastal Landscapes, Benghazi.

## ÖZET

### KENTSEL YEŞİL ALAN PLANLAMAYA EKOLOJİK BİR YAKLAŞIM: BİNGHAZİ KIYI PEYZAJI ÖRNEĞİ

Su havzalarının, göllerin ve kentsel kıyı alanlarının marjinal alanı, günümüzde şehirlerin kentsel manzaralarının önemli yönleridir. Ekolojik yaklaşımın yeşil alan planlamasına uygulanmasıyla, doğayı koruyabilir, doğal kimliğe sahip bir yer hissi yaratabilir ve bu şehirlerin yaşam kalitesini ve sağlığını destekleyebiliriz. Ekolojik planlamanın bir boyutu olarak yeşil sistem planlamasına ekolojik yaklaşım bu araştırmanın ana konusudur. Bu çalışmada, yeşil alanların ekolojik planlanmasının olanaklarını anlamak için örnek bir çalışma olarak Bingazi üzerinde durulacaktır. Araştırmanın temel amacı, çevre koruma yöntemlerinin uygulanmasının ve yeşil alanların planlanmasında ekolojik planlama fikrinin şehirdeki mevcut yeşil alan ağını koruyacağını ve sağlayacağını göstermektir. Ayrıca, çalışma farklı şehirlerde farklı deneysel çalışmaları araştıracaktır. Tez çalışmasında, çalışma alanı, her bir olasılık bölgesi, sorun ve tehdit alanındaki belirli bölgedeki teşhisi gösteren 5 bölgeye ayrılmıştır. Ardından, değerlendirme matrisinde, her bölge, bölgenin gerçekleştirebileceği çevresel potansiyele ve rekreasyonel işlevlere göre sınıflandırılmıştır. Son bölümde, önerilen karar verme matrisi, planlamacılara ve karar vericilere Bingazi kıyı kıyılarındaki potansiyel yeşil alan ağı etrafındaki herhangi bir arazi kullanım kararında uygunluk açısından rehberlik etmeyi amaçlamaktadır.

Bu çalışma ile kentsel yeşil alanların iyileştirilmesi için ekolojik planlamanın rollerini vurgulayan bir dizi öneri sınanarak, bunların kentsel alanlardaki dağılımını ve kentsel planlamaya etkin entegrasyonunun nasıl olacağı değerlendirilmiştir.

**Anahtar Kelimeler:** Kentsel Yeşil Alan, Ekolojik Planlama, Ekolojik Ağlar, Kıyı Benghazi .

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## 1. INTRODUCTION

In recent years, cities have shown increasing signs of environmental problems due to the negative effects of urban activities. Degradation and depletion of natural resources, climate change and development pressure on green areas have become major concerns of cities. In response to these problems, urban planning policies have become a sustainable focus and authorities have begun to develop new strategies to improve the quality of urban ecosystems. An important function of the urban ecosystem is to provide healthy and sustainable environments for both ecosystems and natural communities. Therefore, environmental planning is a functional requirement in creating a sustainable built environment. With environmental planning, human needs are provided while natural resources are used more effectively and sustainably and maintain a sustainable environmental balance. The protection of human health and the environment, the existence of healthy environmental regulations, the reduction of environmental pollution and the provision of green spaces are only a few of the many benefits of environmental planning.

The ecological approach to green system planning as a dimension of environmental planning is the main subject of this research. The potentials of an urban green system planning based on ecological approach will be discussed through Benghazi which is one of the important developing cities of Libya.

In this research, the focus will be on Benghazi as a case study in order to understand the possibilities of ecological planning of green spaces. The main aim of the research is to show applying environmental methods and ecological planning idea in the planning of green spaces will protect and provide existing green space network in the city. Our case area Benghazi is not a big city but has the potential for rapid urbanization because of its unique location as administrative capital of the region, and where public services are concentrated in a major and fundamental way. It is an urban center for the population from all regions of Libya, where students, traders and workers come because of the concentration of administrative, economic and cultural centers in addition to the existence of major universities. The city of Benghazi has entered the process of urbanization due to this feature. In this process, the existing

natural landscapes and green areas, especially in the coastal geography of the city, are faced with the pressure of urbanization.

This study, which proposes the development of urban green system planning by preserving the natural areas, dune areas, wetlands and lakes in the coastal geography as ecological networks, aims to bring a new perspective in the green system dimension to the sustainable planning of Benghazi. In the study the proposal for environmental planning of the green spaces in the city of Benghazi and ways to preserve them will be discussed based on the experiments from different cities. The study found several recommendations that emphasize the multiple roles of environmental planning in improving urban green spaces, and to consider a certain level of qualitative improvements and their distribution within urban areas and their effective integration into urban planning.

### **1.1. Problem Statement**

The city is a multi-ecosystem, consisting of social, economic and natural systems. The green space system is the basis of the nature system of the city, and it is a supporting component of natural products in the urban structure. A suitable green space system can play an active role in air cleaning, climate control, noise reduction, landscape, etc. Linking open natural spaces can contribute to the creation of a coherent green environmental network that provides opportunities for physical activity and increases accessibility within surrounding areas of settlements and rural areas, while promoting biodiversity and the quality of the external environment. Thus, green networks are not isolated concerns or environmental concerns alone, but they can help to provide better and more sustainable spaces and address the basic objectives of development planning. The increase in the population of Benghazi led to increased urbanization and encroachment on open and blue green areas, which caused low vegetation, soil disintegration, increased air and water pollution, and the lack of recreational areas in the city

The research problem includes how ecological planning can contribute to protecting the nature of green spaces and influencing cities under development. In this study, the solutions of the ecological approach to green system planning will be discussed

in order to maintain the continuity of natural landscapes in the medium-sized cities under the threat of urbanization pressure and rapid growth.

### **1.2. Research Hypothesis**

- The ecological approach to green space planning promotes protecting natural areas in the cities with ecologically networking them to each other.
- With the ecological approach to green space planning, while we can protect nature, create a sense of place with a natural identity and support the quality of life and health in the city.
- Urban green system occupied with ecological functions also supports the ecological integrity of the natural network of the region .
- The green spaces planned according to the ecology of landscapes , add value to the city with different functions such as recreation, education(nature), cultural ecosystem services.

### **1.3. Aim of the Research**

The aim of the study is to define the solutions for implementing an ecological approach to green system planning in order to maintain the continuity of natural landscapes in the medium-sized cities under the threat of urbanization pressure and rapid growth. With this aim the main objectives of the study are;

- To improve a strategic model for ecological green space planning in the cities which are compact,medium-sized and in the urbanization process.
- To draw the working steps of this strategy in order to clarify both, the philosophy of approach and the implementation process.
- To provide decision makers with explanatory information that they can use in urban plans in order to protect the green and natural spaces with their ecological base.

### **1.4. Methods and Materials**

The method of the study consists of two parts. In the first part, the knowledge construction will be generated by literature examination which includes theory and practice in the field of ecological planning of green systems.

First, to construct the structure of our strategic model from the ecological planning of view we used fundamental literature resources by which to describe all steps and terminology. These main literature resources are:

- *Design with Nature*, Ian L Mcharg (1992) .

One of the key messages McHarg expresses is that there needs to be human cooperation and a concern for the natural environment and ecology when dealing with urban design. McHarg explores the relationship between the built environment and nature, using this to illustrate how both can be used to their full potential without having detrimental effects on each other. This can only be achieved through a willingness to recognize the importance of ecology in urban landscapes.

- *Cities and Natural Process* , Michael Hough (1995).

This main book is a revised discussion in the perception of nature, expressing the basic need for an environmental perspective when approaching urban design. While retaining the current structure, the author brings together many topics and links them with broader landscape issues such as green road systems, landscape environment, and green infrastructure.

- *Urban Ecology An International Perspective On The Interaction Between Humans And Natural*, JonMarzluf , Eric Shulenberger ,Wilfried Endlicher, Marina Alberti, Gordon Bradley, Clare Ryan and Ute Simon, (2008).

The editors emphasize the drivers, patterns, processes and effects of human settlement. The papers they synthesize provide readers with a broad understanding of the local and global aspects of settlement through traditional natural and social science lenses also learn how human institutions, health, and preferences influence, and are influenced by the others members of their shared urban ecosystem.

- Rall, L., Niemela, J., Pauleit, S., Pintar, M., Laforteza, R., Santos, A., ... & Železnikar, Š. (2015). A typology of urban green spaces, eco-system services provisioning services and demands. Report D3, 1

This reference refers to a classification of green areas through which the classification of green areas in the study area was determined.

- Hellmund, P. C. and Smith, D., 2006. Designing Greenways : Sustainable Landscapes for Nature and People. Island Press, Washington, DC, USA.

This reference brings together examples from ecology, conservation biology, aquatic ecology, and recreation design to illustrate how greenways function and add value to ecosystems and human communities alike. Encompassing everything from urban trail corridors to river floodplains to wilderness-like linkages, greenways preserve or improve the integrity of the landscape, not only by stemming the loss of natural features, but also by engendering new natural and social functions.

The second part of the literature research consists of examples of ideas and cities which use ecological approach into the green space planning. Ebenezer Howard Garden City Idea and the first garden city Letchworth, emerald Necklodge of Boston, , Jiande city of China are the sample cities from their experiences we will draw a path for Benghazi.

Investigation of these cities helped ideas the formation of the proposed strategic model.

The diagram below (Figure 1.1.) shows the general structure of research design for the strategic model of ecological planning of green spaces for Benghazi:

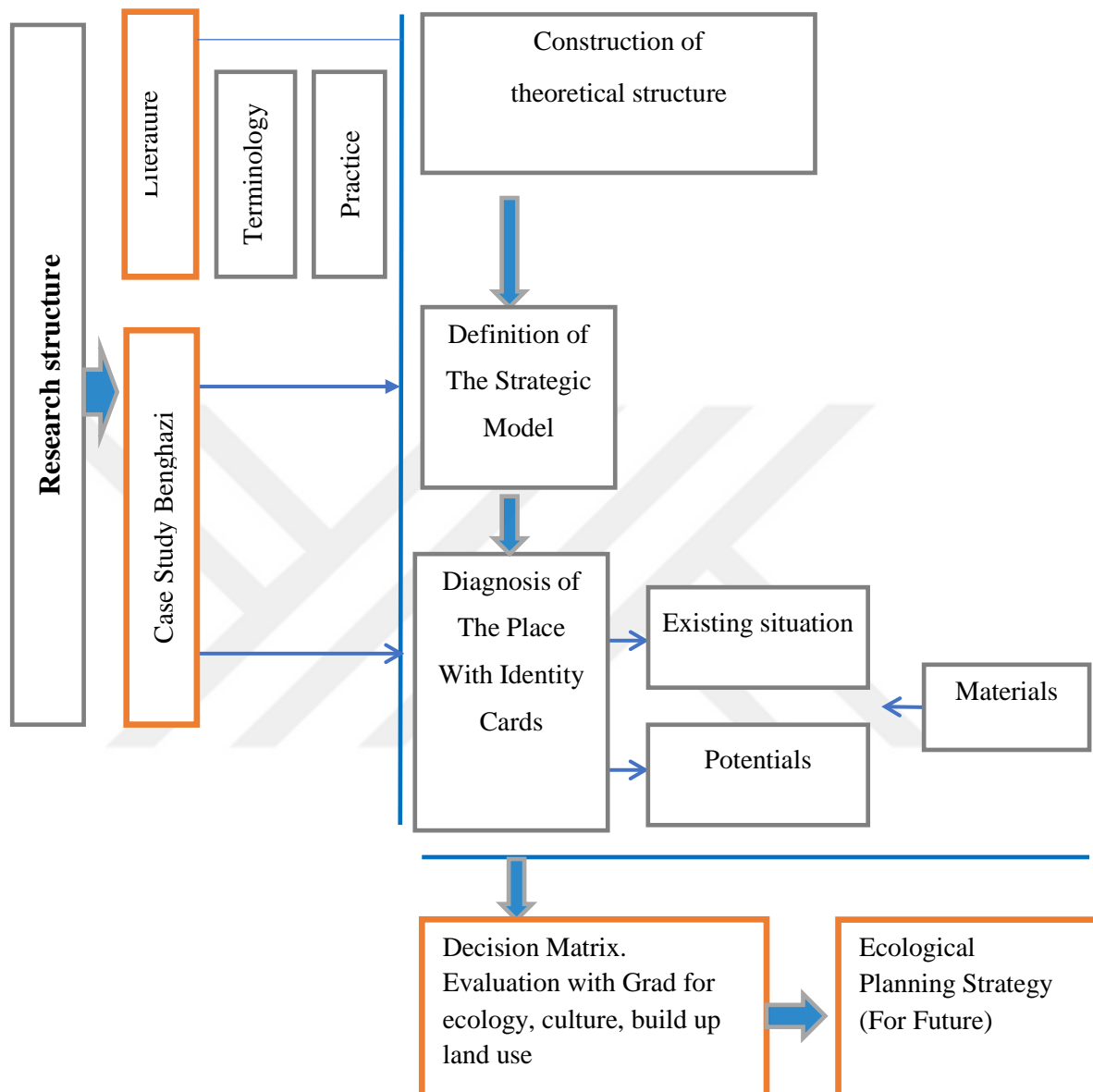


Figure 1.1. Research structure

After literature research, an environmental planning approach model was created. According to the model (in Fig 1.2), the first step is to analyze the current situation diagnosis using different materials / documents to understand natural potentials, threats to landscapes and urbanization needs. Current Land Use The environmental patterns of coastal landscapes in Benghazi were analyzed from Google Earth imagery (2018), site images taken during site visits, and current land use maps (date)



provided by the Urban Planning Corporation and the EMARA Office for Engineering Consultancy. The Corine land use classifications have been used for the definition of natural landscapes in the study area. After the analysis of existing situation in terms of land use the planning tools and their regulations around the natural landscapes have been investigated from Benghazi's 2<sup>nd</sup> (1980) and 3<sup>rd</sup> (2006) generation city plans. The analysis of existing and planned land uses and future plans explained by the politicians will show the potentials and problems of Benghazi's green system and natural landscapes. In the final part we tried to explain the problems and potentials for the study area.

As the study area, we chose the coastal zone of Benghazi because it shows an ecological coherence which defined with sand dunes, lakes, marshlands, wetlands ... et. for this area, we prepare ecological identity cards for 5 different sub-zone (Fig 1.3) shows the form of ecological identity cards:

**Zone Number ( )**

**Analysis of the layers :**

- Urbanized Built Up Area :
- Population of 2nd GPP:
- Existing Population:
- Empty Areas :
- Main Functions and Existing Land use:
- corine land use classifications:
- Main Problems:

**Plan**

**Existing Land use zone**

**Site photo :**

Figure 1.3: A Sample For Ecological Identity Cards.

Diagnoses each area of probabilities, problems, and threats in the selected area. Then, in the assessment matrix, each zone will be classified according to environmental potential, recreational cultural facilities and the use of built-up land that can be built by the region.

According to this capability, each rating was awarded a degree ranging from incompatible, low compatibility, compatible and fully compatible. Accordingly, we

can determine which of these capabilities are appropriate for this region and which are inappropriate.

	Ecological					Grade	Culture					Grade <sub>s</sub>	Build up			
Zone/ area	●	●	●	●	●		●	●	●	●	●			●	●	●
			●	●					●		●			●		

Figure 1.4. The Decision Matrix Of Ecological Planning Of Green Spaces .

The decision-making matrix is intended to guide planners and decision-makers in terms of eligibility in any land use decision around the potential green space network.

## **2. ECOLOGICAL PLANNING AND GREEN SYSTEM RELATIONS IN URBAN ENVIRONMENT**

### **2.1. Definition of Ecological Planning**

Planning as a concept is the use of scientific and technical information to provide alternatives to decisions [1]. Ecology expresses the reciprocal relationship between all organisms, including people, in their biological and physical environments. Ecological planning is to use this geophysical, social and cultural information to make decisions. Ecological planning is one of the tools that gives priority to the study of the biomes, social and cultural systems of the region to determine where a particular land may be best used [2].

#### **2.1.1. Green System Planning as ecological network**

An ecological network is an area of natural habitats that are interconnected physically (territorially) and functionally through populations of species and ecosystems. These natural habitats (for example protected areas) can be connected to one another, “ecological corridors”.

Ecological corridors are linear connection units allowing the passage of species between different living spaces, thus enabling genetic exchange between populations. The ecological network can improve landscape connectivity to a large extent, compared to the planned green space system. This means that the planned ecological network will reduce the fragmentation of the landscape and further complicate the form of green patches and landscape connectivity. As a result, the quality of the urban ecological environment will be improved. Table 2.1 shows urban green spaces as a fundamental system in ecological networks [4].

Table 2.1: Urban green space systems in the different countries[4].

