

Received 14 November 2023: accepted 2 March 2024.

Available online 9 March 2024

INVESTGATING THE IMPACT OF CLIMATE CHANGE ON PUBLIC GREEN PARKS IN CAIRO, EGYPT

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ABSTRACT

Climate change has a significant impact on urban green areas, and its surrounding environments. Public parks had been negatively affected in various aspects including landscaping conditions such as planting design within parks, the need for irrigation, declining of green coverages, mass loss of trees, in addition to the physical activities of visitors including active playing of children, walking, running, playing sports, also the psychological comfort and socializing of visitors. In order to investigate the impact of climate change on public parks in Cairo, the authors present a theoretical basis on the previous affected aspects, then observed and analyzed the previous aspects through an analytical approach in three different case studies which are International park, the Child's park, and Maadi Island in Cairo, Egypt which represent cultural, children, and amusement parks respectively. Our findings provide evidence a highly recorded negative impact on landscaping conditions compared to the other aspects. Physical activities of visitors inside the public parks are from slightly to moderate affected while the psychological comfort of visitors are slightly affected, and socializing is the only aspect that has barely affected. The authors recommend a set of actions in order to mitigate climate change challenges among public parks in Cairo.

KEYWORDS: Climate change, Public parks, Landscaping conditions.

تحديد تأثير تغير المناخ على الحدائق الخضراء العامة في القاهرة

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المخلص

لتغير المناخ تأثير كبير على المناطق الخضراء الحضرية، والبيئات المحيطة بها. وتأثرت الحدائق العامة سلباً في جوانب مختلفة منها ظروف المسطحات الخضراء مثل تصميم الزراعة داخل الحدائق، والحاجة إلى الري، وانحسار المسطحات الخضراء، وفقدان الأشجار بشكل كبير، بالإضافة إلى الأنشطة البدنية التي يمارسها الزوار بما في ذلك لعب الأطفال النشط، والمشي، الجري وممارسة الرياضة وكذلك الراحة النفسية والتواصل الاجتماعي للزوار. قام المؤلفون بملاحظة وتحليل الجوانب السابقة في ثلاث دراسات حالة مختلفة وهي حديقة الدولية، وحديقة الطفل، وجزيرة المعادي في القاهرة، بمصر والتي تمثل المتنزهات الثقافية، والأطفال، والمتنزهات الترفيهية على التوالي. توفر النتائج التي توصلنا إليها دليلاً على وجود تأثير سلبي على ظروف المسطحات الخضراء مقارنة بالجوانب الأخرى. وتتأثر الأنشطة البدنية للزوار داخل الحدائق

العامية بشكل طفيف إلى متوسط، في حين تتأثر الراحة النفسية للزوار بشكل طفيف، ويعتبر التواصل الاجتماعي هو الجانب الوحيد الذي لم يتأثر إلا قليلاً بالتغير المناخي. ويوصي المؤلفون بمجموعة من الإجراءات من أجل التخفيف من تحديات تغير المناخ في الحدائق العامة في القاهرة.

الكلمات الدالة : تغير المناخ – الحدائق العامة – المسطحات الخضراء

INTRODUCTION

Urban green spaces had definitely been affected by climate change. The urban climate frequently differs with the surrounding rural countryside due to its higher levels of pollution, increased temperature, and greater rainfall. Parks and Forests are considered the largest and visible zones of green spaces in a city-scale. Public green spaces including parks are facing the climate change challenges in order to maintain its landscaping conditions. The primary objective of the research is investigating the impact of climate change on public green parks in Cairo, Egypt.

RESEARCH METHODOLOGY

The study has been organized into a total of three separate strategies, each emphasizing on a separate phase of the investigation process. The first strategy involved gathering data and doing a literature study on definition of urban green spaces, definition, benefits, types and history of public parks, and the relationship between climate change and park design. The second strategy involved the analysis of three case studies in Cairo, Egypt for public green parks which are the International park, the Child's park, and Maadi Island in Cairo, Egypt which represent cultural, children, and amusement parks respectively. Analyzing and observing the aspects that are proven to be affected by climate change (according to the literature review) on the 3 case studies. The final phase was deriving results and conclusion which involves a set of actions in order to mitigate the challenges of climate change among public parks in Cairo.

