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**The Role of Green Space to Achieve Environmental Sustainability**

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**Received:** 01-02-2023

**Accepted:** 25-02-2023

**Published:** 13-10-2023

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**ABSTRACT**

The importance of green spaces has increased in cities as a result of urban sprawl after the industrial revolution, therefore garden cities and satellite cities were established depending on green spaces showed the vital role of vegetation cover in facing global warming, by reducing greenhouse gases, such as second and first Carbon dioxide, nitrogen oxides, and increasing the vegetation areas to avoid the environmental threats that threatens everyone during the 21<sup>st</sup> century.

Therefore, all countries, through the conferences at the Rio de Janeiro Summit 1987 to the Paris Summit 2015, are looking for sustainable development that depends on the environmental aspects, economic aspects and social aspects.

From this point the research studies the green spaces in Cairo and the application of standards and guidelines set by Law 119 of 2008 and its executive regulations to approve the goals and general policies for planning, urban development, and urban coordination in order to reach a sustainable green environmental city.

**Keywords:** green spaces - environmental aspects- sustainable development - greenhouse gases.

## المخلص

إزدادت أهمية المسطحات الخضراء فى المدن عقب الامتدادات والزحف العمراني بعد الثورة الصناعية، فتم إنشاء المدن الحدائقية، المدن التوابع، التي تعتمد على المسطحات الخضراء التي اظهرت الدور الحيوي للغطاء النباتي فى مواجهة الاحتباس الحراري للارض، التي تقتضي التقليل من الغازات الدفيئة ومنها غاز ثاني، أول اكسيد الكربون، أكاسيد النتروجين، زيادة مساحة الغطاء النباتي لتفادي الخطر البيئي الذي يهدد الجميع خلال القرن الـ 21، لذا تسعى دول العالم الي تنمية مستدامة محورها البعد البيئي بالاضافة إلي البعدين الاقتصادي والاجتماعي من خلال إجتماعاتها فى قمة ريو دي جانيرو 1987 إلي قمة باريس 2015. ومن هذا المنطلق تأتي دراستنا للمساحات الخضراء بمدينة القاهرة وتطبيق المعايير والدلائل الارشادية التي وضعها قانون 119 لسنة 2008 ولائحة التنفيذية لاقرار الاهداف والسياسات العامة للتخطيط والتنمية العمرانية والتنسيق الحضاري لامكانية الوصول الى مدينة بيئية خضراء مستدامة .

*الكلمات الدالة* : المساحات الخضراء - البعد البيئي - التنمية المستدامة - الغازات الدفيئة.

## 1 INTRODUCTION

Environmental problems are considered one of the biggest challenges facing humanity. Ozone layer erosion and climate change have prompted many countries to take attention on the environment. Plans and programs for sustainable development have been put in place aimed at reducing and eliminate the causes of all kinds of pollution and ensuring the rights of the future generations to a clean environment free from pollution. Among the concerns for Sustainable development is the open areas and green spaces in the built environment to maintain the ecological balance, as open areas constitute one of the main components of cities, for walking, spending leisure time and practicing social activities for the population and a sign of reaching a better standard of living for the population.

Green areas work to protect natural resources and improve environmental conditions, therefore it is necessary when planning cities to take into consideration providing green spaces and open areas, linked together through an integrated system of open areas network in terms of planning, designing and coordinating them to meet the multiple needs of populations. The concept of open areas network planning depends on Exploiting several axes and areas which are already existing such as axes, waterways, main roads, coasts, torrential gorges and valleys in natural areas that can develop urban communities by developing them by providing entertainment, cultural and traffic services and preserving natural resources.

However, green spaces suffer from the dangers of acid rain that causes the destruction of forests, as a result of polluted gases and fuel burned from cars, factories and all urban activities. Forests in countries around the world also face the dangers of fires that devour thousands of acres, in addition to the

encroachment of the urban mass on green spaces and open areas, therefore the trend is towards studying green spaces, designing and planning standards in cities, and analyzing data from a case study to recognize the quality and pattern of use and users.

### **1.1 Research problem**

There is a wide interest in green areas because of the development of its designing methods, its aesthetical benefits, psychological comfort and improving air quality, as it has become one of the elements of sustainable development in maintaining the ecological balance within the city.

However, the effects of expansion in the urban field have a negative impact on the balanced relationship between green spaces and urban development. Moreover, green spaces have become of great importance in the urban aspect, which reduces the percentage of environmental pollution, improves the climate and provides a source of entertainment from a social point of view.

Lack of green spaces as a result of urban expansions at the expense of forests caused desertification, existence of various pollutants, as long with increasing in their concentrations, lack of aspects of beauty, increase of noise and rise in climate temperature, which resulted negative effects in various aspects of life.

Accordingly, the research discusses how to understand the causes and factors that led to these results to improve the relationship between the built environment and the green spaces, and how the standards of designing and planning of green spaces can affect the urban field and the extent of the impact of these standards.