GREEN SPACE TYPOLOGY	OBJECTIVE OR CONDITION	EXAMPLES
Biological corridor	Protect wildlife movement and accomplish other aspects of nature conservation	Mesoamerican Biological Corridor through Central America; Chichinautzin Biological Corridor, State of Morelos, Mexico
Bio swale	Filter pollutants from storm runoff (usually at the scale of a site).	Numerous examples in various localities. See, for instance, the bio swales that are part of the City of Seattle Public Utilities' Street Edge Alternative (SEA) project in northwest Seattle.
Conservation corridor	Blend rural and urban areas in a dense web of transactions, tying large urban cores to their surrounding regions in the same landscape. (From the Indonesian words "desa," for village, and "kota," for town. Also known as the McGee-Ginsburg model. )	Southeast Wisconsin environmental corridors

GREEN SPACE TYPOLOGY	OBJECTIVE OR CONDITION	EXAMPLES
Desakota	Blend rural and urban areas in a dense web of transactions, tying large urban cores to their surrounding regions in the same landscape. (From the Indonesian words “desa, ” for village, and “kota, ” for town. Also known as the McGee–Ginsburg model.	Indonesia and China
Dispersal corridor	Facilitate migration and other movement of wildlife	Owl dispersal corridor in the Juncrook area of the Mt. Hood National Forest in Oregon; Marine dispersal corridors for blue crab in the Chesapeake Bay
Ecological corridors (eco corridors)	Facilitate movement of animals, plants, or other ecological processes.	North Andean Patagonian Regional Eco-Corridor Project
Ecological networks.	Facilitate movement or other ecological processes	Ecological Network for Central and Eastern Europe
Environmental corridor	Protect environmental quality.	Southeastern Wisconsin environmental corridors

GREEN SPACE TYPOLOGY	OBJECTIVE OR CONDITION	EXAMPLES
Greenbelts	Protect natural or agricultural lands to restrict or direct metropolitan growth	City of Boulder, Colorado, greenbelt; London, England, greenbelt
Green extensions	Put residents in contact with nature in their day-to-day lives through a system of residential public green space, shaded sidewalks, and riparian strips.	Nanjing, China
Green Frame	Provide a network of green space for a metropolis or larger area.	San Mateo County, California, Shared Vision 2010 for the county's future development green frame; Addis Ababa, Ethiopia, green frame
Green heart	Protect a large area of green space that is surrounded by development. Originally referred to a specific area in the Netherlands, but now more widely used.	The agricultural open space surrounded by the Randstad, Holland's urban ring, consisting of the cities of Amsterdam, The Hague, Rotterdam, and Utrecht
Green infrastructure	Protect green space for multiple objectives on equal grounds with gray infrastructure (i. e. , roads, utility lines, etc. )	Maryland Green print Program; Chatfield Basin Conservation Network— Denver, Colorado, metropolitan area
Green links	Connect separated greenspac	Green Links initiative to connect isolated patches of habitat throughout the lower mainland of British Columbia
Green space or green space	Connect separated areas of green space and provide a structure around which development may occur. Term is commonly used in Europe	Greater Copenhagen Green Structure Plan

### **2.1.2. The Theory and Practical in Ecological Planning of Green System**

From the practical point of view, the idea of ecological planning of green systems has been implemented in some cities even though it was not mentioned as ecological approach. After 2000's with the emergence of the idea of integrating ecology in city planning, the expression of ecological planning has been clearly used.

In this part, first of all, some sample cities which adopt the ecological approach in the history of urbanization will be discussed and then two example cities will be explained from today.

- **Garden Cities And Letchworth City by Ebenezer Howard**

The idea of garden cities in London in 1898 appeared in favor of Ebenezer Howard, which included the design of a problem-free city offering tenants and convenience services. It was thought that there were only two possibilities in the area of cities or villages:

- The first possibility is the city with all its components, commercial, industrial and residential activities, population density, and disintegrated social life.
- The second possibility is the countryside with its natural elements and the calmness and beauty of nature and purity of weather and the interdependence of social life, but it is far from most services.

Howard saw a third possibility of blending the city, and the countryside into what he called the garden city, which dislodged the negatives of each of the first two possibilities. The impetus for this idea was the designs imposed by the then industrial revolution on European and American architecture of excessive expansion and environmental pollution. He proposed that each city be planned to represent a socially, economically and culturally integrated society that its inhabitants should have basic services and that the land should be public property for the entire population without being allocated to individuals. This idea was called many names such as the rural city or healthy life or the city of tomorrow for the garden.

The foundations upon which the idea of the Garden City was based:

- The land shall be the property of its inhabitants.
- It has a population of about 30,000.

- If more people are needed, it is the creation of a central city, home to 58,000 people, surrounded by central cities and small cities.
- The central city, the surrounding cities are connected by circular network, from the railway lines, the radiological network, of roads.
- Each city is surrounded by farms and natural land (to connect the city to the countryside)

City parks appear as follows (figure 2.1):

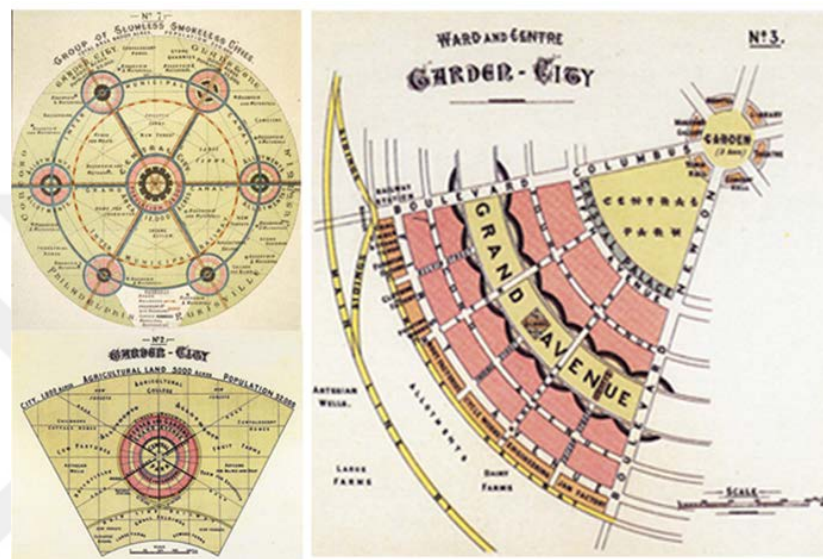


Figure 2.1: The Diagrams of Garden Cities Idea [5].

circular shape, interspersed with green belts, and consists of the city center around which buildings are clustered, and then from the center, 6 radiant streets divide the city into 6 cone parts, Howard City has been very popular in city planning [5]. Letchworth – the first Garden City in England designed according to Howard's principles.

- Letchworth Garden City designed by Raymond Unwin and Barry Parker in 1903.
- Green belt refers to any area of undeveloped natural land that has been set aside near urban or developed land to provide open space, offer light recreational opportunities or contain development. The green belt is important to the ecological health of any region. Green belts acts as a buffer zone and within the city too between the residential and the industrial zones.





Figure 2.2: Letchworth Garden Cities's [5].

- **The Emerald Necklodge of Boston**

Emerald Necklace is a set of 1,100 acres of urban parks associated with waterways and waterways in Boston and Brooklyn, Massachusetts. For 130 years, the Emerald Park has been a sophisticated example of the continuity of ecological communication between blue and green infrastructure. This communication resulted in an emerald-shaped necklace designed by the landscape architect Frederick Olmsted during the 19th century as an example in the application of the environmental planning approach. Boston residents wanted to develop public places in the city and create sophisticated gardens by the 19th century.



Figure 2.3: 1894 Plan for Emerald Park System [7].

Olmsted's idea is to create a green strip that connects many of the water and natural bodies, passing from Boston to Brooklyn, taking advantage of unique terrain and

waterways in Boston instead of one central park accessible from the neighborhood. In addition, it was imagined that the largest area - Franklin Park - must remain open because opening up is the only thing you cannot get into buildings. During this process, it was initially organized and promoted marshes and converted into gardens and redirect the sewage from the river Moody to Charles, where some agricultural land was reconstituted and the extension of the green strip to the pool of Jamaica and the establishment of a green landscape around the pond water. The areas that do not contain green areas was the idea of exploiting the presence of the old transport routes and turning them into a strip of trees lined up on the sides of these paths are parks, now known as Jamaica way, riverway, arborway.[8]

Olmsted's ideas have been based on creating natural environments that are in line with the original local natural character of the site, as well as improving water quality and opening the river between Buck Bay Vence and Riverway Park. Olmsted's ideas helped make Emerald a destination for more than a million visitors a year

- **Jiande City, China:**

Jiande City is found at the shore of Xin'an River, that is within the upper reaches of the Qiantang River in the west of Zhejiang Province of China. The most importance landscape character of this city is the mountains covered by forests, cultivated lands, water landscapes and scattered village lands. In their study. Bo, H., et.al. (2011) defines a strategy for the ecological planning of green network in Jiande City.



Figure 2.5: Jiande City and its view on the Xin'an River[10].

The researchers developed a systemic approach connecting the green landscapes along the edge of river to the forested mountains by using the fringe permeability

effect. Bo, H., et.al. (2011) proposes to set an ecological greening circle which surrounds the city and connect the artificial green areas to the natural landscapes around the periphery. This ecological greening circle named as ecological service area and it carries the main public facilities existing in every green spaces. They named this strategic approach as “Core - Axis-Integration” model, which has the ability to achieve transition from landscape areas to the artificial area.

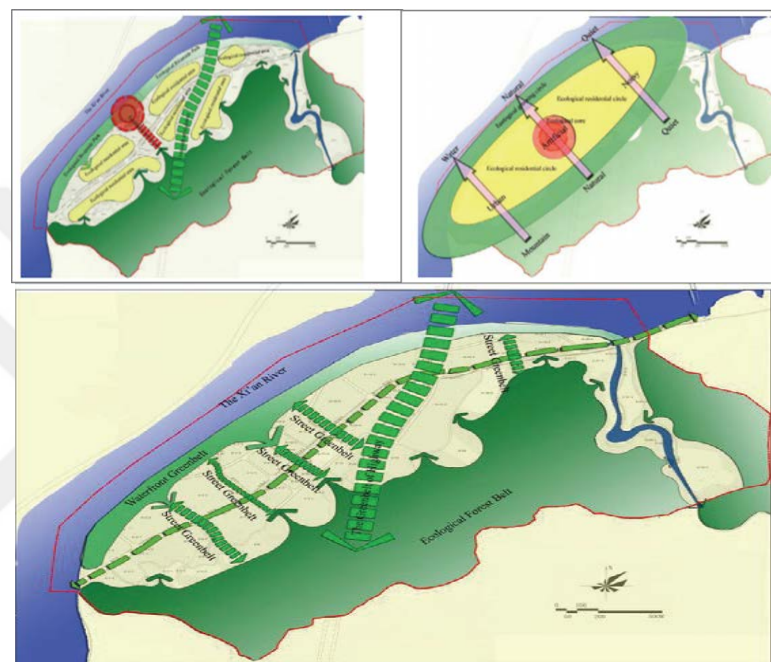


Figure 2.6: Ecological landscape structure diagrams.[10].

In the diagrammatic model they described that along the river the commercial facilities can find place for their land uses. Inside the green circle there are residential areas planned according to the ecological potentials and all system can be facilitated and integrated with the surrounding natural landscape.

This example shows us how to construct the integrated green system for both ecology and economy through using the ecological approach to green system planning issue.

## 2.2. The Importance of Green Spaces as A Part of Urban Ecosystems.

Urban green spaces are very important for health and personal wellbeing of the inhabitants. Moreover, these spaces are commonly known as ‘improving’ cities as

they increase amenity and provide places for both passive and active recreation. They also provide the resilience of cities with their potential for regulating the climate, cooling the city against urban heat island waves. The permeable surfaces of these spaces can reduce the speed of run off during storm events and reduce floods. In the global context, integrated the green spaces can ecologically contribute for the mitigation and adaption to changes of environmental as urban heats and climate change. For instance, the increasing in tree can aid to decrease the effects of climate change through sequestering the carbon [11] and adapt to urban heat through cooling in cities and increasing the provision of shade.

The importance of urban green spaces in developing of nations has been known on Agenda of a global scale in the United Nations since 2030. This agenda was made for the 17 Sustainable Development Goals (SDG's) (Figure 2.7) including city-specific Goal 11 to 'Make cities inclusive, safe, resilient and sustainable'.



Figure 2.7: 17 United Nations Sustainable Development Goals 2015-2030.[12]

The other importance of green spaces is related to health indirectly as in goal 3 'Ensuring healthy lives and promote well-being for all at all ages'. In addition, the Goal 13 related to climate and urgent action as "Take urgent action to combat climate change and its impacts". Goal 15 related to forests as 'Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss'

### 2.3. Multi Functionality of Urban Green

Green space can provide a range of benefits to urban residents including Environmental, social, health, well-being and economic and functions and benefits. These benefits of green space in urban areas are further summarized below.

#### 2.3.1. Environmental Function

Several studies have shown the importance of the environment function provided by green spaces.

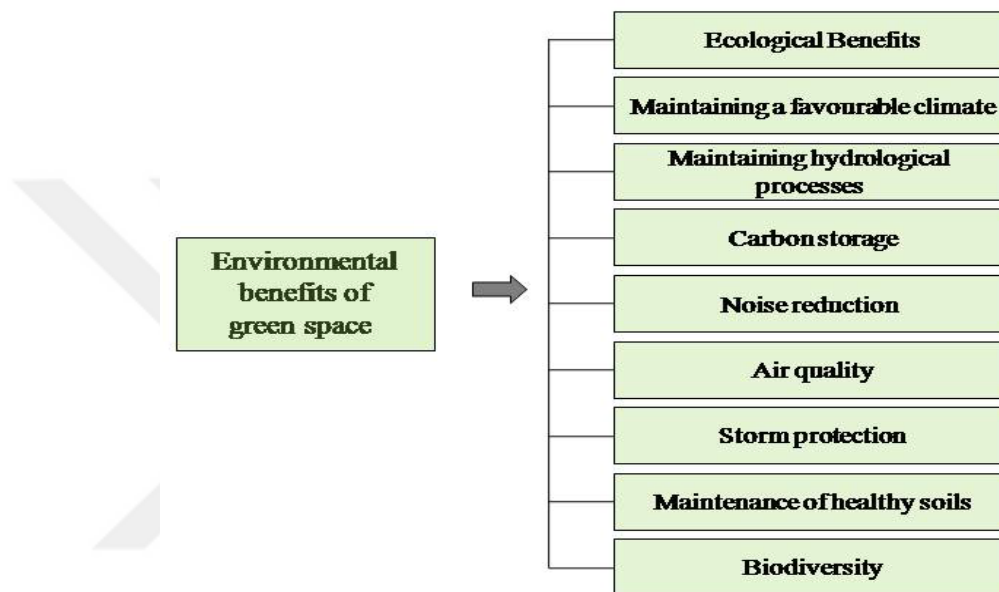


Figure 2.7: A chart showing the environmental function of green urban spaces.

- **Ecological benefits**

Urban green spaces give many advances to cities like conservation of biodiversity and the control of urban climate. The differences between rural and urban areas are usually in solar input, pattern of rainfall and temperature. Solar radiation, humidity, temperature of the air, speed of the wind is significantly change due to the environment of the cities. Effect of urban heat island is due to the large regions covering heat absorbing surfaces, the high energy consume by the cities. Effect of urban heat island can rise the temperatures of urban green spaces to 5°C. Moreover, well-designed green spaces can also protect habitats and preserve biodiversity. Greenspaces that present good connectivity and act as ‘wildlife corridors’ or function as ‘urban forests’, can preserve populations of species. Otherwise, they disappear from built environments [13].

- **Maintaining a favorable climate**

The density of urban areas is related to the local climate like Urban Heat Island (UHI) effect which is caused by paved surfaces that inhibit evaporation, dense structures that diminish speed of wind and materials of building that absorb solar energy in the daytime and release the heat progressively at night. All of these can be slow down the air-cooling process. Many studies measured the degree of cooling up to 1 km from the park boundary[14].They found that the cooling effect is reliant on the surface area, vegetation type and spatial configuration of the green space [15].Moreover, the cooling effect can generate by increase in temperature, dryness and intensity of heat waves, green areas that extends to the surrounding areas[16]. Also, the inclusion of water bodies within the green space can provide greater cooling effects.

- **Maintaining hydrological processes**

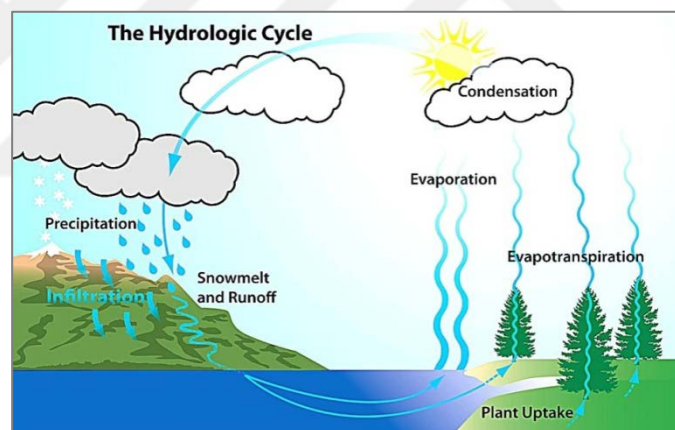


Figure 2.8: Natural hydrological processes.[17].

The conservation of existing forested areas and creation green infrastructure such as green roofs are importance way for reduction in storm water runoff.

Trees and soil can enhance the water quality by remove harmful substances through washing off roads, parking lots and roofs after rain events. Moreover, the vegetation can decrease the need for stormwater treatment through retaining or slowing the flow of precipitation reaching the ground. All of these systems can decrease the risk of flooding and the cost of water treatment [18].

The urban ecosystems could be useful for the economical and ecosystem indirectly by filtering leachates, sediments and pollutants, promoting evapotranspiration and mitigating the microclimate [19]. Also, Improving the complexity of urban habitats as well as resources for urban biodiversity could increase their hydrological resilience under climatic change, [20].

- **Carbon storage**

The volume of biomass of and vegetation type are important factors for carbon storage in urban green spaces. They store high percentage of carbon in trees and only a small percentage store in shrubs and herbaceous vegetation. Little carbon is restored in the green spaces like pruned trees, lawns, and flower beds. It can release significant amounts of CO<sub>2</sub> and nitrous oxide (N<sub>2</sub>O) through fertilization practices [21]. However, the soils; particularly the soil under the lawns, have not a large carbon stock, [22]. They can reduce the carbon dioxide in the atmosphere and release greenhouse gas.

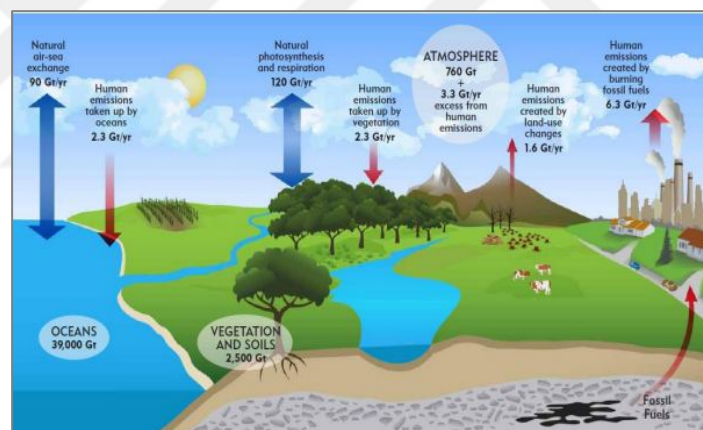


Figure 2.9: The Carbon Cycle. Source.[22].