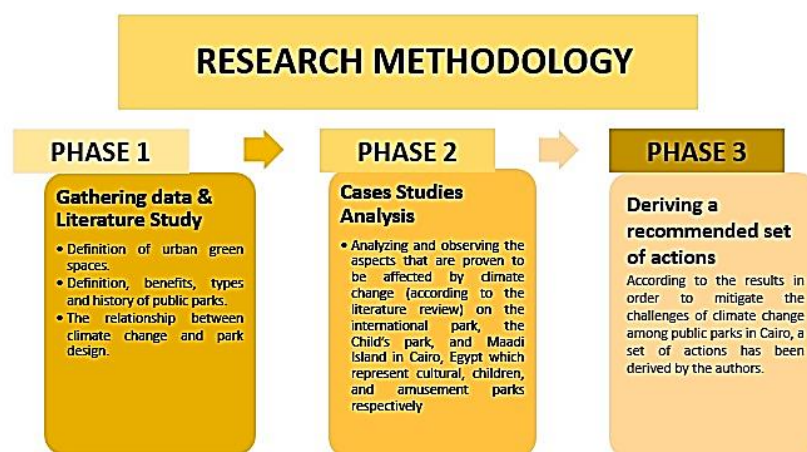


Figure (1) Research Methodology. source: (The Authors)

1. LITREATURE REVIEW

1.1 The definition of urban green spaces

Although, there are various definitions of green spaces and the debate surrounding them has long been persisted, especially for the developed countries, there is still a lack of common accepted definition for urban green spaces (Byomkesh et al., 2012). The semi natural areas also can be named as the urban green spaces which are considered as significant vegetated areas found in urban environments (Leite, N. G., et al, 2023). Natural vegetation or man-made ones covered these urban green spaces and are located in built-up areas (Li, Pussella, 2017). The urban green space includes the formal and informal green sites, with reference to the term of “open spaces” that can massively provide various types of ecological functions (Biernacka, M., et al., 2023).

The European commission (2014) had explored the term green spaces with reference to the green infrastructure, and defined it as a strategically planned network consisted of natural and semi-natural areas with high quality in accordance with other environmental features. This network has been purposely created to provide a wide range of ecosystem services and ensure the conservation of biodiversity in rural and urban environments.

Green spaces are mainly consisted of diverse natural elements including parks, forest patches, open spaces, residential gardens, and narrow tree-lined strips along streets. Arabi et al. (2014) has arranged the green spaces into four categories which are:

- Public green spaces, including parks which are specialized for the public to engage in leisure activities as shown in Figure 2.
- Semi-public green spaces, including the hospitals’ open spaces for example, governments’ or private departments’ green spaces as shown in Figure 3.
- Private green spaces, including the garden units of residential groupings as shown in Figure 4.
- Street green spaces, including the roadways’ tree layouts as shown in Figure 5



Figure (2) Public green spaces.
source: (West minister city council, 2018)



Figure (4) Private green spaces. source:
(Congress for the New Urbanism, n.d)



Figure (3) Semi-public green spaces.
source: (McKenna. S. , 2021)



Figure (5) Street green spaces. source:
(Florian, M-C, 2022)

Moreover, Flachetta, et al, (2023) had stated that urban green spaces include all areas with vegetation that perform a diverse range of functions including air and water purification, environmental pollution control, carbon storage, micro-climate regulation, urban wildlife habitat, therapeutic and spiritual value.

In addition to, Pereira, P., & Baró, F. (2022) had focused on the urban green spaces which have been commonly recognized as a critical part of the urban areas' infrastructure. However, the urban green spaces are under extreme pressure as a logical consequence for increasing the development and urbanization, and their ability to maintain the ecological and social functions is at massive risk. On the other side, Intensive growth of cities are unfortunately faced the reduction of green spaces which increases the existing problems, especially because the ecosystem is closely linked to other components of the urban system: social, economic, cultural or political.

1.2 The public parks

Li, K. et al (2022) had mentioned that the urban landscape depends on the surrounding environment, including suburban, rural, and bioregional landscapes seen in ecological watersheds. Parks and Forests are considered the largest and visible zones of green spaces in a city-scale. Urban parks can definitely protect the biodiversity according to Gonzaga, M. O. (2023). A study had stated that urban parks should be within 400 meters, or 5 minutes walking from the nearest residence (Kemec., et al, 2023). However, the National Recreation and Park Association, USA had mentioned that a space of 0.41 km² has to be kept as urban parks for 1000 residents. Several studies had highlighted on the performance of urban parks that must provide various sorts of traditional and multi-functional purposes. Many authors assured that residents are constantly visiting urban parks as it is considered to be an attractive space for tourists and visitors from the surrounding area (Schmidt et al., 2016).