### **1.2 Hypothesis**

The inadequacy of planning forms for green spaces with the requirements of the population was caused by not applying the international and local principles and specifications, as long with the urban planning law that is related to green spaces.

### **1.3 Research Objectives**

The main objective is to highlight designing and planning characteristics of green spaces, taking into consideration the characteristics of the site and the natural environment, to achieve aesthetical values in the urban space, improve the visual image of Egyptian urbanization, and work to remove all distortions and visual pollution.

The secondary objective is recognizing the cause of the imbalance between reality and the principles of planning and designing, balancing between quantity and quality in planning of green spaces in order

to reach the relationship that connects between principles, specifications and planning forms, in order to prepare an evolutionary reference that enables the urban planner and decision makers to evaluate the patterns of green areas development.

#### **1.4 Importance of the research**

Recognizing the planning and designing features by studying the characteristics of green areas and its reflections on the specifications of a region, and this is done by valuing what is existing before planning, accordingly, will result in creating a balanced environment, improving public taste, achieving aesthetical aspects, and improving human behavior in the use of green spaces.

#### **1.5 Research Methodology**

Analyzing the elements studied on the descriptive approach that describes the phenomenon and then analyzing it to reach an applied solution to the research problem through a case study, as long with depending on many methods to diagnose the status of green spaces, their types and their conditions in existing cities.

## **2 General concepts and terms**

### **2.1 Open areas:**

It is a group of not built and abandoned spaces to be used as an outlet for the surrounding uses, disturb the urban mass, provide spaces that allow ventilation and natural lighting, as long with achieving privacy for some uses that require that, such as agricultural lands, coasts, visually distinct areas, parks, Reserves, parks, squares, public squares, and open areas as in Figure No. (1).



Figure (1) shows open areas that achieve interaction between humans and the environment

## 2.2 Linking axes:

They are land or water strip areas with recreational, cultural or natural characteristics that link between open areas. They are characterized by dense greenery and contain paths (pedestrians, bicycles) that contribute in perception of the visual image of the city. It is also dry or covers polluted canals and drains inside cities and convert them into green areas, as shown in Figure No. (2)



Figure No. (2) shows The Nile River is a water axis through which open areas can be linked

## 2.3 Open Areas Network:

It includes agricultural lands, coasts, visually distinct areas, parks, reserves, gardens, squares, and public squares linked to each other through land or water axes with recreational, cultural, or natural components, as in Figure 3.

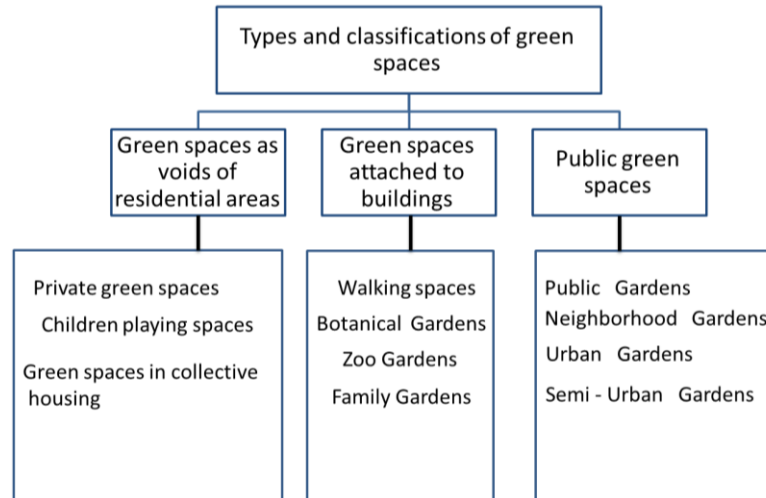


Figure No. (3) shows corridors in open areas consisting of open areas linked to each other by connecting axes

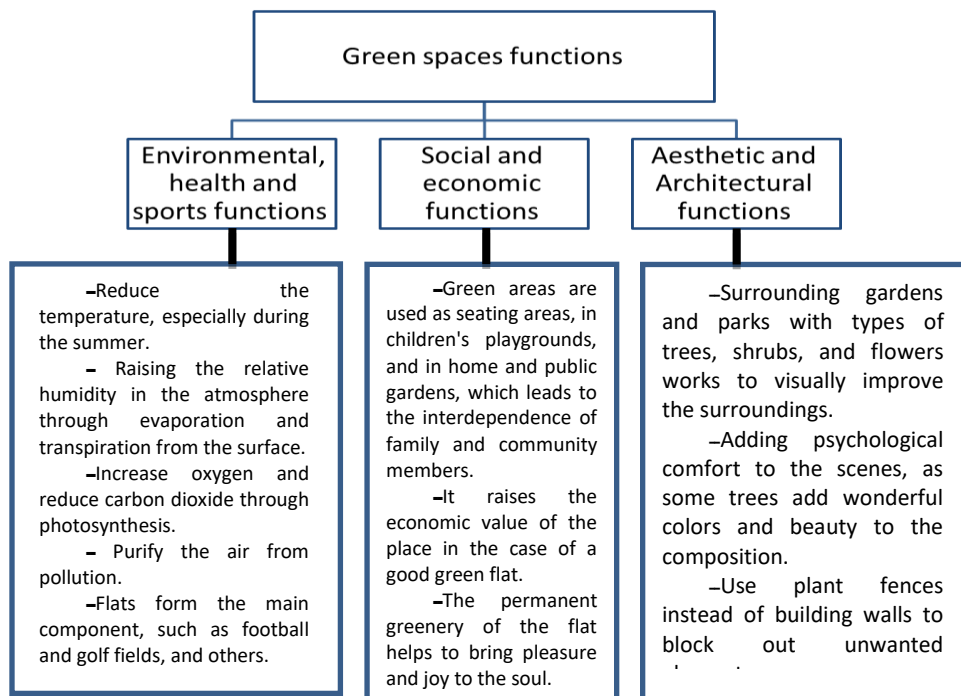
## 2.4 The green belt:

The green belt is linked to the main roads, and it can be a link between countries, regions, parks, or a belt that protects urban areas in the city from noise and pollution sources. The belt also acts as a windbreak, as shown in Figure No. (3).

## 3 Types and classifications of green spaces



2-1- Diagram showing the types and classifications of green space



2-2-Diagram showing the functions of green spaces

## **4 Planning standards for creating green spaces.**

### **4.1 Classification of open spaces and their levels**

The open areas network consists of two main elements are: open spaces and connecting axes. The open spaces in the city are gradated in size. The level of service must be suitable with the number of residents and their needs. Open areas can be classified into planning levels at the levels (national, regional, city, residential neighborhood, the residential neighborhood, the residential group, street gardens and squares).

Linking axes are also classified into (green belt, pivotal gardens, historical axes, recreational axes, environmental axes).

### **4.2 Strategies for choosing the location of open areas in existing cities**

- Achieving a reasonable number of green areas in existing cities, such as Cairo, by working on three axes (preserving the existing ones, protecting them from conversion to other uses or deterioration).

- Improving and raising the efficiency of existing green areas and opening them to expand the base of beneficiaries.

- Increasing green and open spaces.

The location of the open areas can be chosen through the following main strategies:

- Greening unused or exploited vacant lands, such as hills and plateaus.

- Converting all that can be converted from the land into gardens at an appropriate cost, such as railway lands used as workshops and stores.

- Dual use of lands with urban uses, such as afforestation of car parks and cafeterias.

- Transferring and re-exploiting the sites of environmentally polluted activities from within the urban area to the outside, and converting part of it into green spaces.

## **5 Planning standards for open areas**

The planning standards for open areas depend on the local conditions of each city, neighborhood, or residential group. However, there are basic considerations in planning and designing of open areas that must be taken into consideration such as the spaces assigned for open areas are suitable with the size of the population, choosing the site is suitable for the purpose of use, considering the benefits from the topography of the land and conserving the nature of the site.

### 5.1 Open areas at the national level

They are spaces that contain natural elements such as a mountain area or natural waterfalls and water springs. They have special ingredients with an entertainment attraction element at the international level, such as the gardens of the Palace of Versailles in France, or a cultural attraction element such as the zoo or a heritage garden such as the Montazah Palace gardens.

### 5.2 Open areas at the regional level

They are natural areas that are transformed into gardens and parks at the governorate level, such as the Suez Canal region (the Suez Canal), the Greater Cairo region, and the ring road, as major traffic axis.

It is required that there must be at least one area in each city whose area exceeds 100 acres, or 20% of the open areas, and it serves the residents of the region, and there must be a place for gathering and practicing recreational activities and necessary services.

### 5.3 Open areas at the city level

Green areas must be provided in the city so that the per capita share of the city’s population is not less than the minimum stipulated in Table No. (1), at least the area allocated for free or for a fee of 50% of this area as in Figure No. (4)

current situation m <sup>2</sup> / person	Rates of open areas in desert areas		Rates of open areas in the cities of the Nile Valley		The type of residential community
	The target rate is m <sup>2</sup> / person	Minimum m <sup>2</sup> / Person	The target rate is m <sup>2</sup> / person	Minimum m <sup>2</sup> / person	
0.5 – 1.5	7	5	10	7	Existed cities
7 -13	15	10	20	15	new cities
-	10	5	10	5	villages more than 50 acres
-	5	3	5	3	villages less than 50 acres

- The distribution of gardens in the city should be homogeneous with the citizens’ residential areas, and it should be distributed as follows: 30% at the neighborhood level, 30% at the neighborhood level, and the rest distributed to the rest of the city (roads - parking lots - corridors The regional park is not less than 20%. Excess gardens Streets and squares with trees