- **Noise reduction**

The noise from urbanization, traffic, industrial activities, and increase availability of noise places in cities have been threatened the human health (WHO, 2016). As it increased risk of many health problems for instance; loss of hearing and cardiovascular disease [23]. Green spaces can reduce noise significantly by natural sound buffers [24] with vegetation belts 1.5 – 3m [18]. Moreover, planted "noise buffers" can reduce noise by 5 to 10 decibels. Dense green trees are perfect for reduce the noise specially n an area that has noise pollution.

- **Air quality**

In urban areas, the air pollution can be caused by industry, installations and residential heating. Sequent, the air pollution can cause increase incidence of diseases like cardiovascular and respiratory diseases [25].

In these areas, they try to improve air quality by filtering atmospheric particles for example; NO<sub>2</sub>, particulate matter (PM<sub>10</sub>) and SO<sub>2</sub>[26]. Furthermore, as percentage of pollution increases. The vegetation utilizes more contaminants [27]. Trees and shrubs can enhance the quality of air by eliminating the gases spread on the surface of the paper or the particles that stick to the surface of the leaves and. The trees with complex or thin leaves, have a tendency to pick up particles more than trees with wider and smoother leaves. In general, the presence of urban vegetation can decrease the air pollution. For instance; the schools enclosed by green spaces have low levels of traffic-related pollution in their classrooms.

- **Storm protection**

The dense vegetation and trees in urban areas are essential factors for protection from storm events and wind. In addition, the Mangroves are other essential factors for protecting coastal regions from storms, rising of sea level, floods, and erosion as have ability to absorb and disintegrate the wave energy and stabilize coastal land.

The vegetated surfaces have ability to reduce the volume of rainwater run-off and intercept and store water. The useful of trees are more if they are growth in pits which contain permeable soils. So, they will able to absorb extra water. Also, the useful of trees are more if they are growth in pits which contain structural soils. So they facilitate the growth of tree roots under the roads.

Consequence of high levels of surface water run-off, the rainwater removes pollutants away from the surfaces and transports them into water. This lead to decrease the water quality in streams, rivers and lakes. By increasing pollutant stocking at water treatment facilities. Rainwater can be stored, recycled, cleaned and additionally infiltrated into the groundwater by urban green space [28]. (figure 2.10)



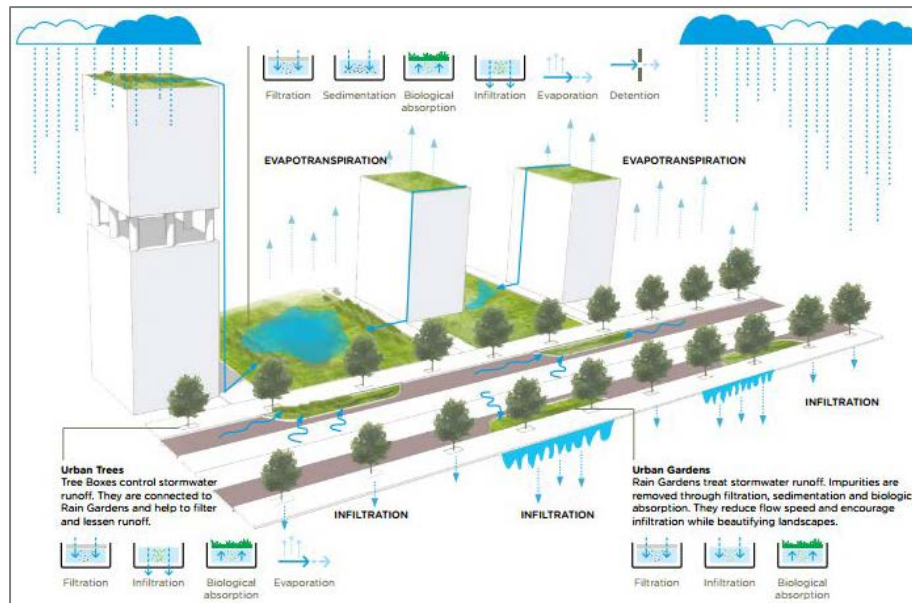


Figure 2.10 : Benefit Of Green Space And Enhance Urban Beauty, Control Erosion And Regulate Water Flow And Sedimentation In Urban City.[29]

- **Maintenance Of Healthy Soils**

Urbanization often consequences of the change in natural soil structure. Its chemical properties and the variety of organisms involve in biogeochemical and hydrological procedures in soil [30]. Native soil profiles are most commonly disturbed through removal, compaction or burial [30],[31]. Previous studies found that construction activities can reduce pH and can increase the sand content in soils under asphalt [32]. Other studies also shown that belowground “heat islands” beneath and surrounding asphalt, pavement and gravel [33]. The temperatures of soil tend to be high temporal variability and exhibit fine-scale spatial heterogeneity which reflect the spatial patterns of aboveground habitat structure. The bulk density, nitrogen (N) and organic matter content of urban soils can also be changed by human activities, mainly alterations in vegetation structure [31].

- **Biodiversity**

Parks and large green spaces also support biodiversity Small areas of vegetation such as roadside edges and green roofs can support a range of plants, insects and birds. Time spent in urban green spaces is a great opportunity to be surrounded by nature. It increases the pleasure of spending time in green spaces when they see that there is

richness in biodiversity where they will also be willing to pay to see enhanced species rich in plants, birds and invertebrates.

Urban green spaces are sometimes an ecological corridor, linking larger parks, creating links between cities and suburbs. This facilitates the movement of animals, birds and insects between individual green spaces and prevents fragmentation and isolation of wildlife [34].

### 2.3.2. The Social Function

According to many studies, access to green spaces can enhance social cohesion [35]. Thus, the presence and accessibility of green spaces in the open air within the neighborhoods is associated with a greater sense of community [36],[37].

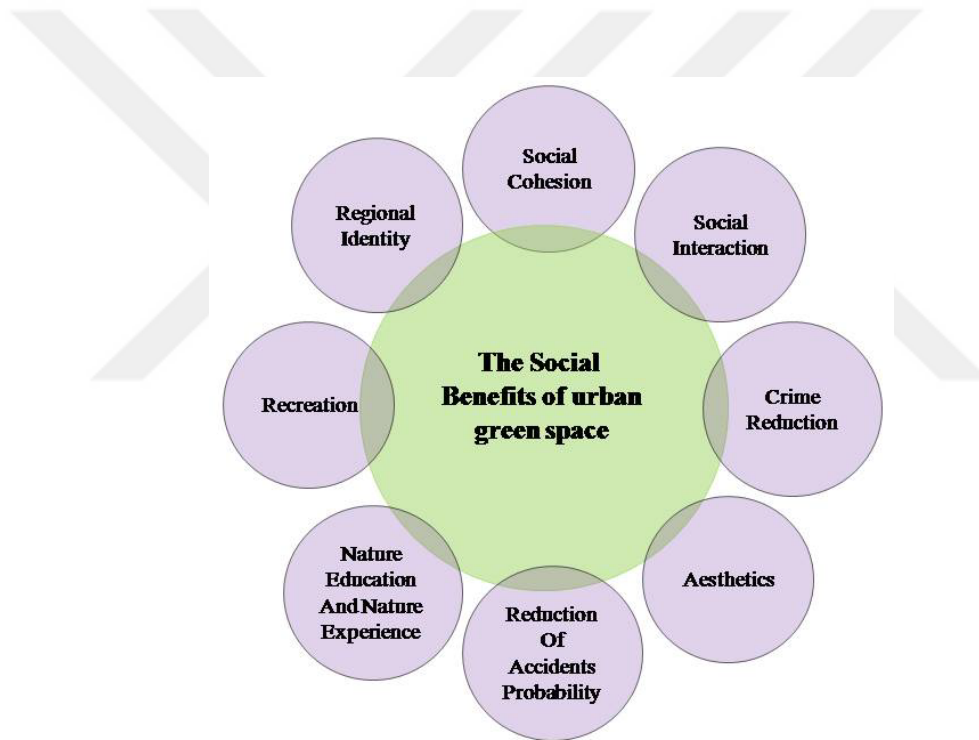


Figure 2.11: A chart showing the social benefits of urban green space.

- **Social Interaction**

In recent years, there have been many studies by many scientists that emphasize the importance of green spaces as areas where people can meet each other, or as a central center of society, providing space for social communication, political discourse and cultural expression [38]. The presence of trees (and their shades) as well as grass in public areas makes people want to spend more time outdoors, improving social interaction among members of society [39]. In open green spaces,

there are great opportunities for social interaction due to easy access to these spaces, compared with other areas in the city. In addition, green spaces can include recreational activities, such as squares, public celebrations and cycling, which increase social interaction [40].

- **Social Cohesion**

Globalization has become one of the causes to make the parts of heterogeneous multicultural societies what makes social communication less cohesive and interactive [41]. Social and environmental green spaces can allow people to meet and interact to establish relationships and develop social relationships within communities. It is not only a place of entertainment but an important place for social development. Through green spaces, opportunities are created for all segments of society to engage in close interaction between social classes of different ethnic backgrounds [42]. When community groups use a range of leisure activities, they increase the sense of social rapprochement.

- **Crime Reduction**

Many studies suggest that urban green spaces may deter crime for several reasons . These reasons include:

- **Social interaction**

Well-maintained green spaces may provide a place for people to interact and hang out. As a result, this may lead to more people and families just milling around. The presence of more people may make it harder for criminals to commit crimes without being spotted and apprehended. [43]

- **Psychological reasons**

Vegetation may also have a calming effect on would-be criminals, according to the study. Researchers suggest that the soothing effect of green space may reduce psychological precursors to violent acts.

- **Community vigilance**

As communities adopt urban green spaces as their own, residents may informally keep watch over these areas, the study's authors said. For example, some neighbors will simply maintain the green space and pick up trash, while others may form loosely organized neighborhood-watch groups.[43]

- **Reduction Of Accidents Probability**

In roads, tree distribution affects the direction and speed of motorists. Trees make a frame of the streets and determine the edges, which helps reduce the speed of cars. In addition, trees can distinguish between the walkway and the motorway, which increases the safety of traffic.

Some studies have also confirmed that the incidence of accidents is lower in streets with trees than on streets with no trees According to [44].

- **Aesthetics**

Most users of green spaces express their preference for the aesthetic values available in those areas in terms of vegetation, trees, water bodies and geographical diversity [45].

- **Nature Education And Nature Experience**

Urban green spaces positively affect the development and physical mobility of children. It also increases knowledge of environmental issues [46]. Many researchers have shown that spending time in green spaces is not just entertainment, but an educational experience that promotes the quality of children's self-development.

Children are more likely to play outdoor rather than indoors because green spaces provide them with a greater opportunity to enjoy natural spaces, shaded trees and green grass [47] It has been shown that the level of play becomes more creative in green areas than in arid areas.



Figure 2.12: Benefits of Connecting Children with Nature.[47]

### 2.3.3. Health and Well-Being Function

Access to nature within urban areas has a positive impact on public health and well-being. Green spaces can help reduce headaches, prolong the lives of older people, reduce mortality and prevent obesity among children and adults. There are some factors that help to achieve health and well-being [48]. (figure 2.13).

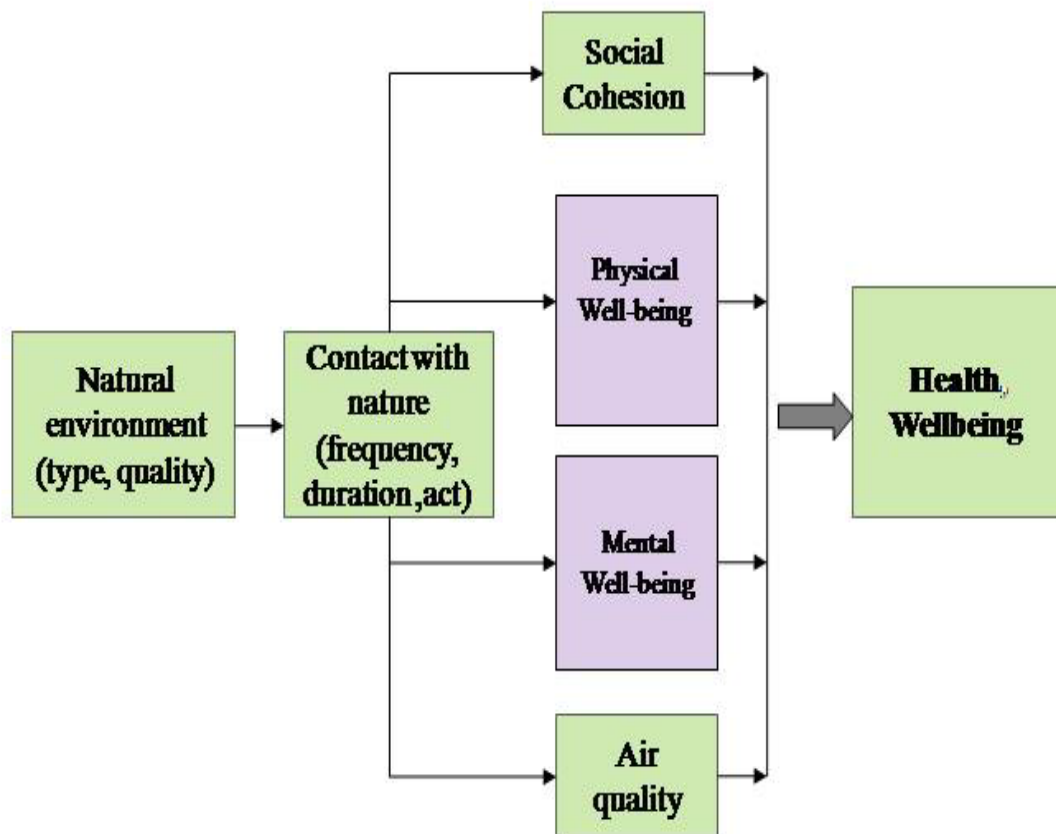


Figure 2.13: A chart showing the basic factors to achieve health and well-being.[48]

- **Mental Well-being**

There are many positive impacts of urban green spaces that have an impact on mental health [49]. such as:

1. Ability to focus.
2. Decreased hyperactivity disorder.
3. Enjoy the comfort and tranquility.
4. Provides a comfortable environment for creativity and enjoyment.
5. Reducing stress, depression and mental fatigue

- **Physical Well-being**

Some studies have confirmed [50]. The exercise of physical activity within the green areas is more useful than in the exercise of sports in urban areas, reducing obesity and lowering blood pressure, one of the most important of these benefits.

### 2.3.4. Economic Functions

An understanding has been reached of both how, and how far, green space contributes to economic regeneration and sustained economic prosperity, as well as how its role can be enhanced in the future.

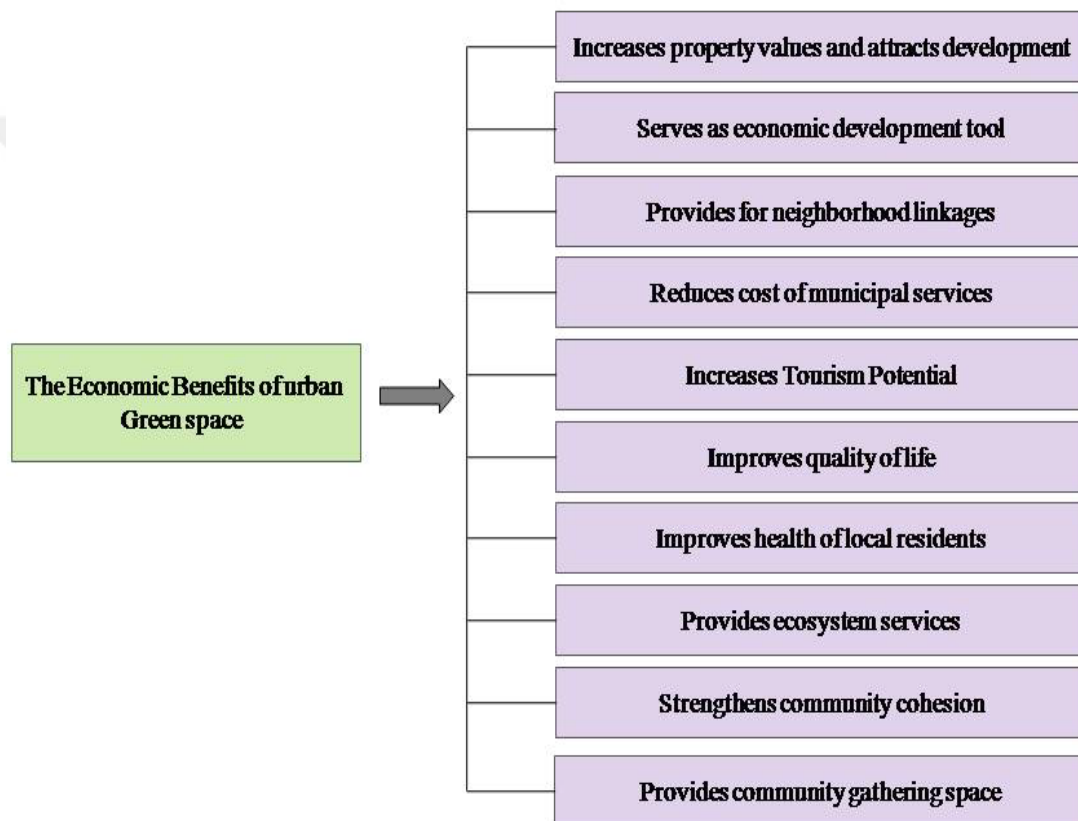


Figure 2.14: A chart showing the Economic benefits of urban green space.

- **Green space increases the economic value of the place**

The price of buildings near parks is increasing.

To build and maintain the garden, high property taxes can be used.

Possible increase in property tax revenues alone.

The initial acquisition cost can be recovered in a few years.

- **Green spaces as a tool to contribute to the development economy.**

Parks and tracks attract companies and residents.

Residential development depends on its presence in or near green spaces.

Attracts business development.

The presence of green spaces encourages investment in urban areas.

