Ain Shams University
Egypt

# Assessing the suitability of residential compounds' landscape to the Egyptian context

## The use of green lawns between socioeconomic and environmental forces

**A Thesis submitted in the Partial Fulfillment for the Requirement of the Degree of Master of Science in Integrated Urbanism and Sustainable Design**

**by:**
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# Abstract

The development of green lawn areas is much associated with the emergence of gated communities in Egypt. We can see a wide large areas of green lawns in most of the residential compounds in Egypt, it's considered as the main selling point that most of real estate developers utilize to sell their developments, which could be a valid point nowadays, as most people are searching for the European dream of having wide green lawns to live nearby, but do this lawns achieve the needed functions and balance for both the socio-economic and environmental aspects.

My argument is that the residential landscape is now seen as a nonfunctional scenery design with many processes needed to keep it maintained which in turns effects the environmental balance. In this research this type of green lawns as the main residential landscape type will be assessed between socioeconomic and environmental forces to evaluate its suitability within the Egyptian context of Egypt in a way that could be applied to many other residential cases in the city.

This could be done by choosing Madinaty as a case study for a sustainable big development in the context of Egypt, while assessing the types of lawns used for different functions within the compound from the point of views of people living in the area, the benefits, and costs for the developers, as well as the current environmental situation of Egypt regarding water scarcity and air pollution main challenges at the time. Ending the research by evaluating the case study, and introducing new environmental sensitive alternatives for landscape lawns, which could be used to achieve the balance between the two mentioned forces.

Keywords

Landscape lawn, Environmental forces, Landscape related economy, Environmental sensitive landscape, Water scarcity, Residential landscape, Egypt.

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# Abbreviations

TMG (Tallat Mostaga Group)

GCR (Greater Cairo Region)

GCs (Gated Communities)

# 1 INTRODUCTION

# 1. Background

Westernisation (adaptation to Western culture) and globalization have driven the form of landscape in residential areas into green lawns worldwide. As we can see, today, lawn is one of the most popular elements of residential areas in many cities (Ignatieva & Marcus, 2018). In some regions, lawns occupy as much as 70% of urban green spaces (Ignatieva, 2011). In the United Kingdom , as much as 60% of private residential gardens use the lawn as the key element in their gardens (Smith & Fellowes, 2014). The approximated total area of lawns in Sweden is as much as 22.5% (Hedblom et al., 2017). Lawns can be found anywhere, in the front and backyards of private gardens, central public parks, golf courses and along streets and roads.

As for Egypt's case, the extensive use of green lawns was much related to the new movement in urban planning "the Neo-liberal approach; privatization, the opening up to private investments, and an increased focus on the private sector", the development of luxurious gated communities which became prevalent in Cairo from the 1960s onward. The first gated community in west Cairo was "Dreamland," the new ambitious city, as shown in figure 1, and then "Beverly hills" in 6th of October region, as shown in figure 2, depending on the Western landscape, and the American lawn dream.

(Fig.1) __ Beverly hills compound, West Cairo (Web source).


(Fig.2) __ Dream land compound, West Cairo (Web source).

Afterwards, real estate developers started the challenge of fulfilling the dream of most people while being against nature. Then hundreds of compounds from west Cairo to the east, and to the new administrative capital are being planned and constructed using the green lawns as a representation to a luxurious lifestyle. When reviewing most of the residential compounds in Egypt nowadays, (ex. Madinaty, Allegria Sheikh Zayed, Uptown Cairo, Palm Hills Alexandria) (See appendix D for photos), it's clear that they focus on the green image in their advertisements to promote the green healthy life people want.

The landscape they're showing is represented in vast green lawn areas, golf courses, so people can enjoy the green view and enjoy doing their activities in that green context, even though each region has different climatic conditions, different economic state, and different social structure.

# 2. Personal background

While I was studying as an undergraduate student in landscape architecture in Egypt, I received an education on how the landscape is different from country to the other, and how the landscape could benefit the environment, if well placed and managed. However, these education have been neglected in the contemporary landscape design in residential gated communities. Instead, the landscapes are inspired from the European gardens from Western countries, and the American landscape lawn dream. The well-mown green lawns, together with huge central parks, and golf courses, became a symbol of a globalised landscape (Chen, 2013). This aroused my interest in the adaptability of such types of landscape within the context of our country.

My study and personal background in Egypt give me an impression of lawn dominance in residential gated communities in Egypt. Therefore, I developed my MSc research by studying lawns in residential compounds, evaluating the impacts and adaptability to the Egyptian environment, as well as searching for scattered applied alternatives.

# 3. Thesis structure

This thesis consists of a total of five chapters. Chapter 1 provides a general background to the research topic: the problem statement, the research objective as well as the research questions of the thesis. In Chapter 2 the theoretical and conceptual framework for this thesis are presented, while Chapter 3 starts by a selection criteria for choosing a case study, and then moving to the different types of analysis to the selected case study, Chapter 4 is based on finding from chapter 3 and provides some alternatives. Finally, in Chapter 5 the results and findings of the study and some recommendations are proposed.

# 4. Problem statement.

Most of the residential compounds in Egypt are using green lawns of the western culture in different forms in their landscape designs to market for their developments, fulfilling the preferences of people's lawn dream, not paying much attention to the impact of these lawns on both socioeconomic and environmental forces, which in turns result in some defects to the environment, the economy, or even to the societal system on the short or long terms. So, the problem that will be addressed throughout the research, is whether the green lawn in the residential compounds is suitable to the Egyptian context, in terms of the environmental conditions, also, the socioeconomics of the real estate developers and people's preferences.

# 5. Research objective.

This study aims to investigate the phenomenon of lawns; as the most highlighted landscape used element in the residential gated communities of Egypt and assess the suitability of different types while considering the socio-economic (The social preferences for these types, as well as the costs and benefits for the real estate developers from developing and maintaining these types of lawns in their projects) and environmental forces (concerning the current state of Egyptian environment). Not only that, but also, discuss other environmental sensitive alternatives which will achieve the balance between the socioeconomic and environmental forces, taking in consideration the suitability of such landscapes in the current generations and not affecting the future generations too.

# 6. Research Questions.

To assess the suitability of lawns, we're going to define two forces which are: Socio-economic force; which is represented in people's preferences and the real estate developer's related costs and expenses for maintaining lawns, second force is the environmental force; which is related to the impacts of these lawns on the environmental components of Egypt's context such as water and air, and whether the current situation in Egypt could anymore holds many lawns.
The research at the end, would be able to answer these questions.

- What are the preferences of people in residential compounds?
- What are the commonly types of lawns used in compounds?
- What are the effects/impacts of lawns on the current environmental components' situation in Egypt's context?
- What are the expenses and the revenues for the developers?
- What are the impacts of lawns on socio-economic aspect?
- What are the different alternatives and scenarios in different residential compounds nowadays?
- Whether these alternatives could be beneficial to the current environmental situation in Egypt.
- These questions will be answered through the selected case study of Madinaty, that could be applied on other residentials compounds in Egypt.

# 7. Definition of terms.

Residential compounds (RCs) and gated communities (GCs), both stands for a form of residential community or a housing estate with controlling entrances, surrounded by fences or walls. GCs usually consist of residential units, with connecting streets, public parks, and spaces to serve the needs of the inhabitants, besides some various shared amenities.

# 8. Overview of Egypt's environmental conditions nowadays

Environmental changes around the world endure a negative impact on lifestyle. The efforts made to decrease or slow the rate of change are unsteady and disproportionate to the speed and rates of change.
As a developing country, Egypt shares most of the environmental problems, that are spreading nowadays. Egypt is facing a wide variety of environmental problems that are mostly associated with air and water. Major issues associated with air and water are water scarcity, and air pollution.
In this research, we're going to discuss these two environmental issues as one of the two most tackled issues with respect to the landscape. As any landscape needs water to survive as it affects the air quality of the surrounding. Therefore water and air are the most associated key issues with the choices of landscapes within the context of our country Egypt.

# 2

# THEORITICAL FRAMEWORK

This chapter provides an explanation of some of the relevant theories related to residential green spaces, and lawns, and their impacts in different regions. It further reviews the, which will establish a theoretical basis for the research for understanding residential Egyptian lawns and help in searching for environmental sensitive alternatives. The theoretical framework of my research is presented in the above Figure 2.

# 1. Residential landscape choices overview in different regions.

Residential landscaping can be defined as the art and the practice of improving the appearance and aesthetic appeal of the area surrounding a home “David Trinklein, Master Gardening: Residential landscaping”. It’s about providing residents an aesthetic view as well as functioning well for residents. Not only does it have benefits for the residents, but also it improves the environmental quality of the surrounding.