1.3 History & benefits of public parks

According to Paden, R. (2022) in a historical study for Public Green Parks which are as old as towns and cities. They ranged from Babylon hanging gardens as shown in Figure 6 to the marshes of ancient London and to the formal gardens of Paris and Vienna. In Victorian Britain the city park was founded, but in 20th century Britain it fell into disrepair and although Victorian parks were seen to be almost crowded but these parks succeeded in stabilizing mental health and reducing discontent. Moreover, at the start of the 20th century, town planning concepts were overwhelmed by the Garden City Movement as shown in Figure 7 which can provide specialized open spaces for creating attractive cities. In addition to, the phase of 1930's and 40's which can be highlighted through their concern for the young's physical and moral welfare, and their emphasis on making the concept of "fit to fight". Also, there were many parks during the second world war were plowed up to grow food.



Figure (6) The Hanging gardens of Babylon.
source: (Cartwright, M.,2018)



Figure (7) Garden city visualization.
source: (Moreira, S., 2021)

Several positive impacts of public green parks have been explored. Konijnendijk et al. (2013) found strong scientific evidences about the contribution of public green parks with the human and social wellbeing either directly through motivating our physical activities or indirectly through promoting opportunities for recreation and nature experience. Others had stated the moderate evidence for the impacts of parks on either biodiversity through the measurement of species richness, or the prices of properties, or reducing obesity, or even local cooling (Gonzaga, M. O., 2023). Other health related impacts had been reported regarding the positive impact of parks as stress reduction, improving mental health, and indirect health impacts by reducing noise, and increasing longevity. Urban parks are also proven to be biodiversity hot spots. This can be extremely useful for both attracting leisure seekers interested in nature, and using these parks a natural and interpretation education area. Others reported the cultural services that urban parks can provide for tourism and social cohesion (Konijnendijk et al., 2013)

1.4 Types of public parks

There are various classifications for public parks according to literature studies. However, the classification of the local open parks according to Cheng. et al., (2021) can be summarized as shown in Figure 8, which are:

Types of Local open parks	- Comprehensive Park
	- Community Park
	- Expo Park
	- Cultural Park
	- Children's Park
	- Amusement Park
	- Sport's Park
	- Shopping Park
	- Water park
	- Lake Park
	- Botanical Garden
	- Ecological Park

Figure (8) Classification of Public Parks. source: (Cheng. et al., 2021), adopted by authors.

City of Gold Coast (2016) discussed that local parks must fulfill the general requirements of the immediate neighborhood through a distance of 400 meters or 5 minutes' duration of walking through offering recreational opportunities and only welcoming short visits. Informal social and sporting activities are significantly provided within most local parks. Common amenities found in local parks encompass

shaded seating areas, open areas for kick and play, and shaded pathways that connect various sections of the park. And in general, local parks lack parking facilities. Moreover, the parking spaces for vehicles, restroom facilities, areas for grilling food, and recreational spaces for children are better suited for parks located in districts or cities. These kinds of parks could be included as a component of a bigger park, like a sports park within a specific area. And in terms of size, these parks are generally smaller than district or city recreation parks and have fewer decorative elements.

Several authors have recommended the importance of implementing the general guidelines of the urban design of local parks. The guidelines generally emphasized on the parks' embellishments that should be designed for offering a safe and user friendly environment, and also on its accessibility and equitability for the community. In addition to, the cost effectiveness as a critical and important pillar, as well as relevancy for the community needs. Other studies highlighted on the social and environmental sustainability of local parks in accordance with the enhancement of natural heritage features.

1.5 Examples of International Public green parks

Urban parks have significantly related to the living environments and people's lifestyles especially with the increasing of global urbanization, and regarding the improvement of public health. Therefore, it took a massive focus from the global urban planners to provide high quality public parks established with good amenities for promoting physical activities as walking and biking, as well as reducing obesity and mental health problems (Konijnendijk et al., 2013).

1.5.1 Broadwater Parklands, in Australia

Broad water parkland is a city parkland which is located in Southport across from the Australia Fair shopping center. The large expand of green space offers several shaded areas for picnics as shown in Figures 9, 10 and the Rock pools water playground is a great place for kids and parents to relieve themselves. The park involves zones for Barbeques, Bicycle stands, Dogs off leash and play grounds with shade sails. It also includes picnic tables, seats and most importantly shade structures (City of Gold Cost, 2016).



Figure (9) Broadwater Parklands activities. source: (City of Gold Cost, 2016)



Figure (10) Image for Broadwater Parklands. source: (Holmes, D., 2013)

1.5.2 New Orleans City Park, in United States

City Park in New Orleans is one of the biggest urban parks in the United States with area 1,300 acres, offers tennis, and horseback riding as shown in Figures 11,12. It is a

kid friendly park in addition to, it includes a zone for golf course, family friendly activities as running and bikes paths, and areas for exercise in addition to green spaces, and botanical garden.