- **Availability of link in urban society**

Green spaces as an element provides connectivity to activity centers



(1)

(2)

Figure 2.15: (1)West Creek watershed, (2) NewYork city high line.[48]

- **Reduce the cost of public services**

Green space helps reduce the cost of many high-cost effects such as noise, pollution, traffic congestion and infrastructure degradation.

- **Enhances and supports tourism potential**

Parks and parks are the most important elements of the tourism sector.

The parks provide entertainment and activities that make it a center of frequency and use for visitors. As a result, visitors can pay usage fees and spend money in the area.

- **Improves Quality of Life .**

Trees and shrubs in cities are working to remove and filter air from pollutant and dust, thus avoiding community costs associated with air triangulation. They can also avoid community costs of managing storms, floods and runoffs of rainwater.

- **Improves health of local residents**

Parks and parks are among the best places for exercise and physical activity, which contribute to reducing disease and saving medical costs.

Easy access to parks and parks enables people to access leisure opportunities at less or no cost



Figure 2.16: Describes Some Of The Volunteers In The Cleveland Metro Parks[48].

- **Provides community gathering space**



Figure 2.17: Describes Enhance social communication In The Cleveland Metro Parks[48].



### **3. ECOLOGICAL PLANNING MODEL FOR THE URBAN GREEN SPACE PLANINNG**

In order to design an ecological planning methodology for green system networking we must analyze the functions, ecological land cover and green space typology of the urban green landscapes. In this chapter we will try to construct basic knowledge about green space start with effective factors, classification systems, functions of green systems in city environment. Finally, we will explain the strategic model for ecological planning of green systems and how to use these theoretical knowledge .

#### **3.1. Effective Factors of The Functions on Urban Green Spaces**

- **The physical environment**

Many studies recognized that the broader contextual variables like the shape of urban green space can provides many benefits. The Physical environmental factors as climate and degree of urbanization are directly affect in the composition, abundance and structure of urban green spaces. Moreover, these factors effect in the level of benefits provided – for instance the provision of cooling is necessary in some places at special times of years, but it is not necessary in other places at other times of year [50].

- **Climate**

In urban green spaces, the temperature has been known as strong driver for the global distribution of plants [51]. whereas the climate has been known as strong predictor for tree species composition. And as a valuable predictor for diversity in the urban forest. the change in Climate and the increases in urban temperatures as a result of urban heat can lead to large alterations in the constitution of urban forests. Furthermore, the benefits of the urban green spaces are vary with temperature change. Shade of the trees can considerably reduce the energy used in cities by reduction in the use of air conditioners [52]. Correspondingly, the wellbeing of human health may due to Shade of the trees in hotter cities. Adelaide is Australia's driest capital city. The weather in Adelaide is as Mediterranean; long dry summers and cold winters with moderate rainfall Because of variability of climate in Adelaide, the different species can grow on it comparing with the cities which have uniform rainfall patterns. The species that are suitable to grow in Adelaide's climate is critical to conserving healthy green spaces.so, the appropriate management of

green space vegetation is essential for the long life using of these spaces. Moreover, the rainfall is essential for some places. For instance, the cities which have Mediterranean climates and long dry summers be likely to have vary growing species than the cities which have uniform rainfall patterns. The Climate is associated with maintenance and irrigation which is importance for availability of high-quality green space within cities and towns. [50]

- **Level of urbanization**

The level of urbanization effects in the structure and the function of urban green spaces [53]. the High urban areas are warmer than close areas owing to urban heat effects. Additionally, the soils are drier as rainfall is taken and piped through the storm water systems instead of infiltrating through the soils. Moreover, the chemical structure of the environment alters because of pollution and nutrient deposition.

- **The social context**

The social environment is a significant predictor for the provision of urban green space as it provides many benefits. the recent studies have found that urban green spaces can be benefit for health of populations. Also, many studies have found that the varying in health outcomes are reliant on demographic factors as well as density of population. Furthermore, disproportion in the provision and design of green spaces can reduce the abundant and available of these in disadvantaged areas [50].

- **Population Density**

Density of Population is an important factor for the distribution of green cover and driving the fragmentation of green space. Increase the densities of population cause changes in the built form. Consequently, this is can lead to more impervious and less impermeable surfaces where plants can grow. These restrictions can be overcome with a policy focus on increasing both green cover and space. For instance, from 1986 to 2007, increase the density of Singapore city caused increase in the green cover from 36% to 47% however the population increased through the application of strong greening policy.

Also, the Inadequate space on the ground can lead to an increase the green interventions encapsulated within the built environment like green roofs and facades [53].

- **Socioeconomic inequity**

The greening disadvantaged areas have large benefits. For instance, previous study has been found that the variations of health is smaller in green areas. The previous evidence regarding increase the physical and the mental health benefits was associated with access to green space. The Trees and the green space can provide evenly benefits for disadvantaged areas and can provide a useful method for health promotion., recent studies in Australia have considered the education level rather than income as a better predictor of the distribution of urban greenery [50].

- **The Significant Attributes Of Green Public Open Space**

Some research suggests that accessibility or distance to green is an important predictor of use, that exposure to green POS can have some mental and physical health benefits and that vegetation structure and composition is important habitat and provides several ecosystem services such as intercepting rainfall, cooling. Building evidence of greenspace correlates and thresholds would help in choosing evidence-based targets and the shaping of urban green space policy.

- **The synergy between the benefits of urban green spaces**

When planning for green spaces, managers and planners often consider the design requirements for human health, biodiversity and ecosystem services in isolation from each other. However, to build an equitable, livable, healthy and resilient city, planners need to plan green spaces to achieve a multiple benefit including human health, biodiversity and ecosystem services. The following matrix (provided as Table 2 overleaf) is a tool that outlines the synergies and benefits of different landscape attributes provided by urban green space. (Table 2.2) show the synergies and benefits of different landscape attributes provided by green space.

Table 2.2: The synergies and benefits of different landscape attributes provided by green space [50].

Benefits from Green Open Space					
Attributes Of Urban Green ry	Ecological Support	Natural Protect	Social & Cultural	Climate Regulation	Biodiversity
Size & area	Physical activity: Large GS with more amenities leads to greater levels of recreational physical activity.	Perceptions of safety: Can be more isolated in larger parks. Can reduce perceived safety when people don't feel visible.	<i>Sense of community:</i> Access to, and use of green GS appears to encourage a greater sense of community.	<i>Cooling, storm protection and noise reduction:</i> Larger areas of vegetation provide greater effects on cooling, storm protection and noise reduction.	<i>Diversity of nativespecies:</i> Larger areas of GS are likely to provide a variety of resources for plants and animals .
Accessibility & distance to a GS	People with access to large attractive GS are more likely to achieve recommended levels of activity. <i>Quality design features of GS supporting physical activity:</i> grassed areas, amenities, walking paths, water features, and wildlife	maximize natural surveillance is therefore important. <i>Wellbeing:</i> Better quality parks are thought to improve neighborhood wellbeing.	<i>Conserving heritage:</i> Larger reserves may be able to preserve landscape level cultural features such as sightlines to surrounding. Small reserves may be able to adequately preserve specific artifacts such as buildings or other significant sites.	noise reduction. <i>Pollination:</i> Native bee species more likely to be found in large and less managed reserves and golf courses.	<i>Conservation of nativeecosystems:</i> Large reserves can have some benefits (e.g. reduced edge effects, habitat for species with large ranges). Small reserves are effective in conserving some species and ecosystems,

	Benefits from Green Open Space				
Attributes of Urban Green space	Ecological Support	Natural Protect	Social & Cultural	Climate Regulation	Biodiversity
Accessibility & distance to a GS	<p><i>Physical activity:</i> Local access (&lt;500m) to green GS encourages physical activity, although the size of GS appears to be important to achieve recommended levels of walking and small GS does not appear to encourage physical activity.</p>	<p><i>Perceptions of safety:</i> The presence of safe road crossings to access GS is important to encourage use.</p> <p><i>Wellbeing and general mental health:</i> Access to attractive GS including the presence of street trees, or views of green GS leads to reduced stress and mental fatigue.</p>	<p><i>Sense of community:</i> Access to, and use of GS encourages a greater sense of community.</p> <p><i>Conserving heritage:</i> Accessibility is important for many cultural heritage sites.</p>	<p><i>Cooling:</i> The cooling effect from vegetation decreases with distance from the green space.</p> <p><i>Noise reduction:</i> Noise reduction is greatest when plantings are close to the source of the noise.</p>	<p><i>Conservation:</i> Conservation can reduce accessibility when people are excluded e.g. fencing. This may be justified in some cases such as the removal of rare orchids, or disturbance of migratory birds, but restricting access may not always be necessary and can limit the</p>

	Benefits From Green Open Space				
Attributes Of Urban Green Space	Ecological Support	Natural Protec	Social & Cultural	Climate Regulation	Biodiversity
Trees	<p>Access to GS with sports amenities is associated with higher physical activity in children.</p> <p><i>Protective diseases:</i> Access to and use of green GS is protective against several non communicable diseases.</p> <p><i>Physical healing:</i> In hospitals, access to nature can lead to faster surgical recovery and higher pain thresholds.</p>	<p><i>Childhood developme nt:</i> Access to and use of green GS is thought to influence different aspects of cognitive developme nt in children, and enhance motor abilitie os.</p>			<p>social benefits provided by conservation areas.</p>

	Benefits From Green Open Space				
Attributes Of Urban Green Space	Ecological Support	Natural Protec	Social & Cultural	Climate Regulation	Biodiversity
Trees	<p><i>Physical activity:</i> Trees provide shade, and create more attractive GS which encourages walking.</p>	<p><i>Perception s of safety:</i> There can be public concerns about falling tree limbs. General mental health: Trees are associated with the mental health</p>	<p><i>Sense of community:</i> Street trees encourage a sense of community. <i>Conserving heritage:</i> trees can form important parts of</p>	<p><i>Cooling:</i> Trees canopy coverage is a good predictor of the cooling effects of urban green space.</p>	<p><i>Habitat for native animals:</i> Old trees with hollows offer habitat for birds and mammals, and trees more generally offer habitat for arthropods.</p>
		<p>and well being benefits of green space</p>	<p>Cultural landscapes</p>	<p>Storm protection: Trees provide protection to infrastructure during storm events. <i>Air quality:</i> Trees can filter atmospheric particulates</p>	<p><i>Conserving ecosystems and native species:</i> Trees can be conserved in their own right, and provide habitat for many species. Native trees can provide habitat for native bird</p>

	Benefits From Green Open Space				
Attributes Of Urban Green Space	Ecological Support	Natural Protec	Social & Cultural	Climate Regulation	Biodiversity
Social infrastructure i.e. provision of paths, lighting seating, water fountains, BBQ, seating, tables	<i>Physical activity:</i> A range of amenities encourages physical activity and recreational walking. In adolescents, access to skate parks and lighting around sports areas encourages greater participation in physical activity.	<i>Perception s of safety:</i> Visible signs of maintenance is important as features and facilities in disrepair contribute to a perceived lack of safety and discourage recreational walking.	<i>Social connectedness:</i> Views of green areas from home increases perceived social connection. Public art, connected paths, playgrounds, seating also thought to increase connection.	<i>Water sensitive urban design:</i> Water features in public open space can be used to filter storm water. <i>Sustainability:</i> Energy and resource requirements should be considered across the complete lifecycle of infrastructure.	<i>Biodiversity:</i> Lighting can interrupt the lifecycles of some species, and keeping some areas free from lights is important to maintain populations of some species.
Habitat & vegetation complexity	<i>Physical activity:</i> Varied vegetation and	<i>Perception s of safety:</i> Vegetation that obscures the	Sense of community & sense of place: Natural areas with complex	<i>Pollination:</i> Habitat and vegetation complexity	



Benefits From Green Open Space					
Attributes Of Urban Green Space	Ecological Support	Natural Protec	Social & Cultural	Climate Regulation	Biodiversity
	<p>topography facilitates different types of spontaneous play for children i.e. tree climbing, building cubbies or playing house or pirates. Gardens and grassed areas also important.</p>	<p>visibility of surrounding houses and roads can reduce perceptions of safety. Designing GS with natural surveillance by having surrounding houses overlooks parks increases perceptions of safety; and reduces disorder.</p>	<p>vegetation can encourage sense of community and connection to local natural heritage.</p>	<p>benefits a diversity of pollinators. Stormwater and noise attenuation: Structural complexity of vegetation helps to reduce stormwater runoff and attenuate a wider frequency of noise.</p>	<p><i>Habitat:</i> Complexity has positive benefits for many species of animals including birds, reptiles and arthropods. The presence of leaf litter, logs, long grass, old trees and native vegetation is generally beneficial.</p>

	Benefits From Green Open Space				
Attributes Of Urban Green Space	Ecological Support	Natural Protec	Social & Cultural	Climate Regulation	Biodiversity
Irrigation	<i>Physical activity:</i> Attractive parks that are irrigated encourage more recreational walking.	<i>Mental health:</i> Lush green vegetation aids the health and wellbeing benefits of green space, and is generally preferred by people	<i>Community use:</i> Irrigated areas of lawn can provide suitable areas for community picnics and outdoor events.	<i>Cooling:</i> Irrigated areas of lawn and irrigated trees can increase cooling.	<i>Biodiversity:</i> Irrigation can allow a wider range of plant species to grow, but can be detrimental where it advantages non-local species over local species.
Heterogeneity	<i>Physical activity:</i> Neighborhoods with greater variation in greenery have	<i>Mental health:</i> Different kinds of people respond to	<i>Social activities:</i> Having a range of green space types provides	<i>Resilience:</i> While having variation in urban greenery can reduce total service	<i>Biodiversity:</i> Heterogeneity in urban greenery is critical to support
	been shown to decrease the risk of hospital admissions for cardiovascular disease and stroke.	kinds of landscapes . Having a range of landscapes provides mental health and wellbeing benefits to a wider range of people.	for a wider range of social activities, such as dog walking, nature appreciation, active sports, and recreational walking	provision, it can increase resilience to external shocks such as changing temperatures or storms and floods.	adifferent kinds of organisms.

## 3.2. Classification of Green Spaces

### 3.2.1. Classification of Green Spaces Depending on Planning Levels.

- **Green Spaces In The National Level:**

Are spaces with special attractions and contain natural elements such as mountainous area or natural corridors and springs of water and sulfur water and can represent its uniqueness with special elements and the attraction of entertainment at the international level as the gardens of Versailles in France or zoos.



Figure 3.1: The Gardens Of Versailles In France.

- **Greenspaces In The Regional Level**

These areas are often nature areas that have been converted into parks, which are large enough to be isolated from the city. The visitors enjoy the natural scenery and the accompanying activities. These areas link the network of open areas with the level of the provinces related to each other or at the level of each city and its region. This is done through some natural elements such as waterways and urban elements such as the main traffic axes such as the ring road.

- **Green Spaces In The City Level**

The general planning of the civil area determines the preferred sites for these green areas, such as areas with difficult terrain, as well as areas surrounding the water or mountainous areas, and plays a large role in the general layout of the city. The planning divides the public park into a variety of gardens, green garden that suits the

wishes of visitors and garden visitors. It should be considered in its planning and design all the required standards and standards, as well as careful study to determine their entries, which does not represent obstacles or traffic problems in the region, as well as the availability of sufficient waiting areas for gardeners. It should be open to all categories and with suitable fees.



(1)



(2)

Figure 3.2 :(1). Al Azhar Park in Egypt , (2). Central Park in New York.

- **Green Spaces In The Neighborhood Level**

Which serve the neighborhood and provide external and internal services to the population and serve every green area of this type of residential communities included in the neighborhood and includes this kind of parks both hiking, sitting and recreation accompanied by movement and the exercise of children's games and sports.

- **Green Spaces In The Neighboring Residential Level**

It is one of the components of the service center in the vicinity. It includes a group of green areas, tracks, seats, playgrounds and youth. The pedestrian corridors play a key role in dividing the green space into its main components, as well as connecting it to the main service center of the neighborhood.

- **Green Spaces In The Level Of The Residential Group**

Are green spaces that exist among a group of medium density buildings to temper the atmosphere and serve the population. It acts as a transitional area between buildings and public green areas.

- **Green Spaces In Road Level And Traffic Axes**

There are in the middle of the streets or on its side to provide places of rest and wait, depending on the display area and the degree of road.

### 3.2.2. Classification of Green Spaces According to Ecological Land Cover.

Urban Green spaces refer to those land uses and land cover that are covered with natural or man-made vegetation in the city and planning areas. It has been long argued about the definition of green space system. Different disciplines have used various definitions from their own professional concept, such as Horticultural Greenland System, Urban Greenland System, Ecological Greenland System, and Urban Green Space and Green Open Space.





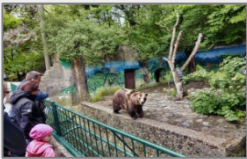
### 3.2.3. Classification Of Green Spaces Depending On Function






Green spaces can exist according to the function in which they are located and operate. (Table 3.1) shows forty-four jobs in which urban green spaces can be found with descriptions and examples.

Table 3.1: Different Function of Urban Green Space .






FUNCTION OF GREEN SPACE	DESCRIPTION	EXAMPLE
Balcony Green	Plants in balcony and terraces, planted mostly in pots.	
Green Wall	Ground based climbing plants intended for ornamental (and sometimes food production) purposes	

FUNCTION OF GREEN SPACE	DESCRIPTION	EXAMPLE
Green Roof	Roof vegetation on thick substrate with irrigation and management. Vegetation established either artificially by seeding or planting or naturally: perennials, grasses, small trees, rooftop farming	
Bioswale	Vegetated and gently sloped pit for filtering surface runoff.	
Tree Alley And Street Tree, Hedge	Trees planted along roads and paths either solitary or in rows. Hedges along roads or paths.	
Street Green and Green Verge	Non-tree, mostly shrubby or grassy verges along roads or other built or natural element	
House Garden	Areas in immediate vicinity of private houses cultivated mainly for ornamental purposes and/or noncommercial food production.	