There are a lot of landscape choices for residential areas in different countries around the world; especially the green choices and each choice has an impact on the environmental conditions of a country, the economical state, as well as the society who acts as users performing the functions provided by these landscape choices.

In residential areas, the green choices are found everywhere, such as the green groups between buildings, the green central part for the community, the border between different functional areas, the green plaza, and the green around water, and are found in many forms; they could be lush grassy lawns, trees, palms, different plantation types, or a combination of two or more choices.

By examining landscape choices of residential areas in different cities, we can see that the choice of lush grassy lawns in the unites states of America covers 2% of the united states' land (Where a NASA satellite study in 2005 found that American residential lawns take up 49,000 square miles (128,000 square km) which is nearly equal in size to the entire country of Greece and now this estimated number is much more). Lawns are the most dominant crop in the United States and it's not a crop that could be eaten; its primary advantage is to make us look and feel good about ourselves.

For Americans, the state of a residential homeowner's lawn is of a great importance in relation to their condition within the community and to the condition of the community in the bigger picture; as Lawns connect neighbors and residential neighborhoods; they're viewed as a socio-economic character indicator, which is translated into the residential property values. Lawns are also an indicative of success; they are a physical demonstration of the American Dream of home ownership. To own a well-maintained lawn is an indication that you have the time and the money to support this attraction as well as when homeowners pursue a green carpet of grass, they hire someone to attend to its needs and this is another indicator of success and is related to a rise in the economic opportunities.

But unfortunately, this is not the case for all the states; as the sheer volume of resources which is required to keep lawns green and lush is astonishing, and seems wasteful in consideration of drought plagued places, as in California. So, in the recent year and due to the to the awareness that was made by social media, the significance of lawns (that persisted in the west for a long time and was aided by water management technologies that helped transform arid landscapes into lush ones) is now changing as well, as it was estimated that lawns consume the equivalent of 200 galloons of drinking water per person per day. Nowadays, Californians, who are fully aware of this wastage, have taken to shaming neighbors who are still insisting on watering their lawns.

There's other landscape choice that's taking place nowadays in Spain, in the private residential gardens the natural grassy lawns are being dug up and replaced with synthetic plastic turf.

It's significant that the residential lawn in the city of Spain was a notable services' provider as in many other regions of the world, it performs important functions for the residents as a recreational area, ornamental area, sports facilities, and other environmental functions.

However, the current application of lawns does not integrate only with these advantages, it required a lot of processes (From watering, mowing, and fertilizing) and cost to maintain. Thus, in Spain most of homeowners replace these natural grassy lawns with synthetic plastic turfs to decrease the cost and maintenance for lawns and at the same time have the same aesthetic green view they wish for. As a result of such trend in children's play park in Denia, in which they replaced the natural lawns with a plastic turf as a less costly alternative, it turned out to be an area plastered in dog excrement and urine which causes catastrophes in health and hygiene (Estruch, V. and Valles-Planells, M. ,2015) And because the artificial turf didn't decompose and didn't allow the wastes to infiltrate to the soil, it caused a lot of issues within the park, and eventually it's turfed out.

Therefore, we can point out that their choice for synthetic turf saved a lot of money and effort, as it doesn't require a lot of maintenance processes and resources as the natural lawn, but it had a negative impact on the society's health on the long term, as well as an environmental diverse impact.

In other countries as China, they depend mainly on bamboos, which were planted in the residential private areas, and were considered as a green aesthetic background and to some extent an independent buffer between different residential properties. Moreover, it is an upright sign in the Chinese culture, it represents the harmony between green landscape and spiritual environment. So, their choice for bamboos had a positive impact on their society, as well as on the environmental quality.

# 2. Residential landscape choices in Egypt's case.

Coming to landscape choices in Egypt, we can see that landscape architects paid much attention to the development of quality residential landscape especially in residential compounds, as the development of high-quality residential landscape was much related to the emergence of gated communities. The environment of a residential compound has very close relationship with human 's life, a properly planned and managed urban green spaces are crucial to the sustainable future of the new communities in Egypt. The value of the green space in the urban environment of such arid climate of Egypt is to provide environmental functions, where Parks, community gardens, and green spaces can reduce carbon footprint. Also, to provide a physical space for social interaction to enhance the sense of belonging and aid the health of residents (Abdelaziz, M. 2018), (Ghonimi I. 2013). During this part we'll briefly discuss the emergence of such gated communities in Egypt, the marketing materials of these compounds which is represented in the applications of green lawns.

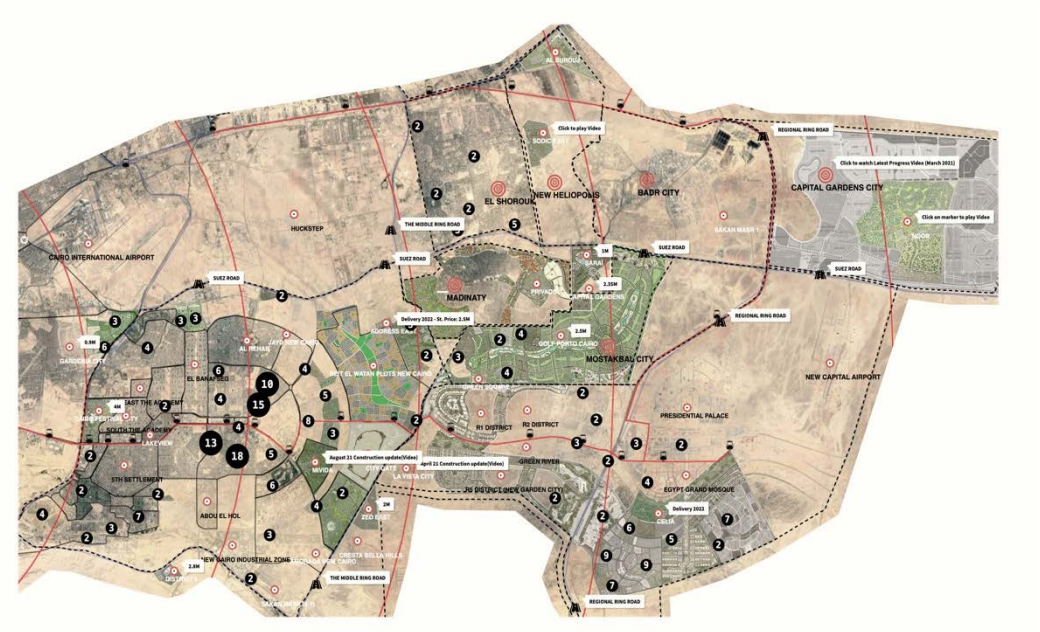
## 2.1 Emergence of Gated compounds.

During the late seventies the Egyptian government constructed new residential communities around Cairo City, to control the urban expansion of the capital city and to direct the urban sprawl towards the desert land instead of the agricultural land. Despite planning new cities surrounding GCR to accommodate the middle class, gated residential compounds as a new development pattern were observed in many of these new cities of 6th of October City, El-Sheikh Zayed, New Cairo, El-Obour and El-Shorouk, consisting of luxurious large-area residential villas, huge green open spaces, and exclusive recreational and social services' including all types of luxuries.
The phenomenon of residential gated communities appeared in 1980s as a reaction to some socio-cultural and economic changes. In the mid-1990s, the Egyptian government begun selling large areas of public land to real estate developers in private sectors -a major policy move towards privatization of urban development- (Neo-liberal urban approach). Up to now, the construction of more than a hundred privately planned gated residential compounds show a mass trend in new-town urban development on the peripheries of the Greater Cairo Region (GCR), the most populous city in Egypt. Gated residential compounds have increasingly become a rewarding segment for the real estate market by providing a new marketing perspective for developers as offering security, and a prestigious lifestyle. The development of gated communities in many communities shows that real estate developers understand the need to offer safety and security to a market that is characterized by customers seeking new living with an exclusive living standard. The concentration on such socio-cultural functions has made changes in people housing preferences through cleverly advertised marketing campaigns. The aim of real estate developers is to sell units at higher prices, which they try to achieve through media and commercial advertisements using landscape as the main marketing material, and that what will be discussed in the coming part.