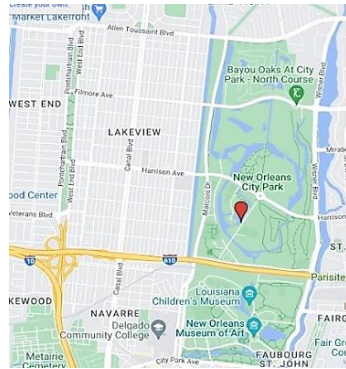


Figure (11) Map of New Orleans City park. source: (Google Maps, 2024)



Figure (12) Image for New Orleans City park. source: (New Orleans, 2023)

1.6 The relationship between the climate change and park design

According to Brown, R. et al, (2015), parks in cities and green areas have the ability to generate thermally pleasant surroundings and lower heat stress sensitivity. However, in order to serve this purpose, parks must be designed in the light of the current climate as well as anticipated future climates. Brown, R. et al, (2015) used human energy budget simulations for investigating the effects of components that influence microclimate in parks. In all test cities, reducing solar radiation intake using trees had the biggest impact. Air temperature reduction was the second-most essential factor, and in some areas, it was nearly as crucial as providing shade. Brown, R. et al, (2015) ran similar simulations using forecasted climates for the middle of the century, reinforcing the importance of city-level initiatives for park design in order to help reducing future climate-related urban health concerns. These simulations revealed that heat waves in many regions will create outdoor areas where people will be in significant danger of heat stress, but that well designed parks can mitigate the threat.

1.7 Public Parks in Cairo, Egypt

Cairo city had rapidly grown from average 7 km² to 840 km² with 9-9 million inhabitants (GOPP ,2012), (CAMPUS, 2020). The urban character of Cairo had been changed due to the major and rapid transformations that Cairo had been gone through. There are fifty-four public parks in Cairo that provide active recreation. Park's distribution in Cairo is not equal according to its districts. The West of Cairo has fortunately the highest number of parks. It includes 8 parks, 7 of them are in al-Zamalek Island. Eighteen parks are in the southern region, and sixteen parks are in the eastern ones. According to the hierarchy of public parks in the previous study, most of the parks in Cairo, exactly 20 parks out of 54 total parks with an average area from 12,000 to 40,000 m². Eighteen Parks has even smaller area with average 2000 m². Generally, there are few number of large parks in Cairo, 7 parks with average area 80,000 m², and 9 parks in average area between 40,000 and 80000 m². Al-Azhar park is considered the

largest public park in Cairo with average are 300,000 m2, the international park, and Merry Land Park comes next with average area 210,000 m2 (Aly.D et al, 2022).

A numbering list of the fifty-four public parks’ names has been shown in Figure 13 with their geographic distribution all over Cairo city across the Nile river, new communities, eastern region, northern region, southern region, western region. The previous literature reviews about Cairo’s green spaces indicates that it has a limited percentage of green spaces. Cairo lost 910,894 m2 of its green spaces in the years between 2017-2020. In spite of the increasing rate of the population, the green spaces decreased from average 0.87 to 0.74 m2. The massive loss was found nearly in Heliopolis and the East of Nasr city. They lost 272.274 m2 and 311,283 m2 respectively between 2017 to 2020 (Aly. D et al, 2022).

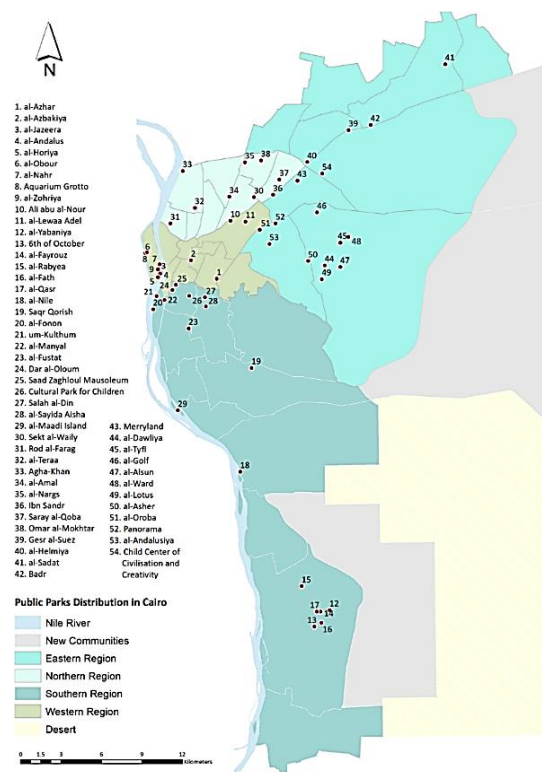


Figure (13) The distribution of Public Parks in Cairo. source: (Aly.D et al, 2022).