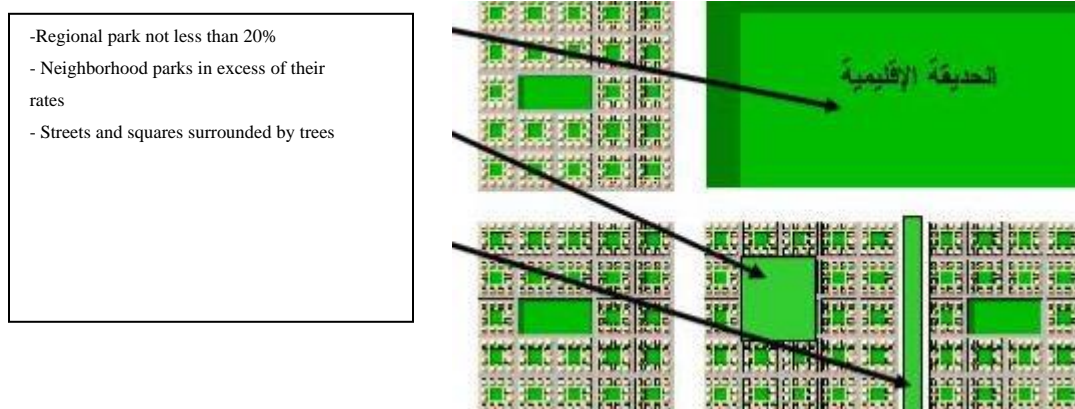


Figure No. (4) shows the open areas at the level of the residential city

### 5.3.1 *Technical requirements*

- There must be existed in these area static and non-static recreational activities in these areas, also they may contain water features such as lakes, fountains, movement paths, sports fields, and children's playgrounds. Attention must be taken to developing open areas and gardens at the city level by constructing roads that lead to these open areas and serving them. Open areas must be provided with the necessary facilities such as Rest houses, cafeterias, toilets, places for families, children's playgrounds and parking lots, taking into consideration the simulation of nature without using geometric shapes.

- Public gardens can be added outside the urban bloc in an area used as zoos, provided that they are far from uses that are not integrated with them, such as residential areas, industrial areas, and health services.

## 5.4 **Open areas at the neighborhood level**

They are gardens that serve the residents of the neighborhood for strolling, sitting, leisure accompanied by movement, and playing sports.

### 5.4.1 *Technical requirements*

The maximum distance to reach the neighborhood gardens is 1 km (15 minutes), the area is not less than 3-5 acres, and the open areas include open areas for sports, the per capita share is one square meter, children's play areas of not less than 200 square meters, public toilets at the rate of one toilet for each An acre of garden space, with a minimum of 2 toilets for males and females, and another for the disabled. The area of the green area should not be less than half of the open spaces at the neighborhood level.

- The built-up areas in the open area must not exceed 5%, and it is easy to reach them on foot through roads that do not intersect with motor traffic, as in Figure No. (5).

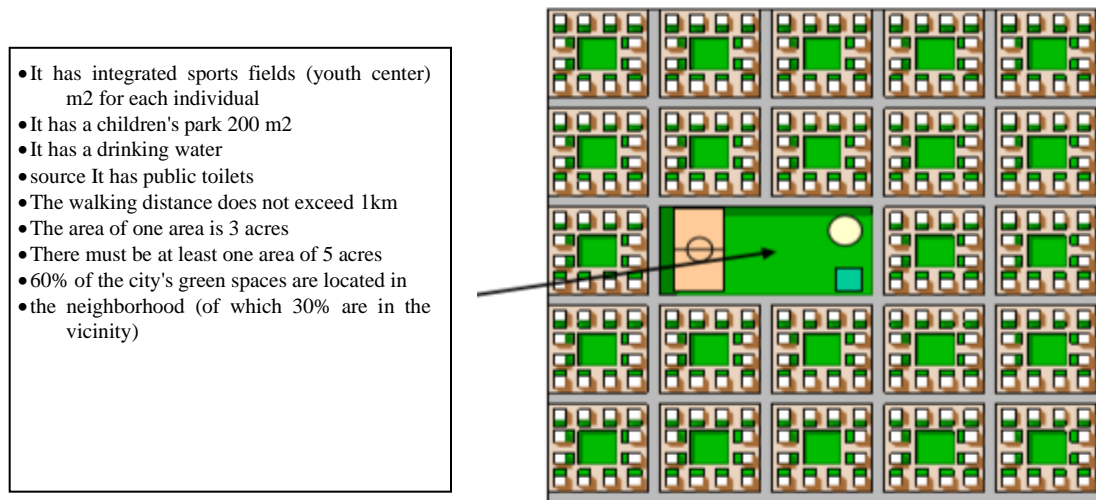


Figure No. (5) shows the neighborhood garden, which includes (small playgrounds - recreation areas - cafeterias - pergolas - service buildings - places for the elderly)

## 5.5 Open areas at the neighborhood level

It serves from 3000-5000 people, the maximum distance from the farthest dwelling does not exceed 400 m, the area is not less than an acre, and the per capita share is from 0.8 - 1.66 m / person.