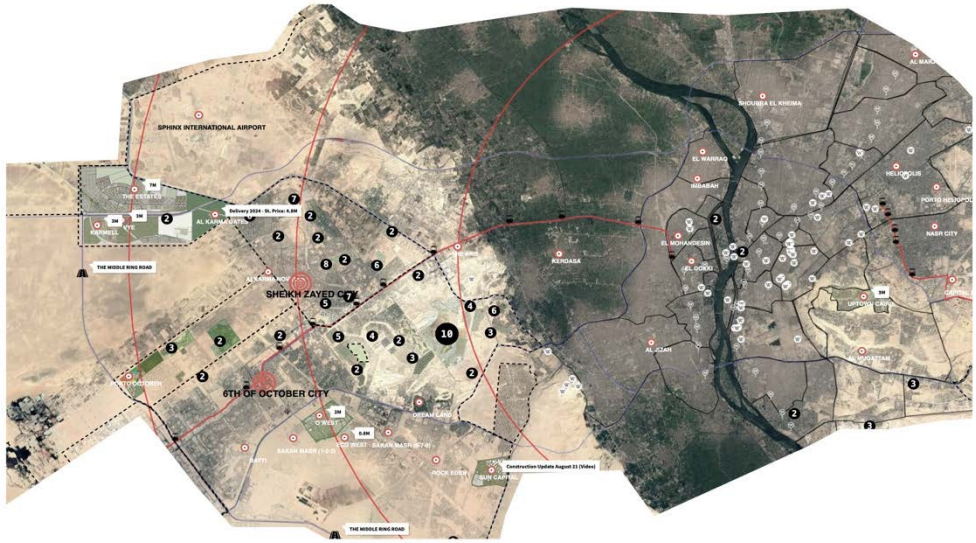
Some of the most popular gated compounds are Beverly Hills City, Dreamland, Madinaty, Katameya Heights, Al-Rehab city, and Hyde Park. These names symbolized specific historical and spatial connections. They are symbols of exclusivity that are used to market not only the physical spaces and residential properties, but also a western style of living (Metwally, M. and Soliman, S.,2013), (Abdelaziz, M. 2018), (Ghonimi I. 2013).
So the first thing that gated communities promise is a sense of exclusivity. Here is an example of how one project was promoted:

*"Intelligently designed to ensure you enjoy your exclusive lifestyle, Hyde Park offers: A garden setting with lush greenery, the main park is exclusively for the residents of Hyde Park and has garden pavilions, gazebos, comfortable benches, an amphitheater and multi-purpose open grass field. A pedestrian friendly neighborhood with up to 7 kilometers of walking and jogging trails that wind throughout the park.... Spread across 4 million square meters, Hyde Park is the most exclusive villa development with Detached and Attached Villas nestled with a 1 million square meter landscaped park, the biggest private park in Egypt. Designed to suit multi-cultural tastes, the villa designs range from the Neo-Classical, Italian-Country to California-Spanish styles. Set atop beautiful vistas and surrounded by Egypt's natural beauty, your home will be amidst striking landscapes and beautiful water features."*

As we can see in most of the residential compounds in Egypt nowadays from the east to the west "as shown in the following figure" we can notice a large, designed areas of green spaces; mostly green lawns, which is much related to the advertisements of these compounds. Real estate developers in their marketing campaigns highlight the application of lawns in their developments not only as an aesthetic view, but also as a lifestyle that many people wish for.




(Fig.3) __ Residential compounds in East Cairo, from new Cairo to the new administrative capital. Source: Egypt Real Estate interactive map.




(Fig.4) __ Residential compounds in West Cairo,
Source: Egypt Real Estate interactive map.

## 2.2 Residential compounds marketing materials “Gated communities from the perspective of developers”.

Some researchers as Rana Tawfiq Almatarneh derived some factors that are important in the marketing to these new residential gated communities. In our research we selected some of them that are mostly related to the landscape of these compounds and how landscape plays an integrated role in the marketing of the residential compounds: social factors, lifestyle factors, exclusivity, and ‘‘other’’ various features such as nature and view.

### 2.2.1 Social factors

Real estate developers market the gated residential communities as ideal sustainable compounds where one can perform various community activities that are located within green open spaces as shown in figures 5,6 and 7, were we find that they always relate the human activities with a green lawn in the background as the base for the activities to complete the image of a sustainability (Tawfiq R. ,2013).

(Fig.5,6,7) __ Social factors translated into photos of people performing activities within the green open spaces (Web source).

### 2.2.2 Lifestyle factors

Factors to a good lifestyle are one of the major and most used marketing materials by various real estate developers. These lifestyle factors are grouped into sub-categories (as proposed by "Rana Tawfiq Almatarneh, Jan 2013" one of the researchers in that field): the good life, active lifestyle, peace/relaxation, golf, and maintenance free (Tawfiq R. ,2013).
Advertisements and marketing provide examples of how a community is packaged and sold not only as a house but as whole lifestyle. Where a family is not just buying a peoperty to live in but a ready-made life, as addressed in an advertisement from Hyde Park: ''Unlimited choices from the tranquility of the vast green spaces include Golf Course, a Clubhouse, parks, walkways, jogging tracks''as shown in figure 8, where they highlighted the green open spaces as the main lifestyle factor to market their compounds.

(Fig.8) __ Green spaces include walkways and jogging tracks (Web source).

### 2.2.3 Exclusivity factors

One of the most important and highlighted services that most high-end real estate developers use to market their compounds is golf courses. The golf course reflects two impressions at the time: First, it claims the exclusivity that developers assure their costumers, and second, it adds a positive value to both home properties as well as the people. The ‘‘Troon Golf’’ and the Clubhouse in Allegria are considered a good example for the exclusivity factors as shown in figure 9.

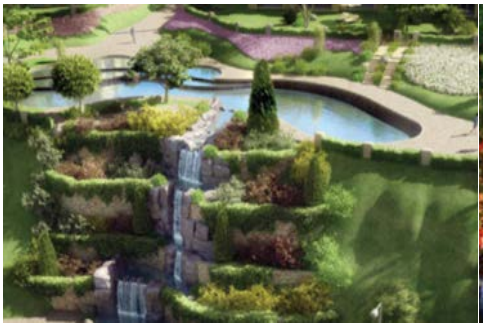
‘Enter a world of exclusivity’’, ‘‘your exclusive lifestyle’’, ‘‘A signature golf course inyour front yard’’, ‘‘Live the luxury’’, and ‘‘The new premium residential district of Greater Cairo’’. All these slogans and quotations are oriented and marketed to rimprove the sense of exclusiveness and significance that gated residential communities can offer. Therefore, residential communities create a product which acts as an exclusive view to sell their units, even if it’s not used as a game as it should be (Tawfiq R. ,2013).

(Fig.9) __ Troon Golf Course in Allegria, 6 of October city (Web source).

### 2.2.4 Environmental factors

Environmental factors according to the researcher can be categorized into greenery, openness, richness of the visual environment, and cleanliness (as shown in figures 10,11).
One of the most common marketing strategies for selling residential compounds is by trading nature and glamorizing the countryside. In each of the compounds all over Egypt, the promotional image for all the developments includes green lawns, open parks, water elements, and other elements of nature as shown in figure 7,8. Marketing strategies target the gated communities as places to escape from the polluted city of greater Cairo. Like ''Hide Park'' advertisements, they boast the concepts of clean air, open greens, absence of smoke and overall better health than living in the city center. Some of the slogans that were used for these purposes include: ''beautiful environments''; ''A world of green''; ''A garden setting with lush greenery''; ''Welcome to the greener side of life''.... etc.

Even the mentioned communities are named after some nature elements to promote the good green life, such as ''Ashgar Heights'', ''Grand Hills'', and ''Beverly Hills''. Many of the developments use names that promote the green concept by using words such as ''Village'', ''Gardens'' or ''Park'' as in ''Stone Park'', ''Hyde Park'', ''Gardenia Park'', and ''Tiba Gardens''. All these names play on this desire of people (Tawfiq R. ,2013).
Most of the advertisements' slogans focus on environmental characteristics, with some words such as Greenery/green/greener/garden/park, all green to promote the clarity of the life they're offering which attracts people's attention and fulfill their European dream of living nearby a vast green lawn space.



(Fig.10) __Richness of the visual environment (Web source).

(Fig.11) __ Stone Park gated community by the Rooya Group (Web source).

The aim of this part was studying the community preferences and the changed market of the residential compounds, we used this survey to derive the relation between the marketing of the new residential compounds and the use of landscape green areas to sell such communities, and what types of landscape images developers use to fulfil the social preferences.

However, from the previous we can conclude that developers of residential compounds with their marketing materials, they claim to offer 'a sustainably green exclusive lifestyle' that could benefit the health of human and integrate humans with nature, this will lead us to surveying nowadays compounds in different regions of Egypt, to see the same green image that most of developers are promoting, not only here in Egypt, but also in different countries they use the same type of landscape which is the green lawns as the highlight of their developments, which made us think is this claim of offering a sustainable life is right for the sake of socioeconomic and environmental forces or there's one force dominating than the other and the claim is just made to sell the communities and was influenced by efforts to sell images of the western green lifestyle in the Egyptian local context, reaching to the current problem that is going to be discussed during the research.