FUNCTION OF GREEN SPACE	DESCRIPTION	EXAMPLE
Green Playground, School Ground	Green areas intended for playing or outdoor learning.	
Riverbank Green	Green space sideways the rivers, streams , lakes and canals, usually with foot or bike paths.	
Large Urban Park	Larger green area within a city intended for recreational use by urban population, can include different features such as trees, grassy areas, playgrounds, water bodies, ornamental, etc.	
Pocket Park	Small park-like areas around and between buildings vegetated by ornamental trees and grass, publicly accessible.	
Zoological Garden	Areas with animals kept in cages and enclosures often combined with planted trees, ornamental beds and cultivated grass.	

FUNCTION OF GREEN SPACE	DESCRIPTION	EXAMPLE
Institutional Green Space	Green spaces surrounding public and private institutions and corporation buildings.	
Cemetery And Churchyard	Burial ground often with covered by lawns, trees and other ornamental plants	
Green Sport Facility	Intensively cultivated and fertilized grass turf tolerant to frequent trampling for sport activities (e.g., golf courses, football fields).	
Community Garden	Areas, collectively gardened by a community for food and recreation.	
Arable Land	Regularly ploughed arable land for crop production.	



FUNCTION OF GREEN SPACE	DESCRIPTION	EXAMPLE
Grassland	Pastures or meadows.	
Forest (Remnant Woodland, Managed Forest, Mixed Forms)	Natural or planted areas of dense tree vegetation.	
Wetland, Bog, Fen, Marsh	Areas with soil permanently or periodically saturated with water and characteristic flora and fauna.	
Lake, Pond	Natural and artificial standing water bodies containing non-saline water with (semi)natural aquatic communities, banks artificial/managed or natural.	
Sea Coast	Contact areas (littoral) between the sea and the land of different characteristics, e.g. sand beaches, cliffs, coastal dunes.	

### 3.2.4. The Evaluation Steps of Ecological Planning Model for Re-Construction Of Urban Green System.

There are key steps to be taken when developing a strategic model for the ecological planning approach of the Green System. (Figure 3.3) illustrates a strategic outline of the environmental planning approach.

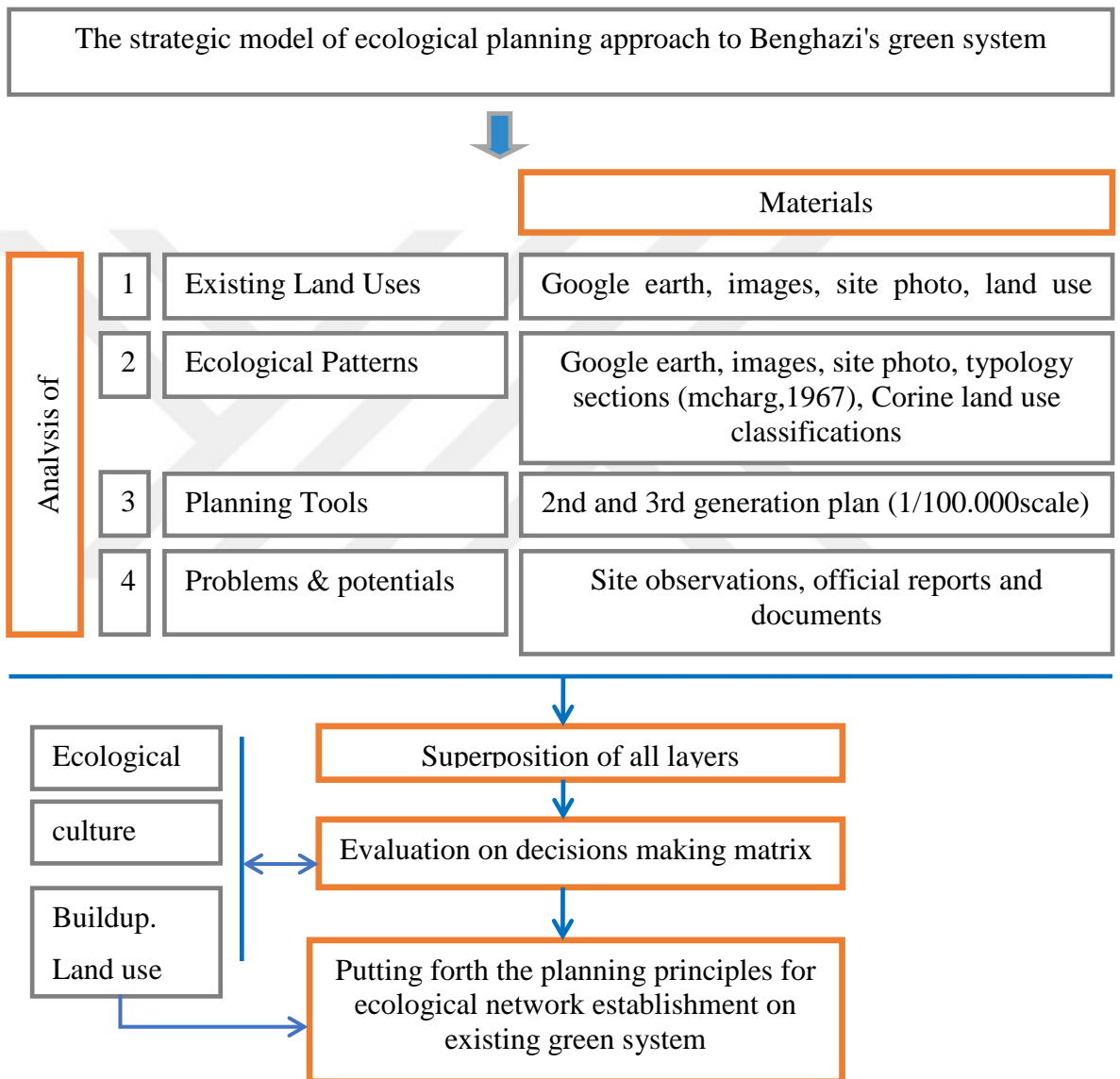


Figure 3.3: The strategic model of ecological planning approach to Benghazi's green system.

The first step is to analyze or diagnosis of the current situation using different materials / documents in order to understand the natural potentials and threats on landscape and urban ecology.

- Diagnosis of current land uses.
- Identify ecological patterns landscapes in the area.
- Identify the planning tools and their regulations on landscapes/green space.
- Identify problems and possibilities of the region.

All of this information is collected by many materials such as (site notes, official reports, documents, Google Earth, imagery, image of the site, land use maps, and satellite imagery).

Preparation of ecological identification cards showing the diagnosis of each area of potential, problems, and threats in the region (Figure1.4).

Preparation of the assessment matrix, in which the region is classified according to the ecological potential and recreational facilities that may be the area (Figure1.5). The decision-making matrix is intended to guide planners and decision-makers in terms of eligibility in any land-use decision around the potential green space network.

#### 4. ANALYSIS OF EXISTING SITUATION IN THE CITY OF BENGHAZI.

##### 4.1. General Background on Planning Phase and Development Projects in Libya.



Figure 4.1. :Location of the city of Benghazi in Libya.


Urban planning roots in Libya dates back to Italian era. Libyan towns had no master plans of any kind before Italian invasion in 1911. In Italian period, four master plans were prepared for Tripoli, Benghazi, Darnah and Misurata. Additional to the master plans, layout plans were also prepared for major cities and small settlements. In 1966, The Ministry of Planning and Development initiated an extensive urban planning program, the-so called `1st Generation Planning Project (1st GPP) with the aim to regulate urban expansion and to make the benefits of the country`s new found oil wealth accessible to as many as possible. The 1st GPP focused on development of master and urban plans; 29 master plans and 148 layout plans which covered whole country by inventory reports were prepared during 1st GPP and were in force until 1988. However, a comprehensive regional planning in Libya commenced with preparation of the 2nd Generation Planning Project (2nd GPP) in 1980. Prior to the 2nd GPP, the urban planning was focused mainly on the first element of urban planning-master and urban layout planning. Detailed long-term national, regional, sub-regional plans were first prepared within 2nd GPP accompanied with master and

layout plans for primer cities and settlements which were in force from 1980 to 2000 (de-facto extended to 2006 for the finalization of the National Spatial Policy-NSP). The 2nd GPP was a comprehensive plan aimed to carry prior macro-plan approaches to local plans. Multi-dimensional planning styles for multi-level planning practices which have been handled within a systematic consistency despite the broad scope and in-depth contents of planning works, made the 2nd GPP to be widely distinguished from other planning experiences in Libya and in the world, as well. The simplicity and transparency as well as integrity of the applied conventional and traditional “physical” planning methodology at these times made the 2nd GPP an exceptional work. . By the year 2000, Libya faced a new era in which some political changes along with new economic developments and socio-cultural preferences in life styles initiated a transformation process especially in cities. This transformation process necessitated a new approach and organization to direct the spatial and economic developments in the country. The new trends are messenger for change and calls for dynamic and inter-active planning approaches unlike to conventional and traditional planning method. [54].



Figure 4.2. : General View Of Benghazi

Table 4.1: Organizational Chart of Planning Phases and Development Projects in Libya.[54]

PLANNING PHASES	PLANS	DESCRIPTION
MASTER PLANS IN ITALIAN PERIOD	Urban Master Plans 1911	<p>The roots of town planning in Libya dates back to Italian era.</p> <p>Four master plans prepared for Tripoli, Benghazi, Darnah and Misurata cities</p> <p>Layout plans were prepared for towns and villages.</p>
1 st GENERATION PLANNING PROJECT	Urban Master Program and Plans 1966-1988	<p>1st GPP included only Master Plans and Layout Plans for major towns and settlements.</p> <p>Al Marj Master Plan of 1963 was the first plan prepared by Libyan planners (Barca Reconstruction Organization) after independence, and the second plan was master program and layout plan for Al Bayda.</p>
2 nd GENERATION PLANNING PROJECT	<p>National Spatial Policy* (NSP) 1980-2000</p> <p style="text-align: center;"></p> <p>The National Physical Perspective Plan* (NPPP)</p>	<p>Sets the guidelines for the planning and management of settlements, infrastructure, services and land use, within vast territory of the Jamahiriya</p>

	Benghazi Region Physical Development Plan (BRPDP) 1985-2000	Refers to NPPP The BRPDP covers Al Butnan sub-region, Darnahsubregion, Al Jabal Al Akhdar sub-region, Al Marj sub-region and Benghazi sub- region
	Sub-region Physical Development Plan (SRPDP) 1985-2000	Refers to the BRPDP Prepared for Al Butnan, Darnah, Al Jabal Al Akhdar, AlMarj and Benghazi
	Urban Master and Layout Plan 1985-2000	Refers to the SRPDP Master and Layout Plans for major towns and settlements
3 rd GENERATION PLANNING PROJECT	National Economic Strategies (NES) 2006-2019	A set of strategies to upgrade the global competitiveness of Libyan economy.
	National Spatial Policy (NSP)  National Physical Plan (NPP) 2006-2030	Benefited from NES and 2nd GPP and previous version of NSP. The guidelines for the planning and management of settlements, infrastructure, services and land use within vast territory of the Jamahiriya. Provided guidance to the regions and sub-region plans
	Benghazi Regional Plan (BRP) 2000-2025	Refers to the NSP, NES and 2nd GPP Covers Al Butnan, Darnah, Al Jabal Al Akhdar, Al Marj and Benghazi sub-regions

	<p>Sub-regional Plan (SRP) 2000-2025</p>	<p>Refers to the BRP To be prepared for Al Butnan, Darnah, Al Jabal Al Akhdar, Al Marj and Benghazi sub-regions</p>
	<p>Urban Master and Layout Plan 2000-2025</p>	<p>Refers to the SRP Master and Layout Plans for major towns and settlements</p>

### 4.2. Sub-Regional Context and Location of Benghazi

The Benghazi Sub-region is located at the western edge of the Benghazi Planning Region (BPR), being bounded by the Arab Republic of Egypt from the east, by Al Khaliq Region from south and southwest, and by Mediterranean Sea from north and west (Figure.3.2). Benghazi is the most populated city in the region with over half a million people in 2011, and the second largest settlement in the country after Tripoli. In region, there are also four mid-sized cities; namely Tubruq, Darnah, Al Bayda and Al Marj with populations between 60,000 and 110,000 in 2011. The region's economy, as in other regions in Libya, mainly bases on hydrocarbon industry

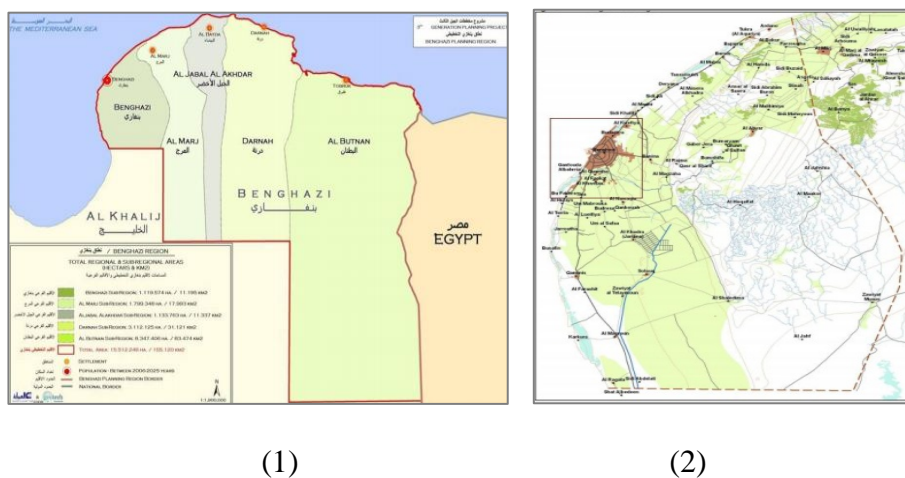


Figure 4.3.:(1)Administrative Divisions of the Benghazi Region .(2)Benghazi Sub-region. [55]



Benghazi Sub-region has a key position in region, in terms of economic activities and urban developments.

Benghazi Sub-region is a relatively flat land, rising sharply towards the northeast towards to Al Jabal Akhdar Mountains.

The land of sub-region has diverse climatic conditions. The northern skirts of the sub-region, with the effect of the Mediterranean Sea and the topographical features, possess very pleasant conditions for human settlement. However, the southeastern part of the sub-region is characterized by semi-arid lands with scarcity of vegetation and other natural resources as well, and provides limited opportunities for settlement. Consequently, population is mostly concentrated at northern part of the sub-region.

#### 4.3. The general Profile of Benghazi

The Benghazi Metropolis area covers an extensive half circle extending from Sidi Khalifa in the northeast to Ganfouda in the southwest, with a particular growth in east direction encompassing the areas of Bu Atni along the Banina (Airport) road.

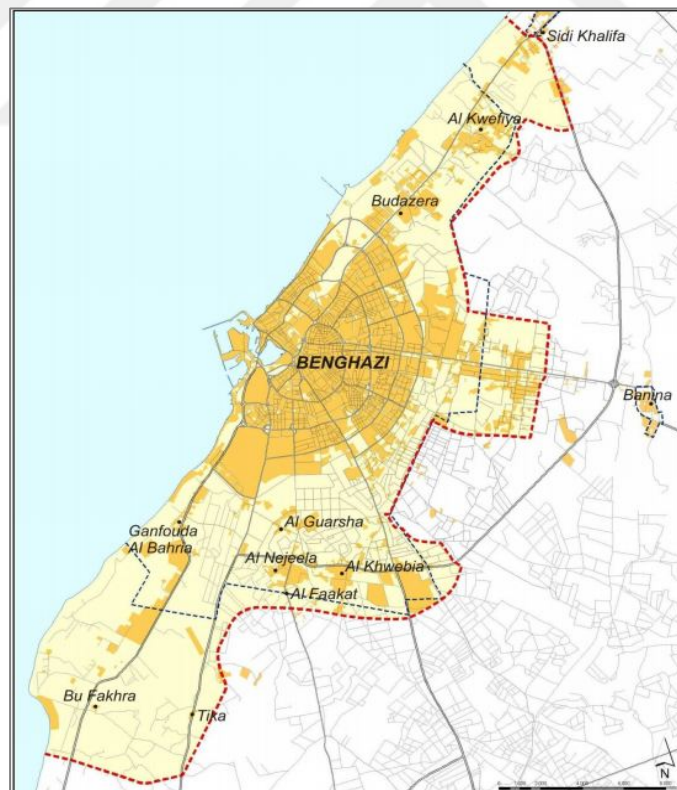


Figure 4.4: The Benghazi Metropolis. [55]

Benghazi is the second biggest city in Libya after the capital city Tripoli. It is located 1,043 kilometers east of the Tripoli and one of the main seaports on the African coast of the Mediterranean Sea. The coast of the city extends along 20 kilometers within the metropolitan area.

Benghazi is dominant city in all economic sectors in the region. The level of economic services (mainly commerce and business), the provision of higher order administrative, public and social facilities (e.g. education, health, culture, etc.), and the existence of international airport and seaport make today Benghazi 1st rank center in the region. A role for Benghazi is also important on the international stage: oil production and the trade links have widened the range of business and economic relationships, more prominently with the eastern Mediterranean and the eastern European countries.

76% of Sub-region's population is agglomerated in Benghazi City. It gathers population from all over the region due to its employment opportunities and metropolitan functions.[55]

#### **4.4. Environmental Characteristics**

- **Climate**

Benghazi's climate is akin to the typical Mediterranean due to its location on the Mediterranean coast, far from high mountain ranges and at considerable distance from the Sahara Desert. Temperature and humidity, as two primary climatic features, create a generally favorable climate in Benghazi during most months of the year. The annual average of temperature is around °20C, whilst the average humidity is 65%. The southerly “Qbli” carry large quantities of sand from the desert and cause rapid rises in temperature in summer.

- **Air Temperature**

In Benghazi, the average daily temperature is °20.1C. The maximum temperature in coastal area is slightly over °26C, whilst the minimum temperature in winter is around °10C as in (Table4.2).

Table 4.2: Average Temperatures[57]

Temp	J	F	M	A	M	J	J	A	S	O	N	D	Annual Aver.
Aver. Max.	16.5	17.6	20.2	24.5	28.4	31.6	31.5	31.9	30.8	27.8	22.8	18.5	25.2
Aver. Min.	8.7	8.7	9.9	13.0	16.5	19.7	20.8	21.4	20.0	17.3	13.6	10.2	15.0
Aver. Temp	12.6	13.2	15.1	18.9	22.6	25.7	26.1	26.7	25.5	22.6	18.3	14.3	20.1

- **Relative Humidity**

The climate of Benghazi in general is humid due to dominant influence of Mediterranean on macro climate in coastal settlements as in (Table4.3).