### 5.5.1 Technical requirements

- It has to be linked to the nursery that serves the neighborhood, easy to reach, provided with a lot of green spaces with seasonal trees, exposed to buildings for reasons of security, provided with public toilets of not less than one toilet for males and another for females, to be included a playground for every 2000 people to play football, handball and safe from transportation methods, finally the playground for children of not less than 100 square meters, built-up areas not exceeding 5% of the total, and green spaces not less than half of the area.

## 5.6 Open areas at the level of residential groups

They are gardens located between groups of buildings with high population densities, in order to improve the climate. They serve a population of 900-1200 people, and the per capita share ranges from 0.08-0.3 m<sup>2</sup>, and the scope of service does not exceed 200 m, as in Figure (6)

### 5.6.1 Technical requirements

It must have a children's playground equipped with simple equipment and toys, with seating, shaded places, rubbish bins, and the space not containing fallen leaves trees.

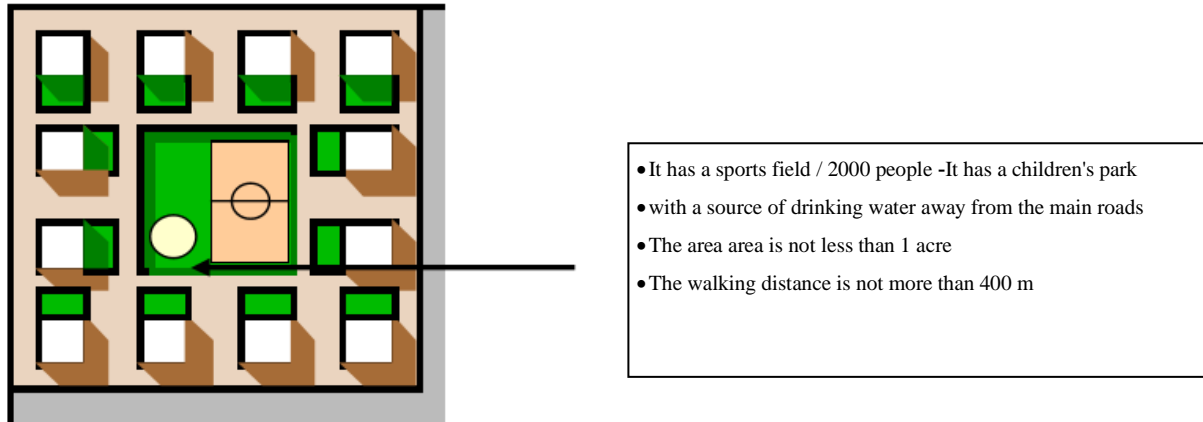


Figure No. (6) shows the green areas in the residential areas

### 5.7 Street gardens and squares

It is built in the middle of the streets and on both sides of it to provide places for rest and waiting, and its area depends on the width of the island, the degree of the road, and the fact that the garden is used to separate the directions of movement or to relax. The open areas in the streets and squares can be calculated as a neighborhood or city quorum under the following conditions: The existence of a safe path for pedestrians to reach, the minimum connected area about 0.5 acres, and the smallest side is less than 10 m. The percentage of gardens in the streets does not exceed the quorum of the neighborhood or 20% of the city's area. It takes place over a period of 20 years, at a rate of 5% annually, as in Figure (7).

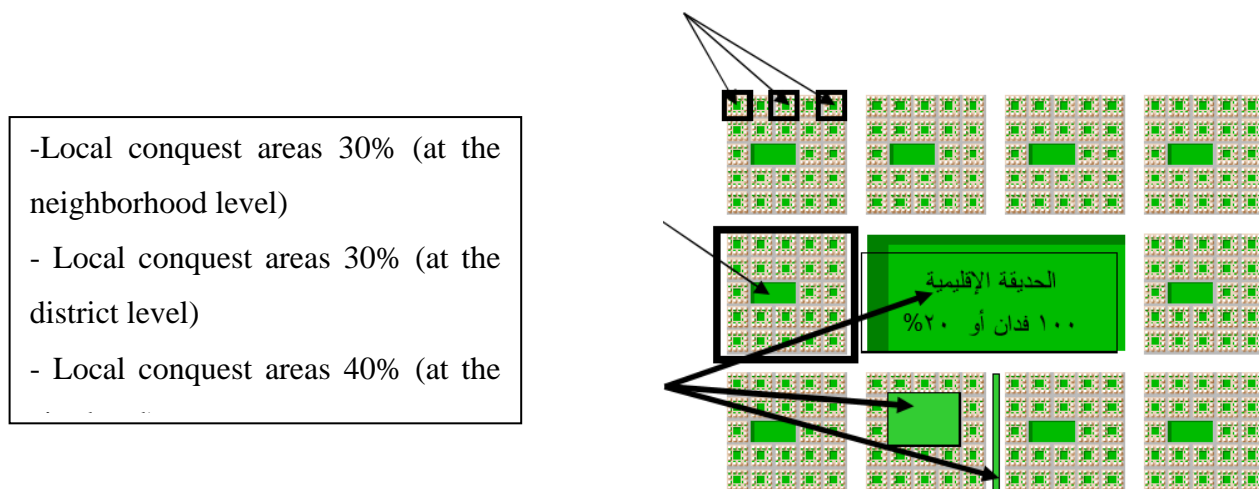


Figure No. (7) shows the requirements for the spatial distribution of open areas at different levels