1.8 Impact of Climate change on Existing Public Local Parks

The urban climate frequently differs with the surrounding rural countryside due to its higher levels of pollution, increased temperature, greater rainfall, and reduced windiness (Bibi, T. S., & Kara, K. G., 2023). The consequences of climate change, such as the projected rise in temperature and occurrence of more extreme weather events, are negatively effecting most of our built surrounding environment, accordingly it will be more pronounced in urban areas in comparison to the surrounding landscape. In Addition to, the changing climate may arouse the negative consequences already witnessed as a result of urbanization, such as increased urban temperatures and flooding (Bibi, T. S., & Kara, K. G., 2023).

According to Revich, B. A., (2023), the presence of green cover and open spaces in urban settings provide several benefits including health, well-being, and ecology. Specifically, these areas of vegetation facilitate natural cooling of the air and surfaces,

while also supporting water management within urban regions. Moreover, the plant life serves the objective of taking in carbon dioxide, thus facilitating the mitigation of greenhouse gas discharges. Changed precipitation patterns could potentially increase the demand for irrigation in the duration of drought's prolonged periods, a phenomenon that will be focused when using increased planting densities or surfaces with limited permeability. Furthermore, unhealthy vegetation coverage will also lead to decrease ecosystem functionality.

Climate change is un-accountable for the increased frequency of more severe and frequent heatwaves, droughts, rainfall, and storms. These extreme weather events have a considerable impact on our towns and cities, consequently affecting green cover and open spaces and diminishing their capacity to mitigate against future impacts. Climate change may also negatively affect the physical and social activities of visitors and workers such as walking, carrying, cleaning, running, gardening, socializing in meeting areas and even engaging in sports activities if available (Rivera, E.al, 2022).

Climate change will have an impact on various aspects that are significant to habitat quality and the urban biodiversity's growth. The modification in temperature, precipitation, extreme events, and heightened concentrations of CO₂ will affect a variety of factors associated with individual species (such as their physiology), the dynamics of populations, the patterns of species distribution, the interactions among species, and the services provided by ecosystems. These effects will arise due to spatial or temporal reorganization (Bellard, C. et al., 2012). The rising urban temperatures and the modified patterns of precipitation will impact the development of species communities by restricting the availability of water during the growing season and by changing the dynamics of nutrients.

2. METHODS

2.1 Analyzing & Observing case studies

In order to investigate the impact of climate change on public parks in Cairo, and based on the previous literature review that explained the impact of climate change on public parks in various aspects, the following study will discuss the analyzing of three case studies in Cairo, Egypt, which reflects the following typology of parks:

- Cultural Park (international park located in Nasr city)
- Children's park (child's park located in Nasr city)
- Amusement park (maadi Island located in Maadi)

Type A: The Cultural Park

Cultural Park is a public park in which it interprets both educational and recreational historical resource to the public. International park represents this typology of parks as a case study.

Table (1) Basic Information - International Park, Nasr city, Cairo

<i>Park Name</i>	The International Park
<i>Park Type</i>	Cultural Park
<i>Location</i>	Abbas El Aqqad street, Nasr city, Cairo
<i>Area</i>	135 acres

Source: (Tantawy, 2012), adopted by authors

Description: The international Park is a public cultural park. Each zone represents certain civilization of many cities of the middle east zone, and foreign countries as well including Kuwait, Bahrein, Saudi Arabia, Japan...etc.



Figure (14) Satellite image for the international park, Cairo. source: (Google Earth, n.d.b).

Figure (15) Image for the international park, Cairo. source: (Tantawy, 2012).

Observations of Occupancy: The occupancy of people in the international park differs along the week where Fridays evening (specifically from 6pm to 9pm in which the peak occupancy hour is 9 pm) has the most occupancy of people during the week however Sundays and Mondays has greater morning occupancy than weekends in the park. People spend in the park up to 2 hours. The Highest Occupancy inside the international park was in Fridays, while the lowest occupancy inside the international park was in Mondays. Morning occupancy in the middle of the week is slightly greater than the morning occupancy in weekends

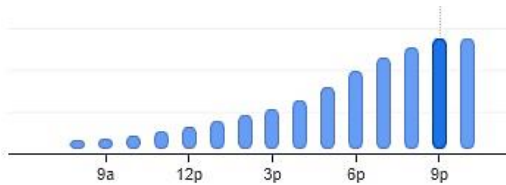


Figure (16) The Highest Occupancy inside international park in Fridays. source: (Google Maps, n.d.b)

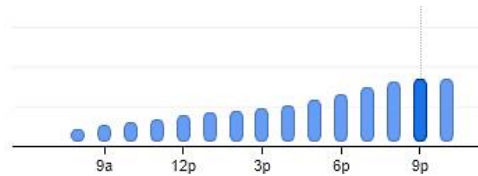


Figure (17) Occupancy inside international park in Mondays. source: (Google Maps, n.d.b)

Type B: The Children’s Park

Children’s park is a specifically designed playground or park for children in which it provides a safe environment that facilitates playing, and enjoying. The Children’s park in Nasr city represents this typology of parks as a case study.