(Fig.12) __ Madinaty, East Cairo advertisement (Web source).


(Fig.13) __ Hyde Park, East Cairo advertisement (Web source).


(Fig.14) __ Waterway, East Cairo advertisement (Web source).

(Fig.15) __ The green river, The new administrative capital, East Cairo (Web source).

# 3. Residential lawns assessment.

Grassy lawns have a significant impact on the cityscape as one of the fundamental elements of green spaces in most of residential areas around the world and an integrated part of people's everyday lives. Most people around the world view lawns as an obligatory element of the urban landscape and public spaces, without considering their social, symbolic, ecological, or aesthetic values, and whether they have diverse impacts on any of the aspects.
The overall aim of this part of the study is to investigate different residential lawns' impacts, as well as considerations behind decisions about the formulation and management in different regions, to come up with a list of criteria to evaluate the residential landscapes in the selected case study.

## 3.1 History of Lawns.

We'll need first to review how the lawns over spread from the western world to our country. During the 17th century, lawns started to appear much at the homes of wealthy homeowners, but due to the large amount of labor needed to maintain its shape, it was a mark only for wealthy people. After that time immigrants from Europe brought them to America.
In the 19th century, as cities developed and became more industrialized, city beautification movements started to increase, and the concept of "park" started to rise. This term was originally referring to the large areas of lawn with their surrounding trees where wealthy English people lived. After that, and with the increase of population, it took a new meaning in socialist America and became a public area consisted of landscaped lawns, trees, shrubs, and water features where all that features were boosted from British estate basis.
Adjusted and democratized, the park became familiar in North America.

Anyone who has visited the United States or southern Canada can see that even the smallest part of the city has its own park: a block or two dedicated to grassy lawn, trees, sand area, a few benches, and a water fountain.
If most of those items were removed while saving the grassy lawns only, it would still be known as a park from their perspectives.
Eventually lawns became the highlighted element of the parks as well as the backyards of most of houses. A key character in this lawn movement was Frederick Law Olmsted (1822-1903), the American father of landscape architecture, who designed New York City's Central Park in the 1850s, as well as parks in Boston, Montreal, and many others. Olmstead not only promoted the use of grassy lawns in public parks, but also designed and planned residential areas in which each residential unit has its own lawn.
In 1830, Edwin Budding developed the first lawnmower equipment, therefore it decreased the large number of labors needed to maintain the lawns which helped in the increase of popularity and usage of lawns in many houses.
Therefore, the lawn became a symbol for the American dream of the middle class where people dreamt of a home surrounded by grassy green lawns, not only a sign of upper-class British people.
The lawn dream was then transferred to the wider world in combination with several turf-based sports such as cricket, football, and most importantly golf. It was adopted elsewhere more madly than in the USA, as the 18th-century landscape ideal garden with no doubt depended on the American concept of parks, golf courses and home lawns, which is then transferred here in Egypt.
We started the journey of lawns establishment, and maintenance processes depending on the environmental resources of consuming excessive water, and chemicals just to maintain the green looking of this lawn dream which is then could be found anywhere especially the residential developments which is the focus of our research.

## 3.2 Lawns impacts

The use of lawns nowadays is seen as a lifestyle product (Giddens,1990). Today, lawns are considered an integral part of all green open spaces in cities (they cover up to70–75%). They can be found in residential compounds as follow, central parks, private residential gardens, golf courses and in the middle of roads. Most people around the world view lawns as a natural key element of the residential urban landscape, without questioning their social, ecological, or economic values (Stewartet al., 2009). There's no doubt that people enjoy lawns and enjoy performing functions such as sitting, playing, walking on them, also these lawns is directly proportional to the economic property's value of a place. However, the excessive management practices used for lawns as frequent mowing and spraying of herbicides and fertilizers, has raised awareness about their potential negative impact on the urban environment. Specifically, the intensively managed lawn is regarded as a biodiverse-poor community and has high global warming impact by releasing greenhouse gases from maintenance practices (Gu et al., 2015; Smith & Fellowes, 2014). Pesticides, and chemical fertilisers as water pollution sources have become increasing concerns in the recent years and can cause negative impacts to people's health (Hernke & Podein, 2011; Zhou et al., 2008). Water for irrigating lawns can take up 30% to 60% of municipal potable water (Simmons et al., 2011).
Having recognized those problems, researchers in the USA (Simmons et al., 2011; Byrne, 2005; Robbins, 2012), New Zealand (Stewart et al., 2009), the UK (Smith & Fellowes, 2013-2014), Sweden (Ignatieva et al., 2015) and France (Bertoncini et al., 2012) started to question the phenomenon of lawns, and started to propose other lawn alternatives, which are more environmentally friendly compared to the conventional lawn.

### 3.2.1 Lawns practices

Green lawns have many benefits. They add aesthetic value, serving as useable and functional outdoor spaces, but unfortunately, lawn areas should be managed with a lot of practices as watering, fertilizing, mowing, which can have detrimental effects on the water resources of a country and the overall health of the community.
Management practices of lawns is highly variable, and can range from high maintenance golf courses, which require high amounts of fertilizers, to some residential lawns that are not watered and fertilized regularly. Many residential lawns, on the other hand, are managed by homeowners who pay little attention to the number of resources invested for lawn maintenance and often receive excess water and fertilizer. Variability also exists in the mowing processes which are either left as a meadow or mowed regularly to maintain the green looking of the lawn. The main management practices of lawns are as follow.

#### 3.2.1.1 Watering

The most critical and limiting factor to a beautiful, healthy green lawn is applying the right amount of water at the right times.
To keep lawns green and with a good looking, they need to be watered regularly some types of lawns needs to be watered from 3-4 times per week, and some other types could need less amount of water or more, depending on the climatic conditions of the country.

### 3.2.1.2 Mowing

To keep the good looking of a lawn, and the green and lush appearance, it should be mowed regularly before the grass height is too much, and the weeds starts to appear. The Outdoor Power Equipment organization predicts that, roughly, people mow their lawns for 25 hours per year.
Lawnmowers release harmful emissions which include Methane, Ethane, Ethene, Ethanol, Nitrous oxide, Carbon dioxide, Carbon monoxide and most important the particulates – microscopic aerial particles released from gas powered mowers. These results in smokiness besides the odor from gas powered mowers which can harm the respiratory system, leading to breathing obstacles especially with kids, seniors, and anyone suffer from pre-existing health issues (Jonas, M. ,2020)

### 3.2.1.3 Fertilizing

Nitrogen is one of the most important elements that gives the plant the energy needed to grow. It's essential to all life on Earth, but it can have diverse impacts on the environment, the air quality, and our health when used in an excessive manner. Nitrogen pollution may be resulted when some nitrogen compounds – like ammonia and nitrous oxide – become abundant. This pollution happens sometimes because of using synthetic fertilizer (Paul, E. ,2019).
Nitrogen emissions as nitrogen oxides (NOX) or ammonia (NH3) share in the formation of primary ground-level and secondary fine particles, which together with nitrogen dioxide, are of the major air pollutants with critical impacts on human health when released into the air (Bowyer, J. and Groot, H. and Henderson, C. and Pepke, E. ,2019). In addition, most nitrogen fertilizers' manufacturing consists of greenhouse gasses (GHGs – typically CO2 and NO), and other gaseous compounds, especially particulate matter (PM10) which are very destructive to the atmosphere.

Furthermore, the increased availability of nitrogen in the surrounding ecosystems as well as the excessive application of fertilizers to maintain as many lawns lead to emissions of nitrous oxide which is significantly contributing to decrease in air quality which in turns results in a climatic change. Nowadays N concentrations in the atmosphere are increasing with a rate of 0.3%/year.