## **6 Principles of designing open areas**

### **6.1 axes**

The open area must be designed according to the nature of the paths within it from the main and secondary axes and its relationship to the entrances and their gradation, and each axis has a beginning and an end.

### **6.2 Scale**

The scale of the elements must be determined in proportion to the spatial space and reflect the nature of the activity and behavioral patterns of the users of the area

Unity and interdependence

The site layout should reflect unity and coherence through the intended repetition of the layout elements.

### **6.3 Proportionality**

All parts and components of the garden must be proportional and balanced with each other, taking into account the proportionality of sizes, types and characteristics of plants and afforestation in order to comply with the nature and design of the site.

### **6.4 Sovereignty and control**

It takes into consideration the employment and highlighting of some of the elements and components of site coordination in order to maximize the sovereignty of a facility or to state the unique value of the site.

### **6.5 Simplicity**

Avoid crowding the garden with trees, shrubs, or buildings and facilities to facilitate the maintenance and service process

### **6.6 Character**

It is the characteristic of the shape and features of the garden that is formed by its establishment, which highlights its personality.

## **6.7 Repetition and diversification**

And that is by planting some trees on the road or a group of plants that are repeated in the same system to form a rhythm and be attractive and beautiful in shape, but avoid boring repetition by planting individual models or setting up models as a fountain to diversify with repetition.

## **6.8 Sequence and extension**

It is the arrangement of the site coordination elements so that it is seen as a visual sequence in order to achieve an aesthetic pattern in a single system.

## **6.9 Colors**

The colors of the plants and trees are suitable for the different site design

## **6.10 Dissonance and compatibility**

The choice of dissonance or compatibility depends on the designer's vision of the distribution of coordination elements

## **6.11 Lighting and Shadowing**

Light and shade are two important elements in landscaping, as the color and shape of the element are affected in terms of shade or intensity of light, and its importance in landscaping may be due to its shape and the distribution of light and shade in it.

## **6.12 Type of plants**

Plants constitute the main element of garden design, and they are chosen after a full study and knowledge of the nature of their growth and the distinctive characteristics of each of them, and they are placed in the appropriate place to fulfill the purpose of their cultivation and use, and that their growth is appropriate to the environment.

# **7 Problems of open areas in Egypt and their causes**

## **7.1 The Problems**

- Transforming cities into concrete forests that destroy their natural environment and lose their green spaces.
- bad distribution of green areas
- The control of transportation methods on the formation of the urban pattern in an unfair violation of the rights and needs of pedestrians.

- The absence human scale and aspect in the design of the existing open areas.
- Misuse of existing open areas.
- The control of the constructed elements on the natural features of the open areas.

## 7.2 Reasons

- The absence of the idea of planning open areas at the national, regional and local levels.
- The absence of the concept of open areas network, which leads to poor distribution of the choice of its location and its lack of connection with each other.
- Lack of water resources that allow the provision and maintenance of open areas.
- Increasing population and building densities and the high real estate value of lands, which led to not using them as open areas.
- Lack of maintenance and neglect of the few existing open areas, which leads to their deterioration.
- Lack of environmental awareness among visitors and users of open areas.

The World Heritage property is the conservation areas that are protected such are gardens, landscape areas and the important open spaces including green areas located on the edges of the historical areas such as Al-Azhar Park, a smaller garden for children in Sayeda Zeinab, and vacant undeveloped areas still surrounding the castle as in the figure No. (8). These areas have an important environmental value for the property of the architectural heritage, as well as they are important for the general urban context of Cairo. Al-Azhar Park and the areas surrounding the castle have an important heritage value, as they are considered points from which the city's fortifications can be viewed. Historic gardens and landscapes must be classified as "no building" areas", and not be affected by any works, even temporary ones.