Table (2) Basic Information – The Child’s Park, Nasr city, Cairo

Park Name	The Child’s park
Park Type	Children Park
Location	Makram Ebeid street, Nasr city, Cairo
Area	92,400 m2

Source: (Londeneya’s blog, 2014), adopted by authors

Description: The Child’s Park is a public children park. The park has a large area of green coverage, sitting and relaxing areas. It encourages several activities such as walking, sports as volley ball and football. Various games for kids are offered in addition to the public services, restaurants and cafeterias.



Figure (18) Satellite image for the Child’s park, Cairo. source: (Google Earth, n.d.c).



Figure (19) Image for the Child’s park, Cairo. source: (Londeneya’s blog, 2014).

Observations of Occupancy: The occupancy of people in the Child’s public park differs along the week where Fridays evening (specifically from 6pm to 9pm in which the peak occupancy hour is 9 pm) has the most occupancy of people during the week, however Sundays and Mondays has greater morning occupancy than weekends in the park. People spend in the park up to 1.5 hours. The Highest Occupancy inside child’s park is in Fridays, while the least occupancy inside child’s park is in Mondays where morning occupancy is greater than the morning occupancy in weekends.

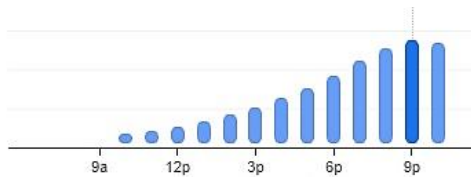


Figure (20) The Highest Occupancy inside child’s park in Fridays. source: (Google Maps, n.d.c)

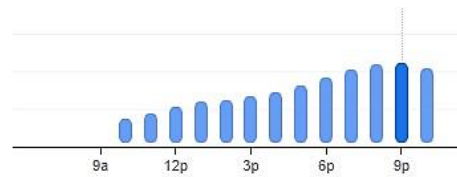


Figure (21) Occupancy inside child’s park in Mondays. source: (Google Maps, n.d.c)

Type C: Amusement Park

The Amusement park is an operated park that provides various activities or devices for entertainment. El Maadi island located in Maadi, represents this typology of parks as a case study.

Table (3) Basic Information – El Maadi Island, Maadi, Cairo

Park Name	El Maadi Island
Park Type	Amusement Park
Location	Korneish ElMaadi , Maadi, Cairo
Area	65,200 m2

Source: (Egypt Antiques, 2022), adopted by authors

Description: El Maadi island Park is a public amusement park. The park has a large area of green landscapes, restaurants, cafeterias, kid’s area, swimming pool. It enhances riding bicycles, playing gulf, doing various sports and has a large area for kids’ games.

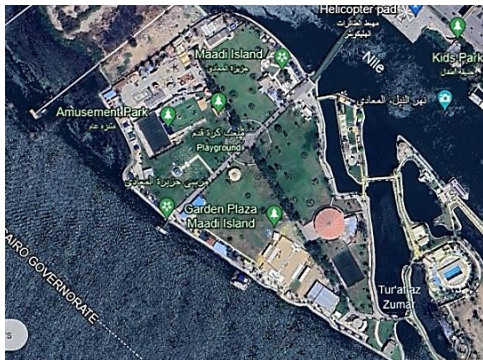


Figure (22) Satellite image for the Maadi Island, Cairo. source: (Google Earth, n.d.a).



Figure (23) Image for the Maadi Island, Cairo. source: (Egypt Antiques, 2022).

Observations of Occupancy: The occupancy of people in Maadi Island public park is less than the international and the child’s park with a noticeable percentage. Its occupancy also differs along the week where Fridays evening (peak occupancy hour at 8 pm) has the most occupancy of people during the week, however Sundays and Mondays has the least occupancy in the park. The Highest Occupancy inside Maadi Island in Fridays, while The Least Occupancy inside Maadi Island in Mondays.