Table 4.3: Average Humidity [57]

J	F	M	A	M	J	J	A	S	O	N	D	Annual Aver.
74	72	68	57	53	60	65	60	58	62	68	71	63.9

- **Rainfall**

Precipitation in the BPR generally occurs in form of rain and occasionally in snow in upland of Al Jabal Al Akhdar area. Almost all coastal strips receive rain over 150 mm. as annual average. The rainfall rate is in general very low in Benghazi City. According to data of Banina Station, annual total rainfall is 257 mm and total number of rainy days is around 56. The highest rate of rainfall is observed in January (72 mm). 96% of total rainfall is realized in 6 months between October and March as in (Table4.4).

Table 4.4:Monthly Average Rainfall and No. of Rainy Days[57]

	J	F	M	A	M	J	J	A	S	O	N	D	Annual Total
Monthly aver. rainfall (mm)	72	38	32	3	4	2	0	0	1	14	32	59	257
No. of rainy days	12.4	8.8	6.5	2.6	1.7	0.2	0.0	0.1	1.2	4.3	6.9	11.6	56.3

- **Wind**

Benghazi Plain and coastal area are open to north, northeast and northwest winds. According to official records of Banina Station, annual average of wind speed reaches 12.5 knots in Benghazi City and its environment as in (Table4.5).

Table 4.5:Monthly Average Wind Speed (in knots).[57]

J	F	M	A	M	J	J	A	S	O	N	D	Annual Aver.
11.4	12.9	12.7	14.7	14.0	12.7	13.0	12.1	12.0	10.8	11.3	12.7	12.5

However, the sand loaded desert wind blowing from the south and the hot and dry local wind, namely the “Qbli”, are the most characteristic feature of climate. The “Qbli” is effective especially during spring, early summer, and during autumn and causes a sudden rise in temperature and a striking decrease of the relative humidity. Total number of days with sandstorm is around 180 in a year. The sandstorm is effective especially in autumn and spring seasons as in (Table4.6) & (Figure4.5).

Table 4.6: No. Of Days with Sandstorm[57]

Seasons	No. of Sandstorm	%
Winter	32	17.7
Spring	50	27.7
Summer	14	7.7
Autumn	84	46.6



(1)

(2)

(3)

Figure 4.5:(1),(2),(3) Sandstorm days in city of Benghazi . (11.12.2010)

- **Atmospheric Pressure**

The monthly average of atmospheric pressure in the Benghazi varies between 1013–1019 hectopascal. Atmospheric pressure increases in winter due to decrease in air temperature and high pressure leads to relatively more rainfall through the winter season. As „Qbli“ hot winds causes an increase in the temperature, atmospheric pressure is low in spring and summer months.

Table 4.7: Average of Atmospheric Pressure in Banina (in hectopascal).[57]

J	F	M	A	M	J	J	A	S	O	N	D	Annual Aver.
1019	1018	1016	1014	1014	1015	1014	1014	1016	1017	1018	1019	1016

- **Topography**

Topography of Benghazi City is generally uniform as it is located on the coastal plain. The symmetrical contours with low slope characterize the main topographical feature of the land in the Benghazi City. This characteristic of the topography slightly changes towards to Banina, where the height increases to 90 - 110 meter above sea level. This structure clearly appears in north of Banina plateau, which gradually elevates until reaching the contour line of 150 meter at the bottom edge of Al Jabal Al Akhdar.

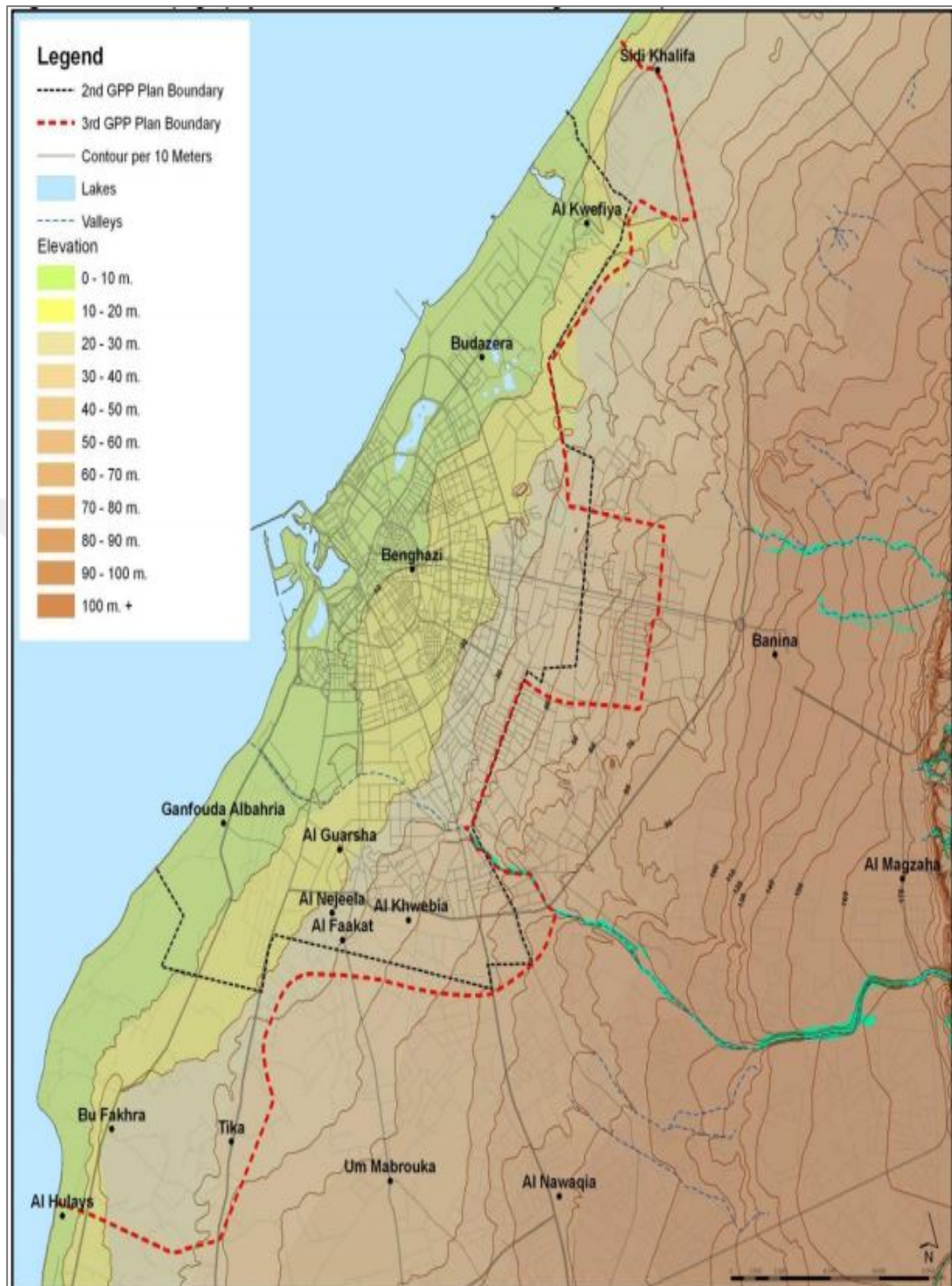


Figure 4.6: Shows Topography And Elevation Zones In The Benghazi Metropolis.[58]

- **Soils**

Soils of Benghazi Plain are characterized by clay soils of heavy mesh, most of which generally derived from lime rocks as they represent the main rock in the region. At the feet of mountain edge red and alluvial soils are spread. However, the valley soils are existing along their streams, while rock soils are available in north of the plain and east of Benghazi City. The soil salinity is one of the most important problems in Benghazi plain, especially in irrigated lands concentrated in the northern part. Among the other problems facing soil in Benghazi Plain is water and wind erosion. Along Benghazi Plain valleys different patterns of erosion, (e.g. surface erosion, tartar erosion, and soil drift).



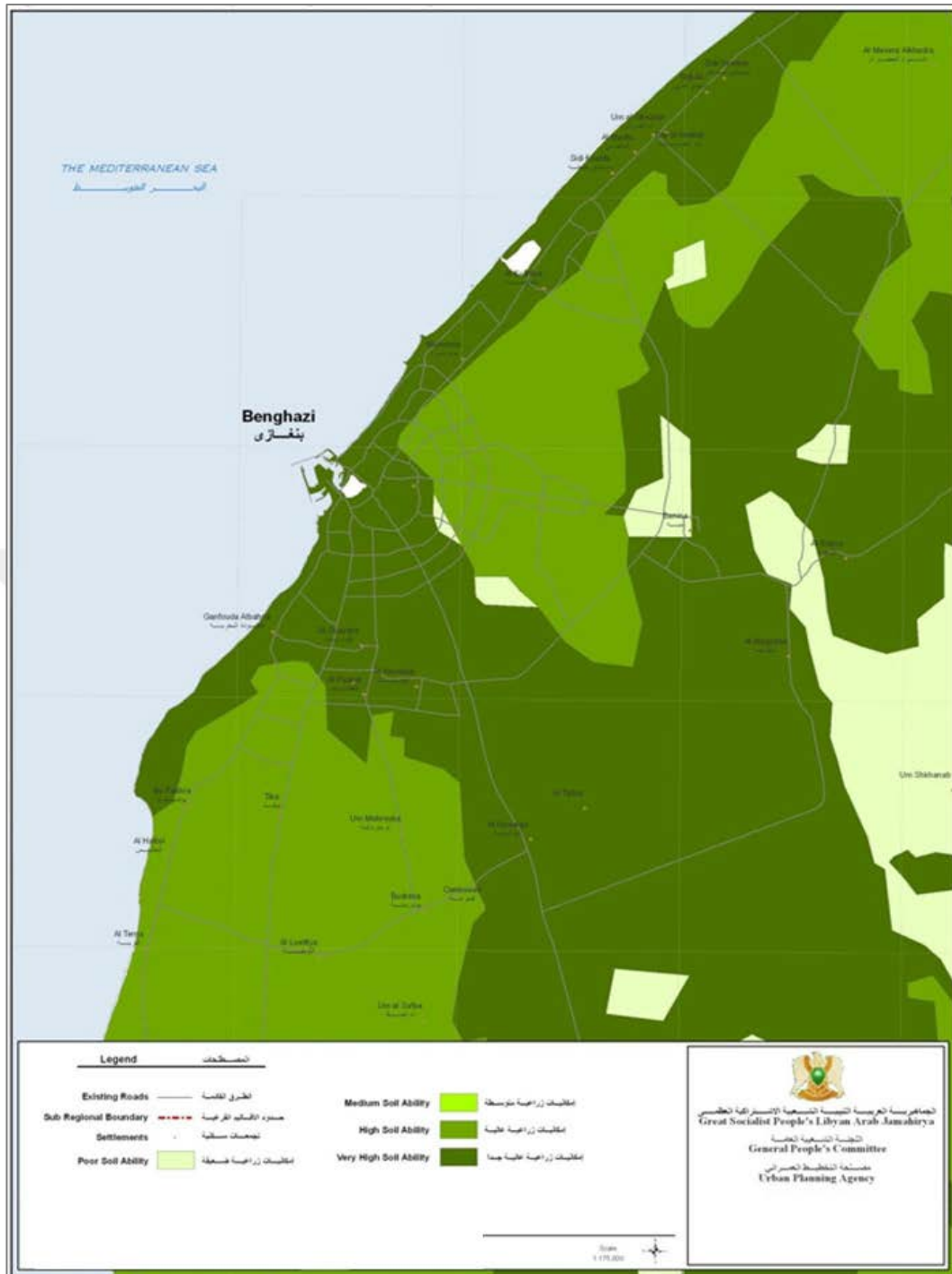


Figure 4.7: Soil Ability in Benghazi Sub-region. [58]

- **Vegetation**

The vegetation in Benghazi plain is poor in general. All types of desert scrubs and Mediterranean plants constitute the typical vegetation Benghazi Plain.



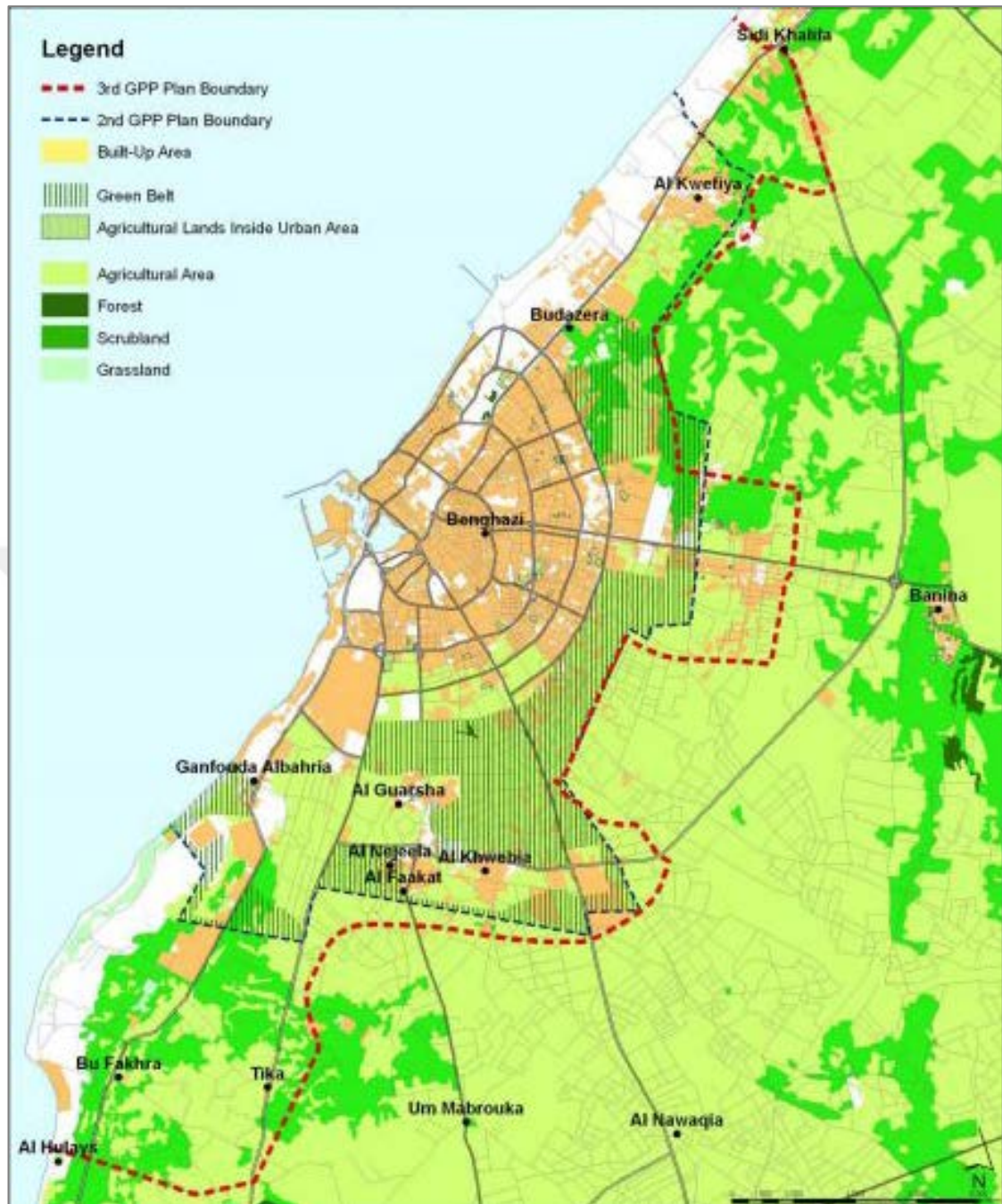


Figure 4.8:Vegetation Cover and Agricultural Lands in the Benghazi Metropolis.[58]

- **Natural Protection Areas**

The sabkhas, lakes and some crest caves in coastal zone of the Benghazi Metropolis constitute the significant natural formations that should be considered as natural protection areas. Benghazi plain, are defined as the natural areas that are permanently or temporally flooded by water, stagnant or flowing, fresh or with low or high salinity. The soft lands with their natural and ecological features are

considered as an organizer of maritime-life, wildlife, and biodiversity in the region. Additionally, they have an economic value as they create a significant potential for scientific investigations, eco-tourism, and recreational activities. (Figure 4.9). Natural Protection Areas in the Benghazi Metropolis [ 58].