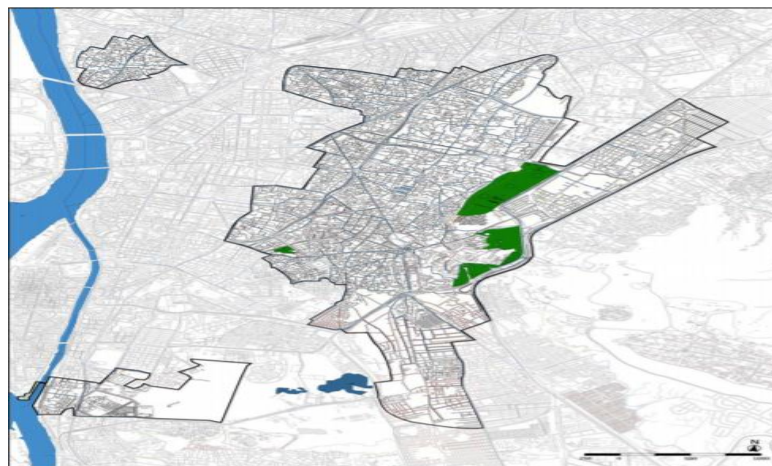


Figure (8) shows parks and landscape areas in Cairo

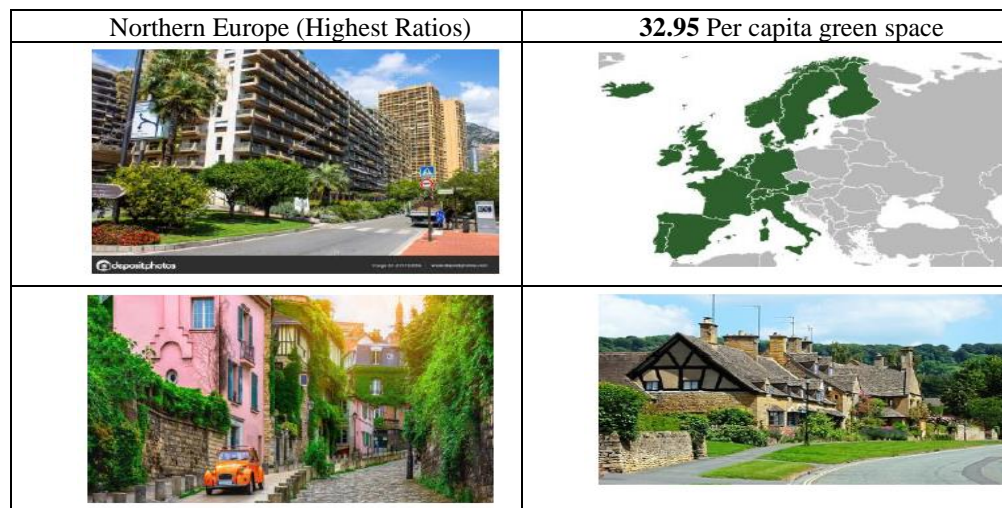
## 8 Global Ratios of Green Space Distribution

### 8.1 Percentage of Green Space Distribution in the City .

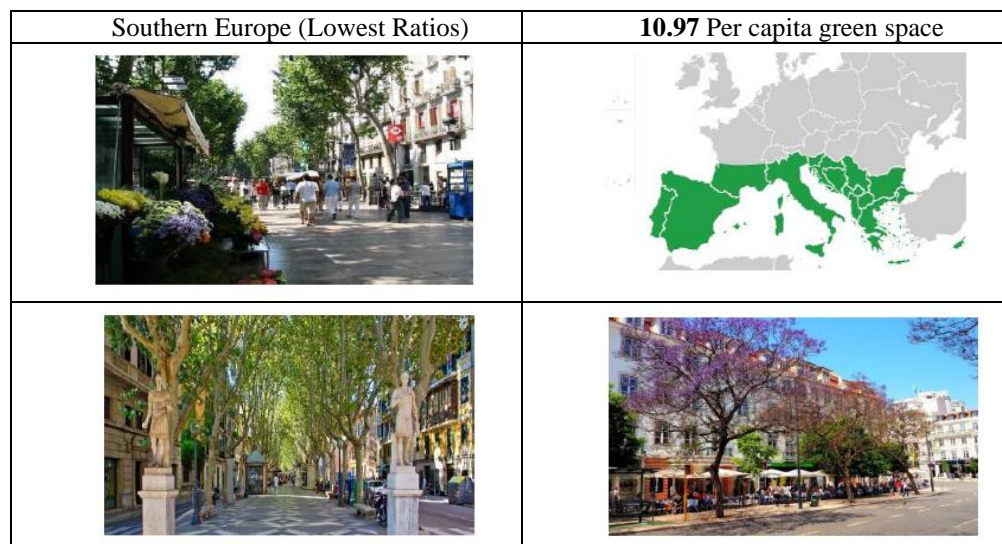
It is a simple and clear indicator, but its negatives can be distracting in case of high densities of residents, high building ratios, and high ratios of heights, but the minimum level usually between 10% to 20% of the space of the city. For example, in Germany, the percentage is 40% to 50% for most of the German cities.