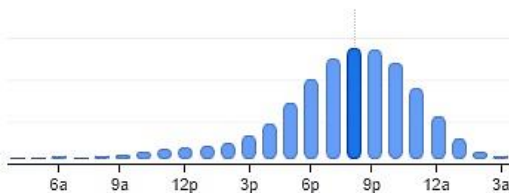


Figure (24) The Highest Occupancy inside Maadi Island in Fridays. source: (Google Maps, n.d.a)

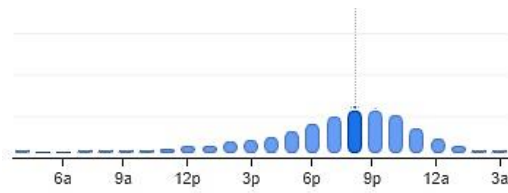


Figure (25) The Least Occupancy inside Maadi Island in Mondays. source: (Google Maps, n.d.a)

Accordingly, from the previous literature review and the previous analysis of case studies, the authors concluded various aspects that had been affected by climate change inside the public parks in Cairo. The aspects that might be affected by climate change are landscaping conditions such as planting design within parks, the need for irrigation, declining of green coverages, mass loss of trees, in addition to the physical activities of visitors inside the parks which are active playing of children, walking, running, playing sports, riding bicycles, moreover, both the psychological comfort and socializing of visitors inside the parks that might be affected by climate change. The impact of climate change on these aspects inside each of the case studies have been properly observed and documented in the following table.

Table (4) Analyzing & Observing aspects that might be affected by climate change in Cairo public parks.

<i>Aspects that has been affected by climate change</i>		Types of Parks		
		Cultural park (International Park)	Children's park (Child's park)	Amusement Park (Maadi island)
<i>Landscape conditions</i>	Planting design within parks	4	2	3
	The need for irrigation	5	5	4
	Declining of green coverages	4	4	2
	The Mass loss of trees	3	2	5
<i>Total</i>		16	13	14
<i>Physical activities of visitors</i>	Active playing of children	1	1	1
	Walking	2	1	1
	Running	2	2	2
	Playing sports	2	2	2
	Riding bicycles	3	3	2
<i>Total</i>		10	9	8
<i>Physiological comfort</i>		2	2	2
<i>Socializing</i>		1	1	1
<i>Total impact of climate change on aspects</i>		29	25	25

Source: The Authors

The previous table shows the analyzing and observing the aspects that are proven to be affected by climate change (according to the literature review) on the 3 case studies (The international public park that represents the cultural parks – the child's park that represents the children's park – Maadi island that represents the amusement park). The researchers put a relative weight while observing and analyzing in which (5 represents extremely affected), (4 represents largely affected), (3 represents moderately affected), (2 represents slightly affected), and (1 represents not been affected at all).

3.DISCUSSION & RESULTS

Based on the previous Table (4) which represents the observing and analyzing the aspects that might be affected by climate change in the previous case studies, the researchers significantly found the following:

- Physical activities of visitors inside the public parks are from slightly to moderate affected by climate change. Active playing of children is barely affected, while physical activities that need extra effort as running, and playing sports are affected.
- Psychological comfort of visitors inside the public parks are slightly affected by climate change, in addition to socializing activities have been observed and it has been found that socializing is barely affected by climate change.
- Landscaping conditions are highly affected by climate change inside public parks in which the need for irrigation and declining the green coverages can be easily noticed by observing in current situation. The mass loss of trees is highly noticed

in Maadi island; however, the design of planting is from moderately to largely affected by climate change.

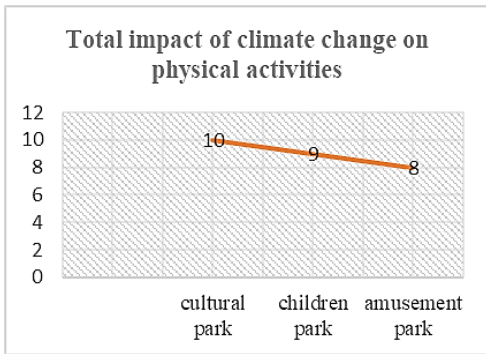


Figure (26) Total impact of climate change on physical activities inside case studies. Source: The Authors

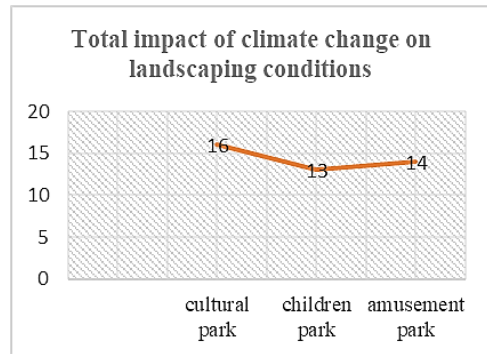


Figure (27) Total impact of climate change on landscaping conditions inside case studies. Source: The Authors