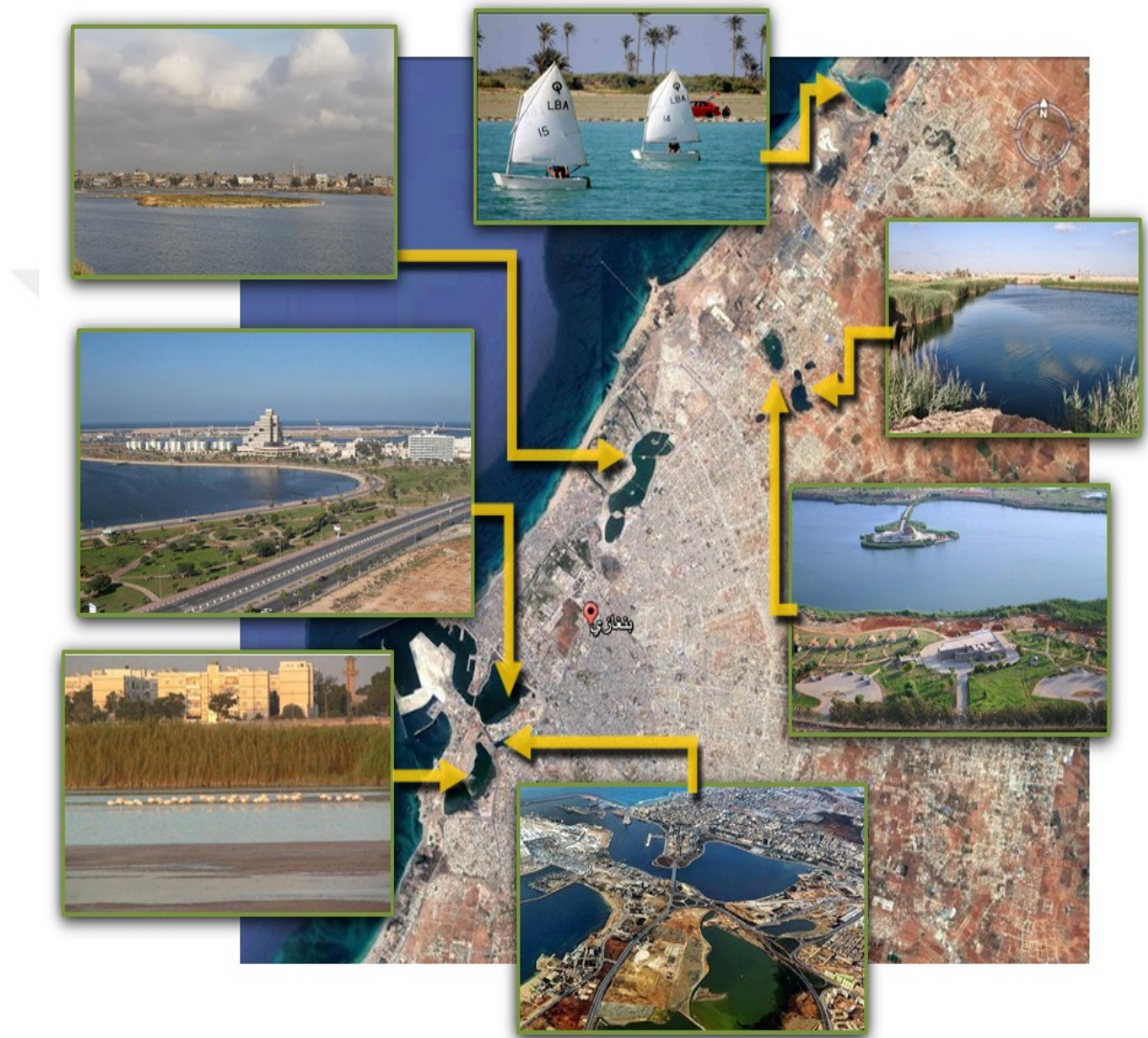


Figure 4.9: Natural Protection Areas in Benghazi.



Figure 4.10 :Natural Protection Areas.[58]

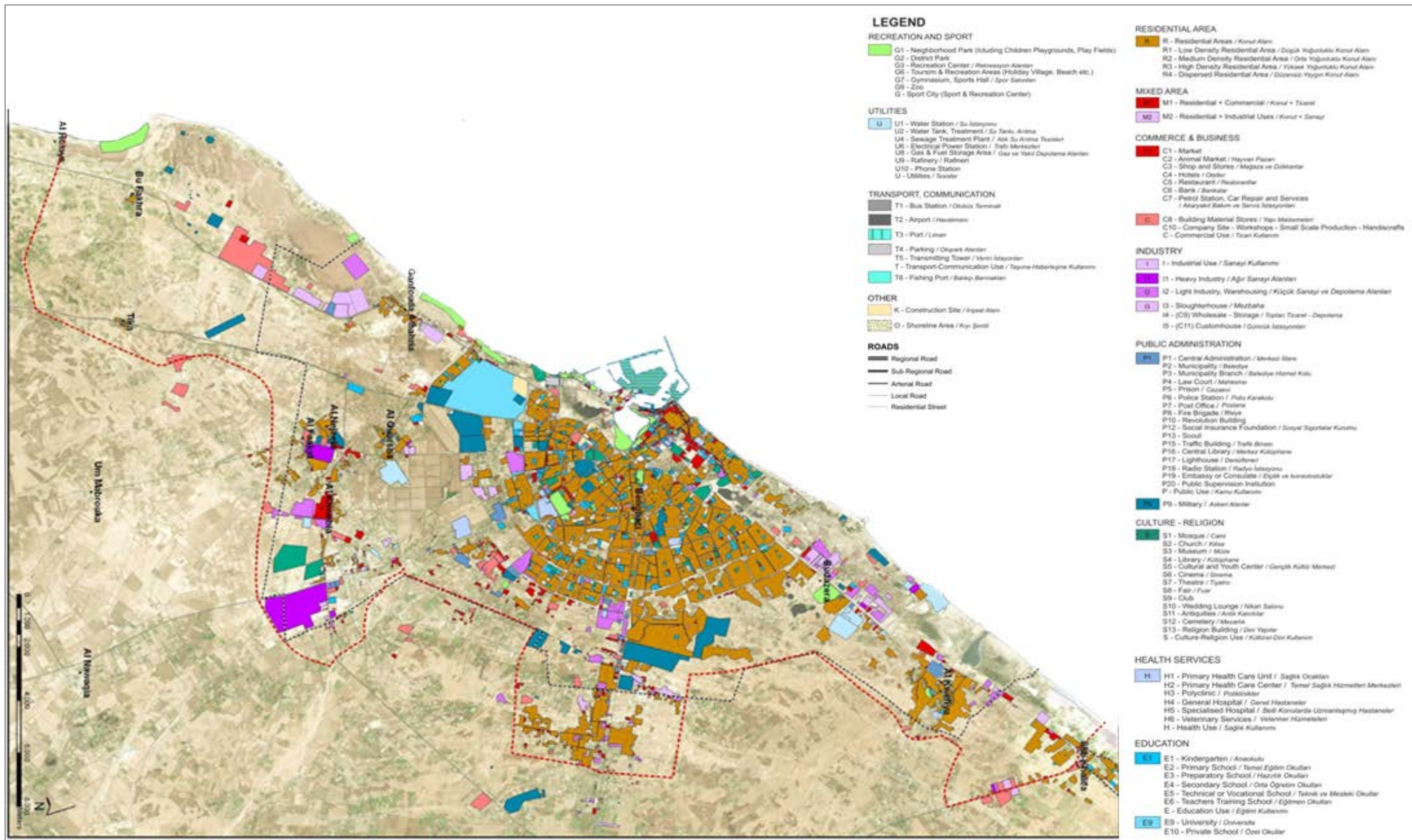


Figure 4.11 :Benghazi Metropolis Existing Landuse. [55]

## 5. IMPLEMENTAION OF THE PROPOSED ECOLOGICAL PLANINNG MODEL ON BENGHAZI.

### 5.1. Definition Analysis of The Study Area.

As the study area, we chose the coastal area of Benghazi because it shows environmental cohesion known as sand dunes, lakes, wetlands and wetlands and provides appropriate environmental factors in the planning of green spaces. In addition to the availability of information and data for this region, we divided the study area into five sub-regions prepared for each area ID card showing both.

The current situation (land use, population, built-up area, available environmental characteristics, basic problems) and comparison with the second generation plan of 1980. Supported information using materials available from(site notes, official reports, documents, Google Earth, imagery, an image of the site, land use maps, and satellite imagery).

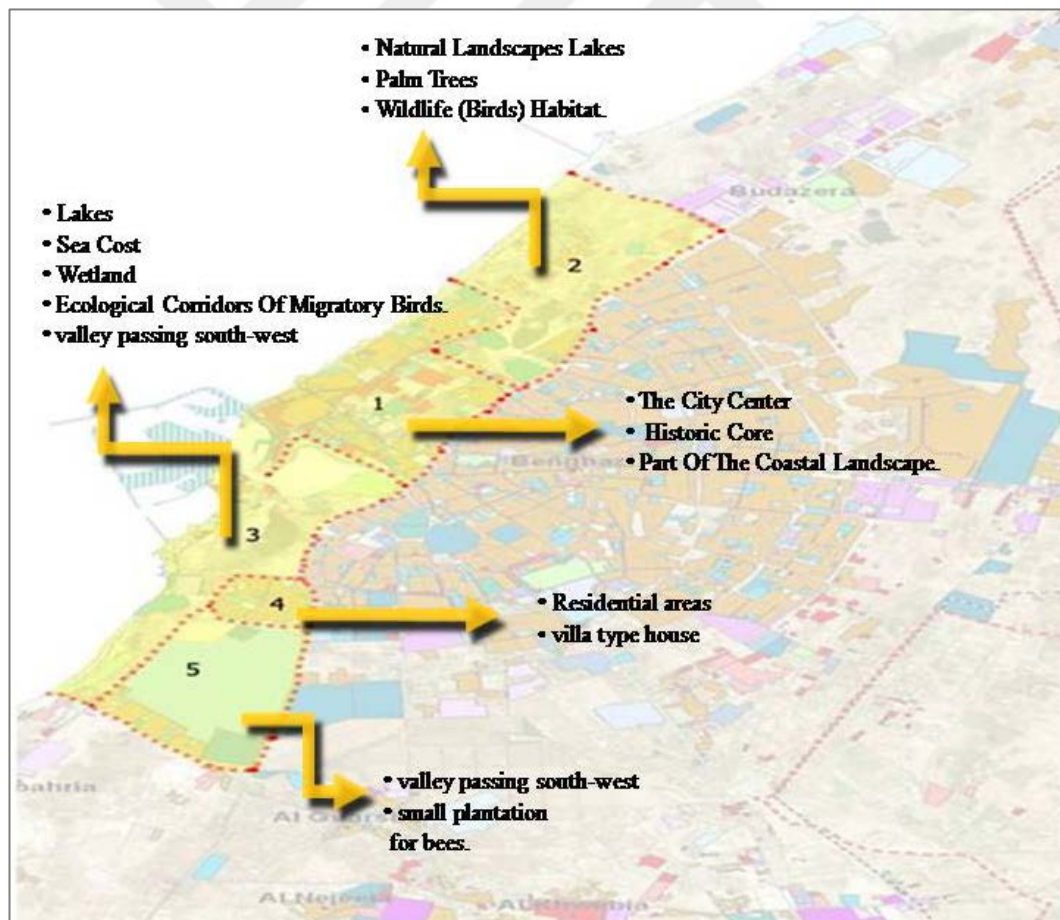


Figure 4.12: General characteristics of the zones of the study.

5.2. Analysis of The Study Area

• Identity card for the Planning Zone 1:

Urbanized Built Up Area : 612 hectares

Population of 2nd GPP : 93.940

Existing Population : 86.500

Empty Areas : 144 hectares

Main Functions and Existing Land use :

Central Business District commerce & business, public & maritime services, traditional functions & residential use.

Existing Land Use /Ecological Zones: Coast Landscape,

institutional green space.

We can note in the three maps we can observe a difference in the use of green areas Between the existing land use and the second-generation

plans, and some green spaces in the second generation have not yet been implemented.

**Main Problems:** Coastal sand dune sprawl, the coastal installations in Benghazi Sub-region is affected by waves and the rise of sea level that causes the damage of most of the outer surfaces of the build, Lack of adequate recreation areas.

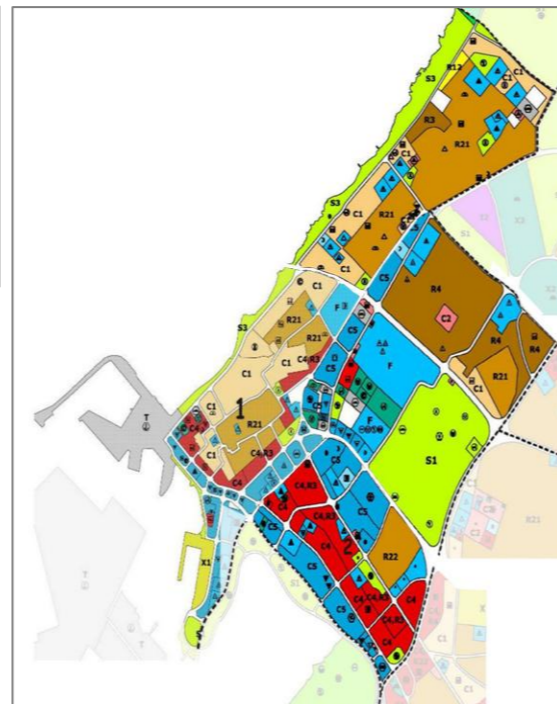
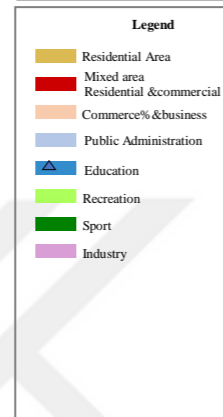


Figure 4.13: 2nd GPP detailed plan zone 1



Figure 4.14: Existing Landuse zone 1



Figure 4.15: Ecological land use Zone 1



A  
Coast Landscape, People Practic  
Some Sea Sports.



B  
Coast landscape, with  
road



E  
public administration social  
& historic cultural facilities



F  
Seaport



H  
waterfront with  
administrative,  
commercial and religious



G  
Empty area

Figure 4.16: A,B,C,E,F,G,H. Existing Photo Zone

• Identity card for the Planning Zone 2:

**Urbanized Built Up Area:** 155 hectares

**Population of 2nd GPP :** 16.3

**Existing Population :** 7.556

**Empty Areas :** 180.8 + lakes hectares

**Main Functions and Existing Land use:**

Cemetery, Renewable energy production,

Residential Archaeological Area

**Existing Land Use /Ecological Zones:** lakes, sea cost,

Underground Caves, Palm trees, wildlife (Birds) habitat.

We can note in the three maps we can observe a difference

in the use of green areas Between the existing land use and

the second-generation plans.

**Main Problems:** Coastal sand dune sprawl, Disordered structure of land use& built environment, lack of integration of different uses, inefficient use of land.

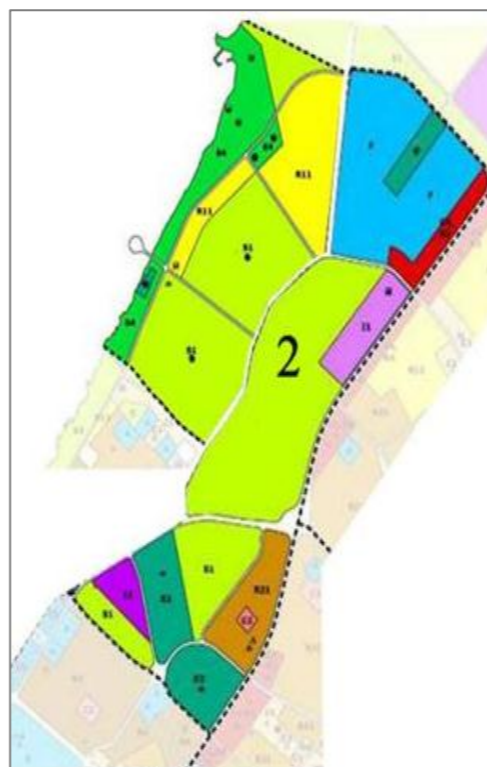
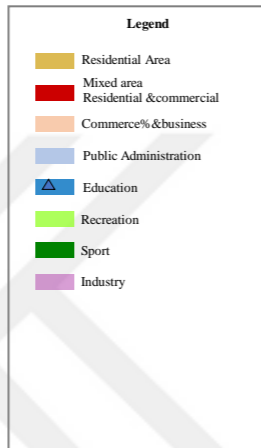


Figure 4.17: 2nd GPP Detailed Plan Zone2



Figure 4.18: Existing Land use Zone 2

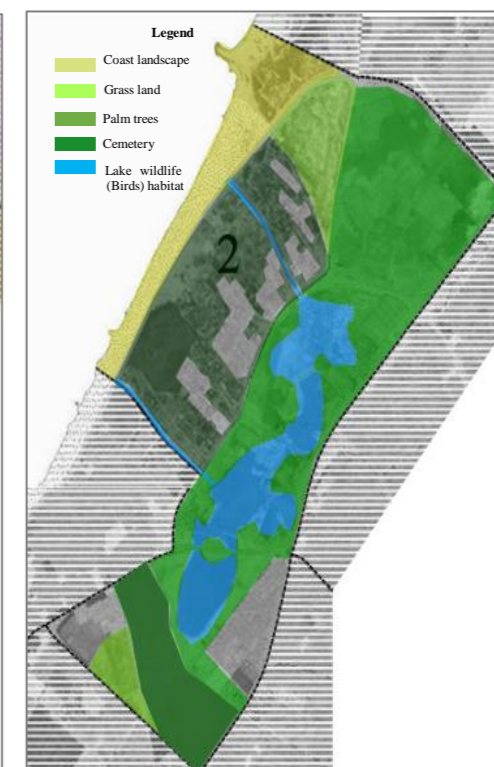


Figure 4.19: Ecological land use Zone 2



A  
Coast Landscape, People Practice Some Sea Sports.



B  
Coast landscape, with road



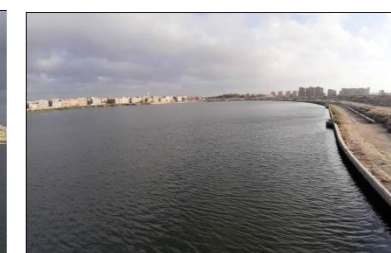
C  
Palm growes



D  
Agriculture Field. Marshlands



E  
Coastal Sand Dunes, Marsh Lands



F  
Natural Wildlife, Cemetery

Figure 4.20: A,B,C,D,E,F, Existing Photo Zone 2.

• **Identity card for the Planning Zone 3:**

- Urbanized Built Up Area:** 350.9 hectares
- Population of 2nd GPP :** -
- Existing Population :** 685
- Empty Areas :** 130.2 lakes hectares

**Main Functions and Existing Land use**

Planning zone, which is located in the south of the city center, is a mixed-use area including functions such as recreation, sports, tourism, accommodation, commerce and residential. Most parts of the zone are covered by the sabkha and lakes designed as sports and recreation area. There exist tourism and recreation areas along the coastal zone.

**Existing Land Use /Ecological Zones:** lakes, sea cost, wetland, Ecological corridors of migratory birds.

We can note in the three maps we can observe a difference in the use of green areas Between the existing land use and the second-generation plans.

**Main Problems:** Disorganized structure of uses and poor quality of the built environment of the harbor, contamination of lakes, isolation of the harbor from the whole.