## 3.3 Case Study of Residential Lawns in China

Coming to assessment of lawns in non-European country, like China which have similar climatic conditions of Egypt -Dry climate- in some times of the year. China used to have an open landscape “called pastures” covered with native herbaceous plants that grow wild without maintaining for biodiversity as shown in figure

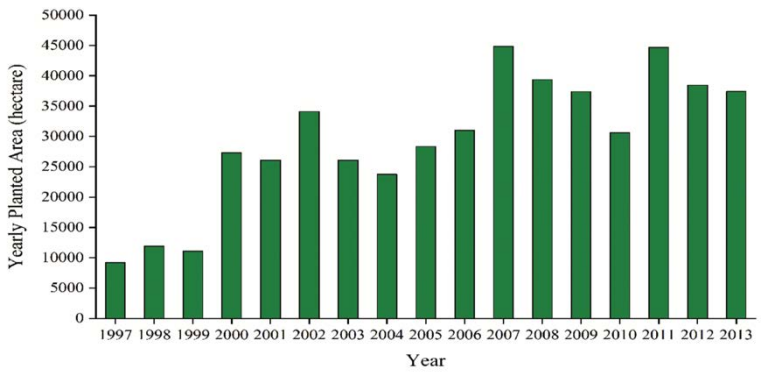
(Fig.16) __ Herbaceous plants, in Zhuozheng garden, China,

Residential villas' gardens had a mixed character which kept the irregular unmaintained herbaceous plant species which represents the artistic concept of old Chinese Gardening besides some adopted elements of Western landscape character which is the lawn; as one of the crucial elements in Western landscape architecture. Due to several changes in the Chinese government, the lawn was widely used in residential areas in China.

At this phase, the lawn became a monoculture and had approximately close-cut surfaces, due to changes in people's attitudes, so that a landscape scene was not considered aesthetic until the signs of human order were clearly visible.

In China, the lawn area increased dramatically in the period between1997–2013, from 9,210.53 hectares to around 40,000 hectares, although it varied over the years as shown in figure (Yang, F. and Larsson, A. and Ignatieva, M. and Xiu, N. and Zhang, Sh. 2019).

(Fig.17) __ Area of new lawn planted annually in China from 1997 to 2013.




(Fig.18) __ Garden villas in Shanghai.

The western globalized landscape lawn can be observed throughout China now, despite the varying climatic conditions.

In order to achieve 'perfect' lawns, demanding management practices with advanced chemicals, tools and techniques is applied in China, which is very costly and resource-consuming as well. Turf grass seeds and lawnmowers, as well as facilities for irrigation, were all imported from European countries and North America.

However, the climate conditions are not convenient for the growth of these imported grassy lawns. Furthermore, irrigation and mowing equipment is very expensive to import, which has made lawns even more expensive to maintain in China than in European countries.

For example, in Dalian city 5 to 10 million water tons are needed for lawns' irrigation every year. In addition, the lawn has to be mown every four to five days and the mowing costs overall are about (€666.5– 800). Because of the monoculture and un-suitable climate, lawns are exposed to diseases and it takes much time, cost and effort to maintain them. In total, therefore, the cost of establishing a lawn is (€1.1–2.7) per squared meter and the annual maintenance costs are about (€0.8–1.1) per m2. In addition to these high costs, the intensive management of lawns in China caused severe environmental problems as surface water pollution from the chemicals and fertilizers used -about 70% of surface water and more than half of the groundwater have been contaminated-, greenhouse gas emissions during mowing and heavy use of water for irrigation. Not only that but also, almost half of these lawns are bordered, and people are not allowed to walk on them. That would result in social issues, as these lawns were only used for ornamental purposes and for 2,000 years only privileged people groups could use them, thus residents and lawn managers do not truly recognise the real functions of lawns. Lawn managers are afraid that if lawns were opened fully to people, that would cause extensive tramping, which would deteriorate the lawn appearance and affect its quality (Huang, H. and Zhang, Y. ,2019).

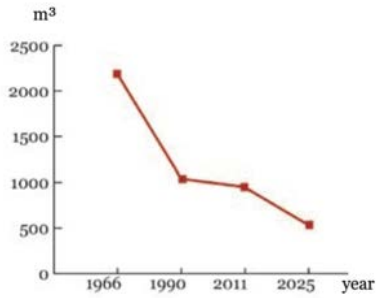
As a conclusion to this case, at present, China is facing environmental problems that has been caused by the overuse of water and chemicals for maintaining lawns. In terms of the growing area of planted lawn in China, its negative impact on the urban environment cannot be ignored and actions should be taken related to lawn use (Yang F., Larsson A., Ignatieva M., Xiu N., 2019).

## 3.4 Relating to Egypt's conditions nowadays

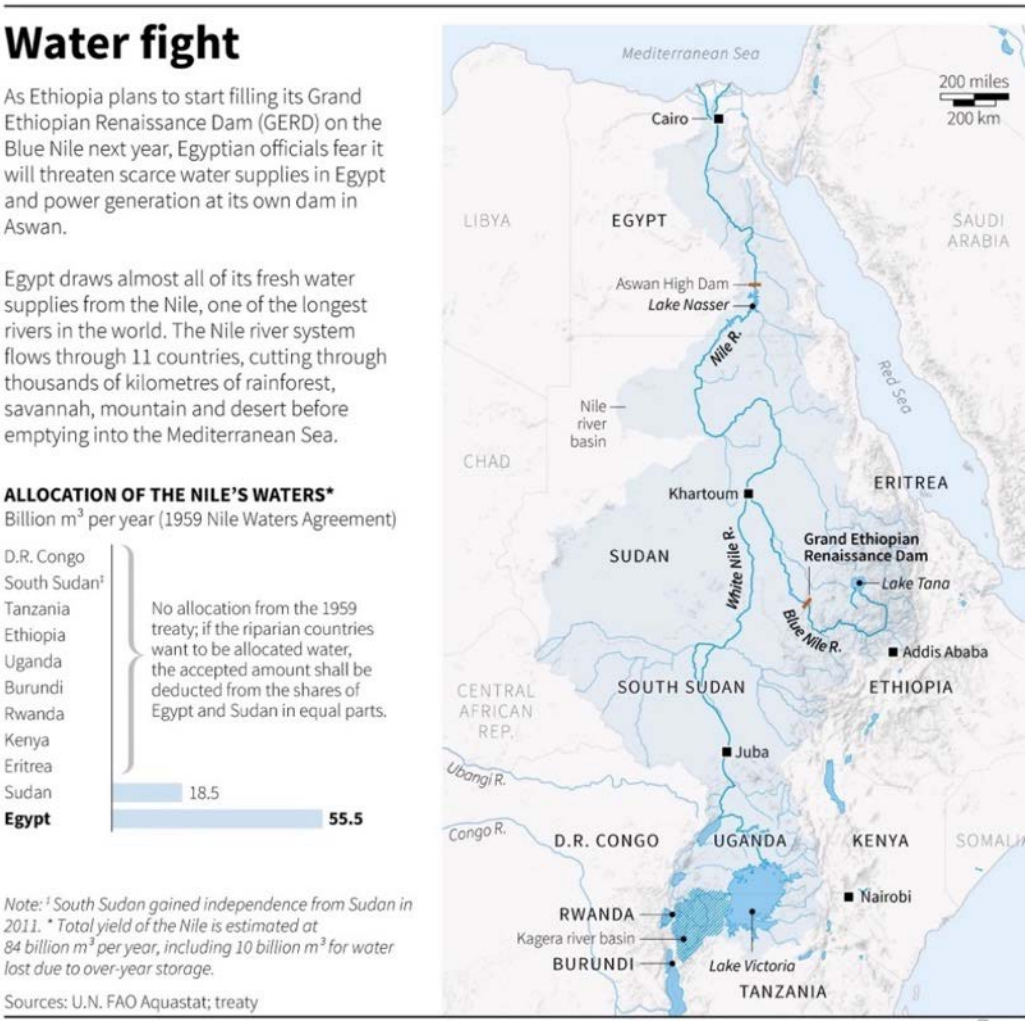
Egypt shares most of the environmental problems of developing countries. Two of the most important health and environmental problems are, water scarcity as well as air pollution.

### 3.4.1 Water scarcity

Egypt has been suffering from serious water scarcity in the recent years, as shown in figure. Uneven water distribution, squandering of water resources and ineffectual irrigation techniques for different types of landscapes are some of the considerable factors playing chaos with water security in our country. Egypt has only 20 cubic meters per person of internal renewable freshwater resources, and thus the country depends densely on the Nile River as its main water source. The Nile River is the spine of Egypt's industrial and agricultural sector and is the primary major source of drinking water for all the population. Growing populations and great economic development in the Nile basin countries, environmental degradation and water pollution sources are decreasing water availability within the country. Egypt is experiencing an annual water loss of around 7 billion m3.




(Fig.19) __ Water Availability / Capita / Year (Web source).




(Fig.20) __ Water Fight,
(Web source).

United Nations nowadays is already warning that Egypt could possibly run out of water by 2025, and it's predicted that 1.8 billion people all over the world will live in certain water scarcity.