Indicator in Europe	Western	Southern	Eastern	Northern
Area (ha)	29625.04	25595.24	18958.96	48816.15
Residential Area	4936.69	2489.48	2665.92	5661.93
Green urban areas	853.24	399.2	462.06	1288.32
Per Capita Green Space (m <sup>2</sup> per inh.)	27.25	10.97	13.71	32.95

Table 1: Ratios of Green Spaces in Europe



Shape no ( 9 ):shows the way of distribution of green spaces in the Northern Europe



Shape no ( 10 ):shows the way of distribution of green spaces in the Southern Europe

## 8.2 The current per capita green area according to the current urban regulations in some Arab countries

Indicator	Damascus Syria	Manama Bahrain	Dubai Emirates
Area (km)	105	30	4.12
Per Capita Green Space (m <sup>2</sup> per inh.)	0.70	2.5	13.18

Table (2): the current per capita green area in some Arab countries

## 9 Case study in Egypt

Al-Azhar Park is considered a qualitative step in the field of planning and designing public parks and gardens. The designs were made in 1996 and were opened in March 2005. The Designers: CITES International, Dr. Maher Estino, Dr. Laila Al-Masry, and the owner: Historic Cities Support Program at the Aga Khan Foundation for Culture.

Al-Azhar Park aims to exploit the distinctive context of the place, its location, its inspiring topography, and the unique visual scenes of historic Cairo. It also aims to create interaction and dialogue between all these elements and to stimulate vitality, which can be observed in a number of treatments used in the garden, the flatness of the land versus its slope, to cultivate regular geometric patterns in the garden. Opposite the free formations and also the green grass carpets extending against the desert plants planted along the slopes overlooking the city, highlighting the contrast in the planting of the focal areas of the flat and dry extensions on the slope in the direction of the city.



Figure No. (11) shows a general location for Al-Azhar Park, the new green lung of Cairo



Table No. (3) shows the constituent elements of the Al-Azhar Park project and an evaluation of whether or not they exist

Its use in design		element	serial
Not existing	existing		
	√	External flooring	1
	√	Internal flooring	
	√	pavement	2
	√	stairs	3
	√	ramps	4
	√	Light fixtures	5
	√	Guide signs	6
	√	Sitting places	7
	√	fountains	8
	√	Water falls	9
	√	sparkling	10
	√	Children playing area	11
√		Telephone booths	12
	√	Waste bins	13
	√	External boundary wall	14
√		Internal fences	15
	√	pergola	16
√		sculptures	17
	√	Sound units	18
	√	Service buildings	19
√		security	20
	√	toilets	21

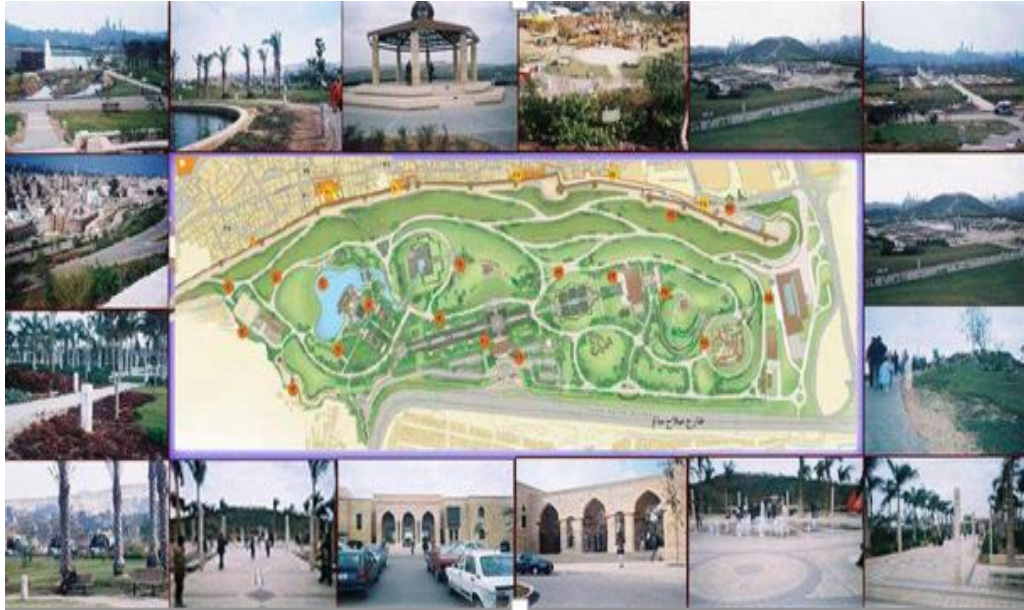


Figure No. (12) shows the surrounding streets and an analysis of the project's components

## 10 Recommendations

1- Follow the scientific foundations for designing green spaces and the Egyptian code for the per capita share of green areas, while providing the material capabilities necessary for the establishment and maintenance of green spaces.

2- Exploiting urban enclaves and places of buildings that are about to fall to replace green spaces.

3- Encouraging private investment in green spaces.

4- Educating the population about the necessity of preserving green spaces.

5- Activating the role of civil society organizations in development processes and contributing to changing the value system

6- Habits and behaviors that are considered one of the biggest challenges facing achieving sustainable development.

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