Figure 4.21: 2nd GPP Detailed Plan Zone 3

Figure 4.22 : Existing Land Use Zone3

Figure 4.23: Ecological Land Use Zone 3



A  
Lake Landscape, Active recreational space (sport. Walk, run for children.

B  
lakes

E  
Lake, wildlife (Birds) habitat

H  
Palm grows

G  
Landmark, Tourist Facilities

Figure 4.24 : A,B,C,D,F,G, Existing Photo Zone 3



• Identity card for the Planning Zone 4:

**Urbanized Built Up Area** : 96.2 hectares  
**Population of 2nd GPP** : 4.000  
**Existing Population** : 7,785  
**Empty Areas** : 8.5 lakes hectares

**Main Functions and Existing Land use**

Residential areas, villa type houses.

**Existing Land Use /Ecological Zones:**

House Garden, tree alley and street tree, hedge.

There is a difference in green areas. The difference is also in the layout of internal roads. There are many empty spaces.

**Main Problems:** Inefficient use of open spaces, lack of social and cultural facilities

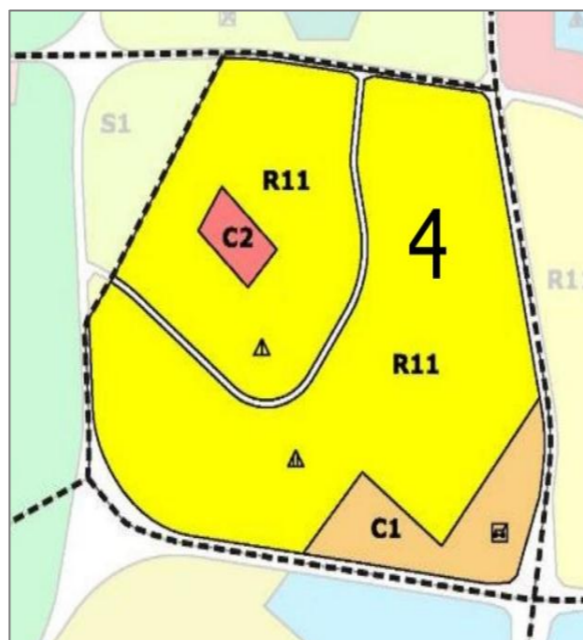


Figure 4.25 : 2nd GPP Detailed Plan Zone 4

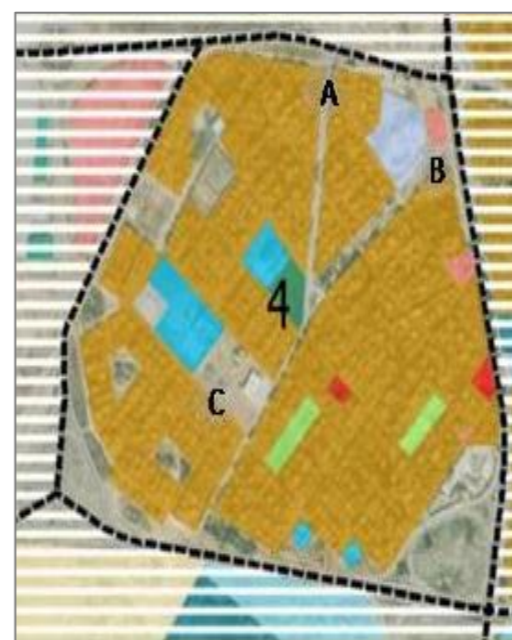


Figure 4.26 : Existing Land use Zone 4



Figure 4.27: Ecological land use Zone 4



A

B

C

Figure 4.28: A,B,C Existing Photo Zone 4

• Identity card for the Planning Zone 5:

**Urbanized Built Up Area** : 552.0 hectares

**Population of 2nd GPP** : 6,000

**Existing Population** : 9,942

**Empty Areas** : -

**Main Functions and Existing Land use:**

University & residential area

**Existing Land Use /Ecological Zones:**

There is a valley passing south-west, A small plantation for bees, institutional green space, public residential garden.

According to the three maps there is a difference in the distribution of green areas. The presence of residential use very close to the valley may cause some flooding during the winter. There are many empty spaces

**Main Problems:** Occupation of the university campus by some other functions, The presence of residential use very close to the valley.

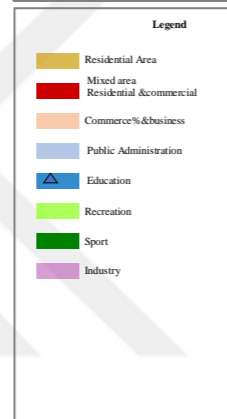


Figure 4.29: 2nd GPP Detailed Plan Zone 5

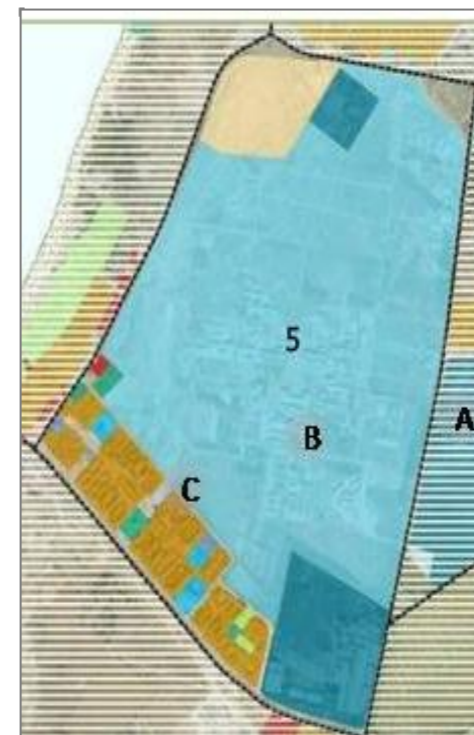


Figure 4.30 :Existing Land Use Zone5

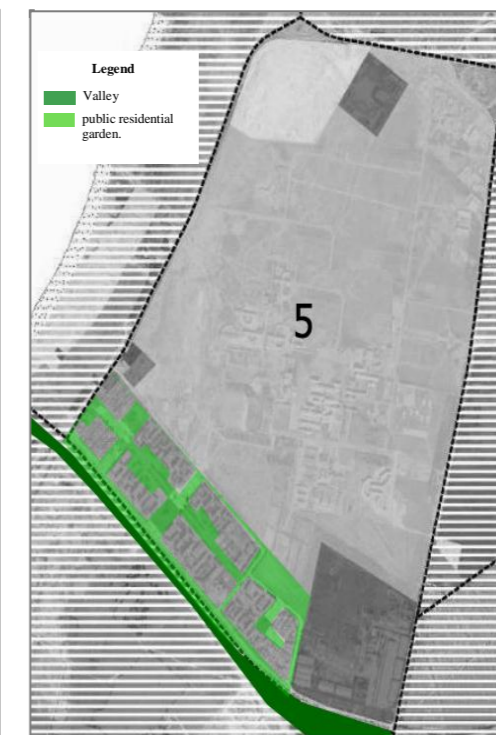


Figure 4.31: Ecological land use Zone 5



Figure 4.32: A,B,C Existing Photo Zone 5.

5.3. The Evaluation of The Green System Compatibility with Decision Matrix

Table 5.1: The diagnosis of each zone shows the potentials, problems, and threats of the selected Zone

		Ecological Potentials											Cultural/recreational functions											Built. Up land uses									
		Hydrological. cycle.	Soil formation.	Support of biodiversity	Support wild life habitat	Climate regulation	Renewable energy production.	Waste storage	water treatment	Air cleaning	Fresh water resource	generic resources	Total	Aesthetic/ view/ landscape	spiritual	Active recreational space (sport. Walk, run for children	Passive recreational spaces	Historical areas	social event venue public space	sense of place	Education / Training	Heritage preservation	Economic Activity	Noise Reduction	Security / Safety	Total	Residential Area	Industrial	Commercial	Public facilities	Tourist Facilities	Roads / Motorway	Total
Zone 1	Institutional Green Space		●	●	●	●		●	●		●	21	●	●	●	●	●	●			●	●	●	●	●	41	●	●	●	●	●	●	19
	Coastal Landscapes	●	●	●	●	●	●	●	●	●		●	19	●	●	●	●	●	●	●	●	●	●	●	●	41	●	●	●	●	●	●	18
Zone 2	Coastal Landscapes	●	●	●	●	●	●		●	●	●	38	●	●	●	●		●	●	●	●	●	●	●	35	●	●	●	●	●	●	18	
	lakes	●	●	●	●	●	●	●	●		●	32	●	●	●	●	●	●	●	●	●	●	●	●	43	●	●	●	●	●	●	14	
	Ander ground caves		●	●	●							7	●	●	●	●					●	●		●	17			●	●	●	6		
	natural	●	●	●	●	●	●	●		●		●	31	●	●	●	●		●	●	●	●	●	●	28	●	●	●	●	●	●	16	
Zone 3	Coastal Landscapes	●	●	●	●	●	●	●	●		●	34	●	●	●	●		●	●	●	●	●	●	●	34	●	●	●	●	●	●	17	
	lakes	●	●	●	●	●			●	●	●	28	●	●	●	●		●	●	●	●	●	●	●	25	●	●	●	●	●	●	16	
	Environmental corridors	●	●	●	●	●		●	●	●		●	32	●	●	●	●				●	●	●	●	27		●	●	●	●	●	13	

Strong ● Full compatibility. 4 grades  
 Middle ● Medium compatibility. 3 grades  
 Fair ● Low compatibility. 2 grades  
 No ● in compatibility. 1 grades

Table 5.1: The diagnosis of each zone show the potentials, problems, and threats of the selected Zone.

		Ecological functions										Cultural/recreational functions										Built. Up land uses											
		Hydrological. cycle.	Soil formation.	Support of biodiversity	Support wild life habitat	Climate regulation	Renewable energy production.	Waste storage	water treatment	Air cleaning	Fresh water resource	generic resources	Total	Aesthetic/ view/ landscape	spiritual	Active recreational space (sport. Walk, run for children	Passive recreational spaces	Historical areas	social event venue public space	sense of place	Education / Training	Heritage preservation	Economic Activity	Noise Reduction	Security / Safety	Total	Residential Area	Industrial	Commercial	Public facilities	Tourist Facilities	Roads / Motorway	Total
Zone 4	Residential Area		●	●		●			●			10	●	●	●						●			●	●	13	●	●	●	●	●	●	15
	Public garden		●	●		●	●		●		●	15	●		●	●								●	●	15	●	●	●	●		●	16
Zone 5	institutional green space	●	●	●	●	●	●		●	●	●	38	●	●	●		●	●	●	●	●	●	●	●	●	40	●		●	●	●	●	15
	Public Residential garden		●	●	●	●	●	●	●		●	24		●	●	●			●				●	●	●	20	●		●	●		●	14
	valley	●	●	●	●	●	●		●	●	●	26	●	●	●	●	●	●			●	●	●	●		23	●	●	●	●	●	●	13

Strong ● Full compatibility 4 grades  
 Middle ● Medium compatibility 3 grades  
 Fair ● Low compatibility 2 grades  
 No ● in compatibility 1 grades

## **6. RESULTS AND CONCLUSION**

During the assessment of the matrix, we developed recommendations and a planning proposal for the study area that could support the development of environmental and urban green spaces according to the environmental approach.

### **6.1. Findings. And Results. of the Study.**

#### **Zone 1:**

Through the evaluation matrix, we note that zone 1 has high potential and compatible in terms of cultural and recreational function where the degree of compatibility (40). On the other hand, we note that the region has also obtained a high degree (21), which qualifies ecologically for its occurrence on the coast that supports biological diversity.

Therefore, we recommend the development of cultural, commercial, tourist, recreational and recreational facilities taking into account the important ecological side along the coastal road, the pedestrian revitalization project, and the region plan through the promotion of GPP 2nd.

#### **Zone 2:**

The second region (38) received the highest acceptance in terms of environmental potential compared to other uses. The presence of migratory birds for migratory birds can provide an opportunity for the functions of the Convention on Biological Diversity, stability and the region's association with the sea is very large,

Can create an opportunity for the functions of the Convention on Biological Diversity, and possibilities for the development of waterfront, tourism and tourism. Paly can also be linked to zone 1 and create a strong ecological pathway.

#### **Zone 3:**

In zone 3, we see very high environmental potential, with the lake, sea line and the possibility of the ecological corridor having varying degrees of (34, 28) and (32), which also supports environmental planning, biodiversity and natural protection of migratory winter birds.

In addition to the high level of leisure and tourism on the coastline, we see through the matrix that the area has a score of (34), especially the sea side of the area.

Elements The common ecology and natural potential of zone 2 and 3 contribute greatly to the creation of green corridors between these zones. The potential of Area 1 will contribute significantly to the environmental communication process.

#### **Zone 4:**

According to the evaluation matrix we note in zone 4 that residential use, the more favorable built land has obtained the highest degree of admittance (15) and can be supported by the coordination of natural roads and the promotion of residential gardens.

#### **Zone 5:**

In zone 5, it is noted that the potential of the upper region is the cultural and entertainment use compared to other possibilities. The region has not reached 40 degrees, which qualify it for use, as well as the presence of many green spaces that support the educational and cultural side as well as the appropriate environment.

The protection of the campus and the preservation of the Wadi Qattara region is a rich source of vegetation cover and its exploitation in leisure and tourism activities.

In the proposed alternative (Figure 5.1), to create a green ecological network we tried to connect the regions to each other by following

- Planting roads and enhancing green areas, whether in the coastal landscape or in a center located in Area 1, which can connect lakes between the region (2, 3) to contribute to the creation of the ecological network and to facilitate easy access to green spaces.
- Achieve what has been proposed by the second-generation plan for green spaces.

To sum up, a continuous system of green areas has been designed, where natural resources are well used, and green and open areas can be reached from the city's surroundings to the city and the center as well. The continuity of the green zone system is achieved through the city center by integrating the green system with the lake phenomenon.

## 6.2. CONCLUSION

Green spaces and green spaces, particularly in the coastal areas of Benghazi, face the pressures of urbanization. The aim of this study, which proposes the development of urban green areas planning through the conservation of natural areas, sand dunes, wetlands and lakes in the coastal areas ,The study found several recommendations that emphasize the multiple roles of environmental planning in improving urban green spaces, and to consider a certain level of qualitative improvements and their distribution within urban areas and their effective integration into urban planning.



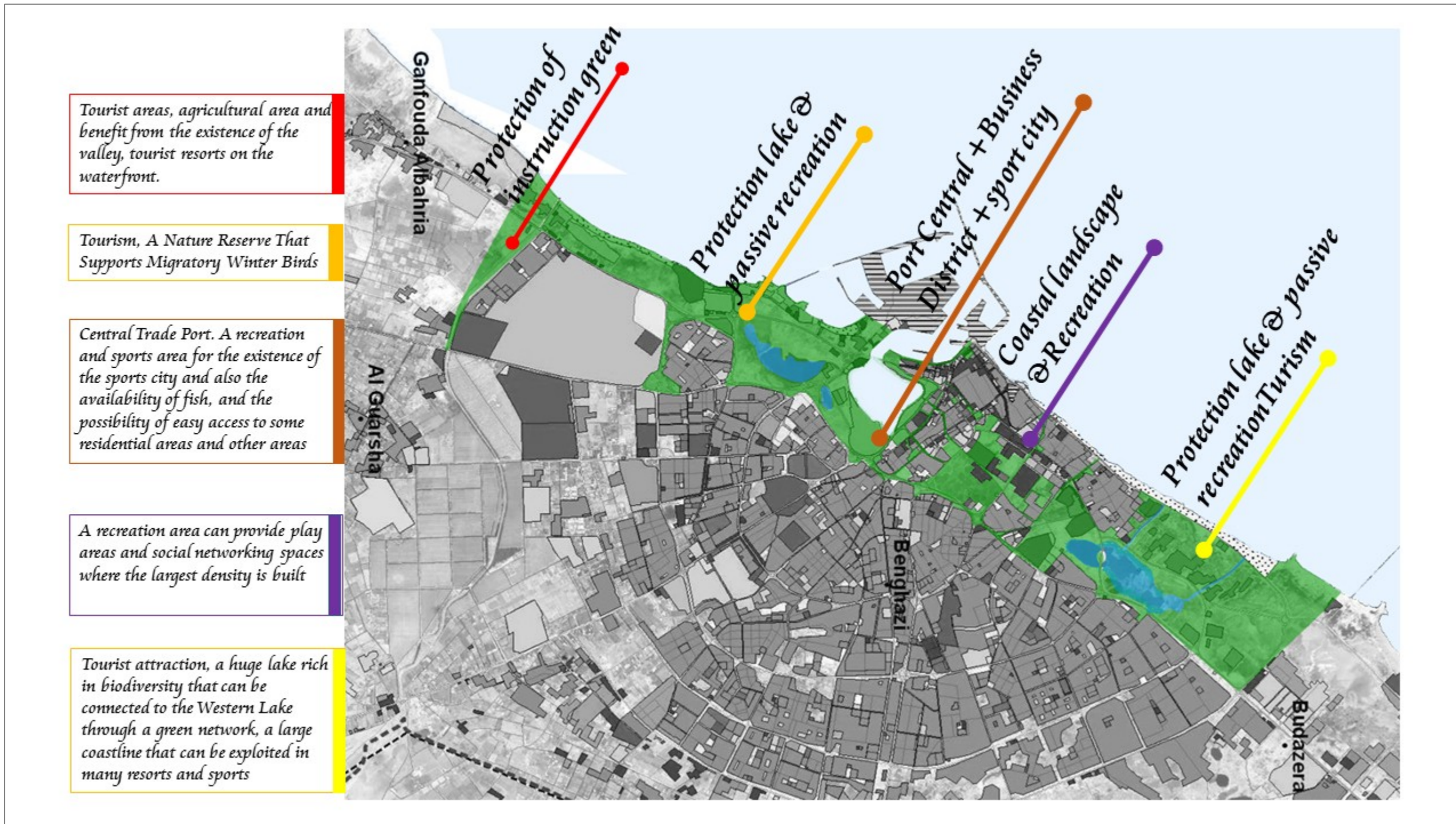


Figure 5.1: The Green System Network Way Strategy For The Coastal Area In Benghazi.



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