Egypt receives approximately less than 80 mm of rainfall per year, and only 6 percent of the country is cultivable and agricultural land, with the rest of the country a desert form. This results in needless excessive watering and the use of reckless irrigation techniques such as flood irrigation (an out-of-date irrigation method where many gallons of water are pumped over the large areas of crops). Egypt regulates majority of the water resource derived from the Nile River from the time of colonial-era treaty, which assured that Egypt has 90 percent share of the Nile and prevented their neighbors from drawing out any water drop from the Nile without taking a permission. However, in recent years countries adjacent to the Nile such as Ethiopia are now gaining more control over the rights for the Nile (Aziz, M. ,2020), (Dakkak, A. ,2020).

A great challenge is now being tackled; the issue of building a dam in Ethiopia and hydroelectric plant upstream that could result in decreasing Egypt's share of the Nile. For now, a crucial concern for Egypt is the construction that's being made by Ethiopia of the Grand Ethiopian Renaissance Dam (GERD) in the Blue Nile, which is a primary water source for the Nile River. The construction of the GERD started in December 2010 and has the capacity to store 74 to 79 billion cubic meters of water and generate 6,000 megawatts of electricity for Ethiopia per year.

This creates a great challenge for Egypt, who is frightened that by time this dam would decrease the water amount it receives (55.5 billion cubic meters) from the Nile River. Egypt is now concerned that in the dry months, the water amount derived from Nile River would be decreased due to the GERD thus decreasing the water reached downstream for the use of Egypt. This will greatly affect Egypt's trials to mitigate the water shortages during dry months.

The United Nations. World Water Development report for 2018 warns that Egypt is currently beneath the U.N.'s verge of water poverty, it is presently facing water scarcity (1,000 m3 per capita) and dramatically is heading towards an absolute water scarcity (500 m3 per capita).

### 3.4.2 Air pollution

In 2019, Egypt experienced a Moderate air quality with a US air quality index AQI reading of 63. This is according to models proposed by the World Health Organization (WHO). The air quality index is indicated whether it's within the range or out of the range according to the percentages of the so called "Particulate matter" or "Particle pollution" the term stands for a mixture of solid particles and liquid drops found in the air. Some particles, such as dust, dirt, or smoke, are large or dark that could be seen with the naked eye, others are so small and could only be seen under a microscope. These particles could be inhaled and cause a serious disease, other larger particles could reduce visibility in some areas, so PM2.5 and PM10 are the types of particles that have a great effect on the air quality.

Measuring these particles in Egypt, In May and June, Cairo achieved the WHO target model of less than 10 µg/m³. In September and November, the air quality decreased to 36.9 and 46.4 µg/m³, respectively. For the rest of months, the air quality was counted as "moderate". When compared to the rest of the world, Egypt's rank is 56th most polluted country out of a total of 98 which is something to be considered and needs a change in the country's beliefs and habits.

By overlooking the percentages in the recent year, August 2020, air pollution recorded high levels among residents of Greater Cairo especially than other cities within Egypt, researching the reasons for the pollutants increase in Cairo,

and found out some reasons that are not limited to emissions from vehicle exhausts and public transport, burning of waste, and emissions from agriculture and landscaping, which affect the citizens feeling in most of the parts of the city, in which they feel extreme rise in temperatures and high humidity, and general discomfort. "Egypt's Vision 2030" has a lot of contribution to achieving the Egyptian government's goal for the sake of the environment, which is to reduce air pollution from these particulate matters by 50% by year 2030.

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The previous literature gave us some information about the appearance and history of lawns and shed light on the environmental impact from the excessive use of Western landscape lawns, to fulfill people's preferences. From the case study of china, we can come up with some factors to be used to assess the suitability of the residential lawns in the Egyptian context in the selected case study in Egypt (In the next part there's a brief overview for the case, and for the selection criteria, it will be discussed clearly in the coming chapter 3 of the case study itself). From these factors, the maintenance practices of lawns; includes mowing, fertilizing, as well as irrigating, the economic costs related to the maintenance practices, the social preferences and needs of people living in a residential area, besides the environmental conditions of the country.
So, the methodology for the case study is based mainly on 1) Surveying types of lawns within the compound, 2) Analyzing these types according to the maintenance requirements from water, fertilizing, and mowing needs and adding economic dimensions to the costs of these practices, 3) Social survey for the people preferences, 4) Relating how lawns could affect the mentioned forces (Socio-Economic, and Environmental forces). And that's how our selected case study will be analyzed and presented in the coming chapter 3.

# 4. The Case: Madinaty Compound.

Madinaty is a residential suburb aimed at becoming a complete city, in northeast Cairo Governorate, Egypt. It is south of Shorouk and northeast of New Cairo, built on 8 thousand feddans (33.6 million square meters), designed and built to provide a sustainable life for 600,000 inhabitants in 120,000 housing units. A 27.3 million square meters area of the project is devoted to residential areas, each area is being provided with a set of fully integrated eco-system services and household services,

The project is being constructed by Talaat Mostafa Group. The Master Planners are HHCP Design International, Inc. The landscape architects are the SWA group. Construction began in July 2006.

I use it with its different landscape areas (including lawns and golf courses) as a case like most of residential compounds in Egypt's context nowadays, to apply my proposed argument and assess the suitability of the existing landscape types in such compounds with the three mentioned systems (Environment, Societal and Economy).


(Fig.21) __ Madinaty, East Cairo, Source: Sites international website.

# 3

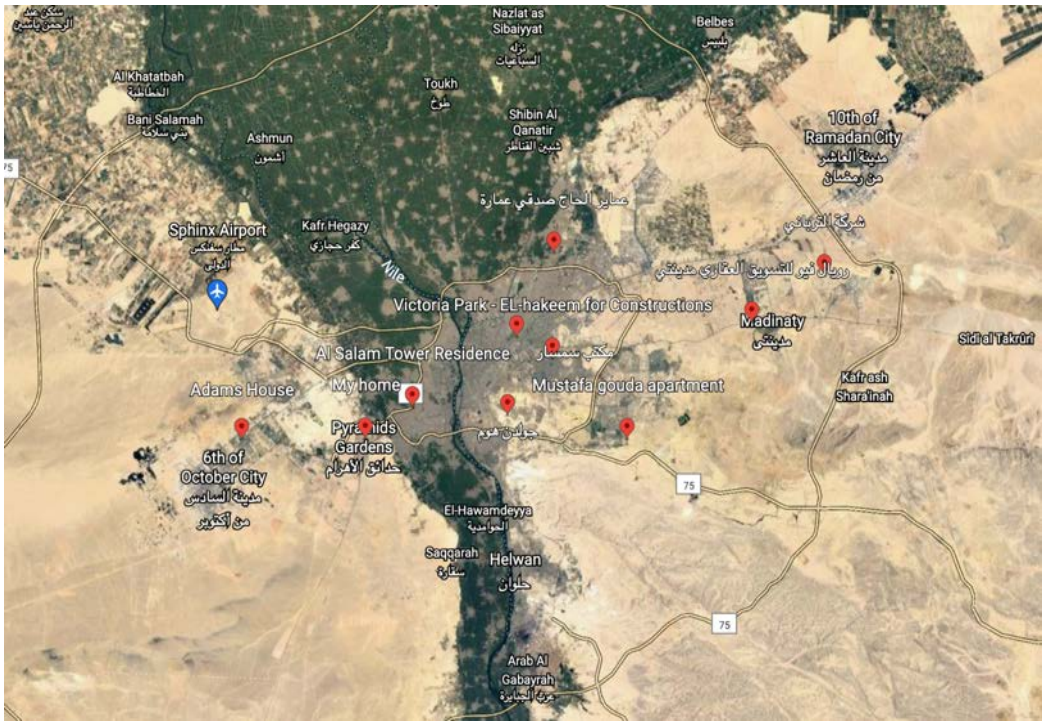
# THE CASE STUDY

# The Case Study

(Fig.22) __ Madinaty Compound, New Cairo.
Source: Google Earth.

# 1. Case study analysis objective

Focusing on the previously mentioned landscape lawns which have been widely used in the residential compounds, the objective of the case study is to analyze landscape lawns (including golf courses) between socioeconomic and environmental forces in residential compounds and their interrelations as a) socioeconomic force: studying the people's preferences and lawns functions in relation to the economic supply of these functions, b) Environmental force: landscape requirements in relation to the current state in Egypt's context.




(Fig.23) __ Cairo compounds,
Source: Google Earth.

# 2. Framework for choosing case study

We aimed to create a model that could be able to answer most of questions related to the objective of the research in the field of assessing residential landscape lawns between different forces.

The selected case study is Madinaty compound by TMG in East Cairo, Suez Road.

### Why Madinaty?

It's a huge compound of 8000 feddan that replicates a whole city and managed with the same developer. The developer TMG (Talaat Mostafa Group) is a well-known successful one, with experience of over 20 years. The developer is advocating that they're learning from the previously constructed project AL-Rehab, Madinaty is claimed to be built based on learning experiences and social preferences of AL-Rehab, which make it a unique case.