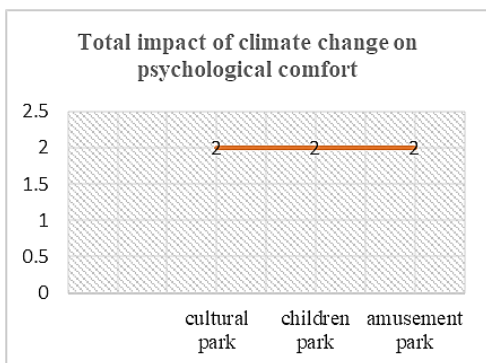


Figure (28) Total impact of climate change on psychological comfort inside case studies. Source: The Authors

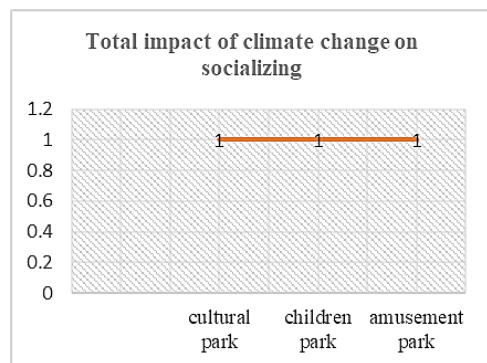


Figure (29) Total impact of climate change on socializing inside case studies. Source: The Authors

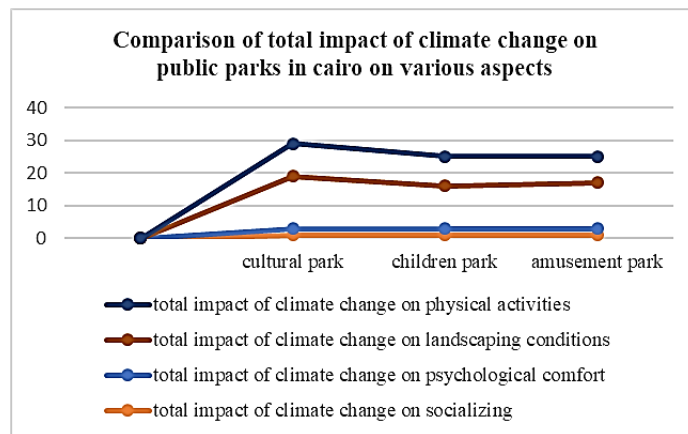


Figure (30) Comparison of total impact of climate change on various aspects inside case studies. Source: The Authors

The previous graphs can demonstrate the state of public parks in Cairo, especially cultural parks, children’s parks, and amusement parks. The International park (cultural park) is the most affected park in terms of total landscaping conditions, while the child’s park (children park) is the least affected. The Maadi island has the largest score of total loss of trees and the three sorts of parks has a massive need for regular or maybe updated

sort of irrigation. The green coverage had been highly affected in all sorts of parks. Socializing is the only aspect that has barely affected by climate change. According to the previous analyzing shown in Table (4), cultural parks has the greater total impact of climate change on the previous aspects while both children park and amusement parks have equally total impact of climate change.

Moreover, both psychological comfort and socializing have the same evaluation among the three sorts of parks. Landscaping conditions are the most and highly aspect negatively affected by climate change among public parks, on the other side the socializing aspect is the least aspect negatively affected by climate change.

Accordingly, the authors recommend a set of actions concerning minimizing the impact of climate change on public parks in Cairo through the following Table (5)

Table (5) A recommended set of actions in order to minimize the negative impact of climate change inside public parks in Cairo.

Aspects	Recommended set of Actions
Monitoring	Long-term monitoring for the public parks over the whole scale of Cairo
	Monitoring the mass loss of trees inside the parks
	Monitoring the rate of declination of green coverage areas inside the parks.
Management	Resources management is essential in order to minimize the negative impacts of climate change on landscaping conditions.
Improvement	Using various shading systems in public parks and especially for green areas to decrease the negative impact of climate change on parks' visitors.
	Updating sorts of irrigation for avoiding the declination of green coverage areas.
	Updating the selection of plant material inside parks which can support the massive negative impact on landscaping conditions.

Source: The Authors

4. CONCLUSIONS

The current study has defined major aspects that are affected by climate change among public parks in Cairo which are landscaping conditions such as planting design within parks, the need for irrigation, declining of green coverages, mass loss of trees, in addition to the physical activities of visitors inside the parks which are active playing of children, walking, running, playing sports, riding bicycles, moreover, both the psychological comfort and socializing of visitors inside the parks that might be affected by climate change. The research findings can significantly demonstrate the highly recorded negative effect of climate change on landscaping conditions of public parks in Cairo compared to the other aspects. Long-term monitoring for public parks in Cairo should be obligatory in order to minimize the negative impacts of climate change.

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