There's research that discussed al-rehab landscape and talked about some major defects in the choice of green lawns all over the compound and the water management in comparison with the water scarcity case in Egypt nowadays. They mentioned "Nonfunctional "landscape scenery design" with high maintenance requirements and excessive water consumption are the main challenges in Al-Rehab case that needs to be tackled" "Diester L., 2013".

This arouses my interest in the case of Madinaty to fill the gap between what TMG is claiming about the suitability of their landscapes in both Al-Rehab and Madinaty, and on the other side the research that states the defects in the old case Al-Raheb.

This besides other factors that made Madinaty the best for my research,

a) Spatial location; Madinaty is within a proximity to my place of living in order to be able to visit frequently and make the needed studies, b) Occupancy rate; Madinaty already have an occupancy rate of more than 50%, and that will help to widen the questionnaire base, c) Diversity of lawns functions; in which there're the central park, golf courses, as well as semi-public lawns between

different zones, d) Diversity of social classes; different social levels within the compound means different property values with different landscape amenities', Unlike Katameya heights for example that's made for upper class mainly, Madinaty have different social levels from middle to upper social class, which will help in building a wide perspective of people's preferences of living nearby grassy lawns.
Therefore, we found Madinaty is the most unique and suitable case to test my hypothesis of the suitability of residential lawns within the Egyptian context.

# 3. Introduction to the case

Madinaty compound lies in the eastern part of Cairo, it was developed by TMG (Talaat Mostafa Group) the leading community real estate developer for Madinaty, the commence date is July 2006 and to be fully completed by 2035, the total land size is 33,600,000 m2, the expected population is 600,00 capita over 120,000 residential units. In April 2013, the total sold built up area BUA was 45.7% of the land, and by 2017 51% was sold. The construction is planned to take place over 6 overlapping phases, each phase will take from 3-4 years to be implemented (as shown in the following figure). The total intended residential BUA will be 16.82 million m2 from the total land size, with over 4 million m2 of non-residential BUA, which will leave 12.78 million m2 as a landscape area within the compound.
The Master Planners are HHCP Design International, Inc. The landscape architects are the SWA group.
The following figure 18, shows the master plan for all the phases of Madinaty including the implemented and the under construction.

(Fig.24) __ Madinaty Masterplan, East Cairo,

It's a large residential compound designed and built to provide a sustainable residential community which provides housing for different social classes that are overlooking a wide range of green open spaces to fulfill most of people's European dream of living in a green community, besides all the needed social services in an integrated green landscape base.
The intended percentage of greenery per capita is 25 m2 of greenery per inhabitant which is quite large amount.

In this chapter, we're going to analyze the suitability of the used green landscape lawns to the context of Egypt in relation to the different forces for residential landscape (Socioeconomic, and environmental forces).
To evaluate the suitability of a landscape, we need first to understand the purpose of designing such type of landscape from the point of view of the developers of the place, so, we started by establishing a contact in TMG and discussed the concept of the green landscape design in Madinaty.
I got some statements related to the initial concept of such landscape, "Sustainable green city", "Residential units being provided with a set of fully integrated household services", "Ensure adequate oxygen levels within the city", so the aim of this assessment, is to ensure that the landscape lawn provide such concepts and whether its sustainably green for the sake of social preferences, economic revenues as well as environmentally friendly or it has some diverse impacts that needs to be highlighted.

# 5. Overviewing natural lawn types in Madinaty (Physical Survey)

Madinaty landscape is based on a green lawn whether natural of artificial as seen in the following figures, and as mentioned by one of the landscape architects there, it's about 4 million square meter area of land, it is situated all over the compound in different forms that could be categorized as follow: (1) Golf courses (As a service or good for certain people), (2) Public lawns (In the public spaces), (3) Semi-public lawns (For the residential zones), and (4) Private lawns (For the private villas).

For each category, we're going to analyze both the environmental force (Which is related to the maintenance processes for the chosen type of lawn; watering, mowing, and fertilizing), as well as the socio-economic force (Which is related to people's preferences, and the share in the expanses of lawn maintenance).

(Fig.25)
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Madinaty, East Cairo, Source: Own on google earth

## 5.1 Golf courses (As a service or good for certain people)

(Fig.26) __ Madinaty Golf course area (Web source).

(Fig.27) __ Madinaty Golf course area, Source: Own.

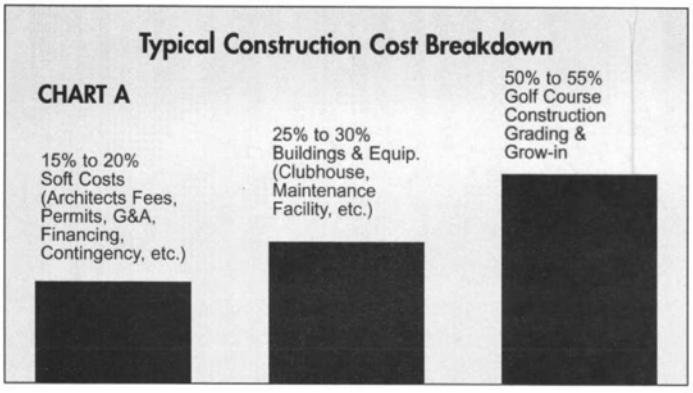
Golf courses depends mainly on green lush lawns, it's considered a good or a product rather than just a view, some interviews was made with employees works for TMG regarding the golf courses practices and maintenance, besides some desktop research to understand the maintenance processes of golf and assess it environmentally and socio-economically.

By that we can have an impression of how golf is a business of proving a product for people who wish to play golf rather than providing only an aesthetic view for people to live nearby, as golf should be maintained regularly using lots of processes, we're going to mention for Madinaty compound in the following part.

Madinaty Golf community provides a full-service leading golf destination designed by Robert Trent Jones, with 18-hole golf course and 9-hole footgolf course situated in the heart of Madinaty. Managed and maintained by Troon, the world's commander in golf club management.

Some research hers in the field of golf mentioned that the cost data for golf was categorized into three major categories: (a) Golf Course Hard Costs (the actual construction of the golf course); (b) Surrounding building implementation and Equipment Costs (the actual construction of the buildings needed for the services and equipment purchases); and (c) Soft Costs (such as design fees, permissions, and management, etc.) (Creed, R. ,2001), as shown in the following figure 28.

(Fig.28) __ Golf courses costs (Web source).



The data showed a wide variance in total golf project costs (excluding land) from about $7 million to about $25 million, with an average cost of about $14 million (which will be considered for Madinaty).
There are a lot of aspects in the maintenance process for golf as follow:
1) Labor needed for implementing the processes (Labor is encounter for 50-60% of the golf course maintenance budget as mentioned by one of the employees in TMG).
2) Fertilizing and plants protectors are the main aspect for the maintenance of golf, as they save the green lush views of golf, but it doesn't really encounter for a high major budget but is considered to have high impact on the environment).
3) Mowing fairways, is a process that is done regularly two or three times per week, which needs labor, equipment, and fuel consumption.
4) Bunker raking frequency, as this process is made two to three times per week, which requires labor to do so.

Besides the costs of constructing, and maintaining the golf, there are on the other side benefits paid by the consumers and customers of the golf which balance the original costs as claimed by one of the landscape architects in TMG group, for example in Madinaty, purchasing villas overlooking the golf which are sold with an average of 15 million EGP (As mentioned by one of the sales), Membership at Madinaty golf club starting 200k for a lifetime or 4000 annually, Golf playing starting from $43 per player, Other golf course nearby services include; restaurants, Gym membership, joining golf academy, and hosting social events which all adds up to the benefit of the golf course which at the end overweigh the costs.

Mohamed Atallah, a board member of the Egyptian Golf Federation (EGF) and the representative of Talaat Mostafa Group (TMG) at its Madinaty Golf Club, said that there're few golf courses in Egypt nowadays eight of which are in Cairo, and about 16 in other regions of the country like Alexandria, Sharm El-Sheikh, Ain Sokhna and Hurghada.
He stated that the few numbers of golf courses is due to the high cost of the construction and maintenance practices, and also not much people in Egypt usually play golf, as Egypt currently boasts about 2,500 golf players only, which is not a large number, this brings the fact that the development of golf courses is more about a selling point that most of the real estate developers depend on to market for their projects, therefore it turned out to be a valuable investment in the residential market rather than being a hobby and a sport.
Mike Kahn, president of GolfMAK, Inc., a golf consulting firm based in Bradenton, Fla., said: "A golf course is almost like a human being on a lifeline; you can't take your eye off it for a second. They're very, very demanding. They can be a very good investment if a buyer...approaches it as a pure business proposition before the romance of owning a golf course takes effect".

As a conclusion, Golf course is a challenging business nowadays due to the economic pressure and the current situations happening not only in Egypt but all over the world after the pandemic, so most courses nowadays should develop options for lowering the costs of maintaining golf courses, without negatively affect the golf experience.
So real estate companies need to think wisely before taking such a step, they need to consider the costs of construction and maintenance as well as their environmental effects before using it as an advertisement tool for their projects.

Although the benefits received for the real estate companies from establishing golf courses in their residential projects overweigh the original construction costs, but we can't ignore the maintenance costs to maintain it, which at the end affect the satisfaction of the residents, due to the increased amount of maintenance costs they should pay monthly and yearly to keep their view,

If we come to the environmental force for golf course, we can assess according to the maintenance requirements. For these courses, two types of grass are used in Madinaty which are Seashore paspalum and Bermuda grass.
Seashore paspalum is a native, low growing, warm season, perennial grass that reaches almost 20 inches in height.
It's tolerant to heat and drought, and grow preferably in sunny area, and sometimes partially shaded area, as it requires average drainage, but to maintain the green grass look should be watered regularly. To be used in golf it should overgo some processes.
-Recommended Mowing Height: Golf course green turfs are usually maintained between 1/8 and 1/5 inch (Reel mower).
-Recommended Mowing Frequency: To maintain the green turfs for golf fairways, paspalum should be mowed three to four times per week.
-Fertilization Requirements: Desirable results are achieved with split applications of 1/2 - 1 lb of nitrogen per 1000 ft2 throughout the growing season. This is much lower than the fertilizers' requirements of bermudagrasses. Seashore paspalum responds well to nitrogen fertilization from 5 to 8 lbs./1000 ft2 per year.
-Water requirements: If portable water, it requires 1 – 1 ½ inches of water per week to keep its color and shape.
If irrigated with recycled water a quality test must be conducted regularly to make sure that the quality of lawns is still acceptable.

While Bermuda grass is a warm-season grass, it's used mainly in warm areas that typically reach high temperatures.
It can withstand heat and high temperatures, so it's used in countries with climates like Egypt with hot and dry summer. It's characterized also by its durability to the golf high traffic as it's a tough type of grass with the same high-quality green looking.
-Recommended Mowing Height: for Golf courses and athletic fields the mowing height must be in a range of 0.75 to 1 inch (Reel mower).
-Recommended Mowing Frequency: for Golf courses and athletic fields, it must be mowed Daily to weekly using a rotary or reel mower, which requires a high maintenance rate to keep it with high quality for the golf players.
-Fertilization Requirements: 0.5 to 1 lb Nitrogen per 1,000 ft2 per month during the summer growing season; 2 to 6 total lbs Nitrogen per 1,000 ft2 per year.
-Water requirements: Bermuda grass needs from 1 to 1.25 inches of water weekly to retain its color and quality during summer (It takes about 620 gallons of water to apply 1 inch of water per thousand square feet of grass).

Therefore, after rough calculations, we can conclude that if the total implemented area for golf course in Madinaty is 5 million m2, and the built-up area is assumed to be 40%, so the golf course lawn area is about 3 million m2, so the water requirements according to the types of lawns used will be 20,000 Gallons, and the fertilizers requirement would be 7 lbs of nitrogen per month, as well as mowing processes on daily bases.

## 5.2 Public lawns (In the public spaces)

For the public lawn's category, the central park zone is selected to assess such type of lawns. The central park in Madinaty spreads over 35 feddan, and paspalum vaginatum was used as the main type of grass for this area, the maintenance processes based on an interview with one of the landscape architects in TMG, unlike golf courses, paspalum vaginatum lawn maintenance processes differ as follow:

-Recommended Mowing Height: public use paspalum is maintained as 2 inches.

-Recommended Mowing Frequency: To maintain the paspalum at this height it should be mowed only 1-2 times per week unlike golf courses.

-Fertilization Requirements: Desirable results are achieved with split applications of 4 lbs. of nitrogen per the growing season throughout.

-Water requirements: it requires only one inch of water weekly.

So, coming to calculating the water requirements needed for the central park of 147k m2, 981 gallons of water are needed weekly.

And for the fertilizer's requirement, for 147k m2 park, 6 lbs. of nitrogen are needed per the growing season.

(Fig.29) __
Madinaty Central Park,
Source: Own.

## 5.3 Semi-public lawns (For the residential zones)

For the semi-public lawn's category, residential zone B01 was selected to assess most of the residential zones within the compound, there are almost 6 residential zones are implemented until now, and other 7 still under construction, they have the same landscape character of green paspalum vaginatum lawn in the middle of the cluster with surrounding units, the average area of these lawn depends on the zone area, but for residential zone B01, the lawn is about 300k m2, and according to the maintenance processes of paspalum that were mentioned in the previous section (3.2.2 Public lawns (In the public spaces), the water requirement for this zone is 2000 gallon weekly, and for the fertilizers requirement is about 12 lbs. of nitrogen per the growing season. What if this water and fertilizers requirements are the same for the rest of 15 other residential zones, the number would be much big for the water consumption and usage of nitrogen to maintain this lawn?

(Fig.30) __ Madinaty Residential zone B1,
Source: Own.

(Fig.31) __ Madinaty Residential zone B1,
(Web source).

# 6. Socio-economic Analysis

## 6.1 Empirical study

The subjective evaluation of residential landscape in Madinaty may vary according to the resident's characteristics and preferences, including demographic factors from CAPMAS and reasons for choosing the landscape view to live nearby from SURVEYS, as well as the disadvantages perceived by people that will help in assessing the acceptability to different landscape alternatives.

The overall evaluation of Madinaty community is observed through a self-reported measure of whether the different landscapes' disadvantages outweigh the advantages in a residential compound. Measures of the current state of some environmental factors in Egypt that's most related to the study, as well as measures of the property values in relation to the type of landscape view is also included in the evaluation of the residential landscape.

Demographic characteristics, housing prototypes and preferable landscape views are tested as influences on the perception of the advantages of some types of landscapes to residents.

The evaluations of residential landscape characteristics that may contribute to the opinion of replacing some types of landscapes are also considered.

Because owners who perceive the disadvantages of landscapes may be more likely to agree on the landscape alternatives to live nearby, the economic factor of the houses with different landscape views is also included in the study.

## 6.2. Data collection.

The data used in this case study analysis were collected through self-administered written questionnaires for residents in Madinaty project. To obtain participation from as many residents as possible, the research survey was publicized through a notice delivered to known residents via email and support was solicited from some people that i know living there, who posted the questionnaire on the official platform for Madinaty residents.
The questionnaires were available to answer between 15th of June 2021 and 25th of June 2021.
Because of covid-19 nowadays, most of surveys are carried out online plus few interviews face to-face with friends living in the area.
Questionnaires were available in English and Arabic so as many people could answer.
The questionnaire collected demographic data about the respondents along with the landscape view they're living nearby and their preferences. Limited information about their maintenance and price ranges paid was also obtained. In addition, the consumers were asked about the role played by various values in their home purchase decision regarding the type of landscape offered in the surrounding as well as their knowledge about current state in Egypt in relation to the environmental factors, and lastly their preferred alternative for the existing landscapes according to their priorities.
A total of 109 residents answered the questionnaire; however, some questionnaires were returned with incomplete answers.

## 6.3. Variables.

The primary dependent variable to be measured in the study is the social preferences related to the residents living in the area, and what are the different types of landscapes related to these social preferences. The responses are categorized as some living in residential apartments with an open public spaces Infront of their houses and some living in private villas having their own landscape garden.
All the variables that are used in the analysis are listed in above Table 1.

The independent variables for the analysis obtained from previous literature that was discussed in chapter two about the different residential landscape impacts whether positive or negative in different regions and some alternatives recommendations that have been used in some parts and would be discussed in last chapter.

## 6.4 Results.

A total of 109 residents responded to the questionnaire. The respondents' profiles are listed in the above table 2. Due to nonresponse on some items, the total number of respondents partially varies within the analysis.
Most of the respondents about 70% are of age range 25-65 (Adults), and 30% of respondents are between 15-24 (Youth), for the seniors age range 65 and over no one replied. Then comes the length of residence in Madinaty in which there are about 50% are living there from 5-10 years, about 42% living there recently from 0-5 years, and only 8% are living there from 10 years or above, this question was an important one to have varieties in answers to evaluate the expanses of living nearby a specific landscape for short or long time and whether there are impacts on the long term.

Then coming to categorization of respondents by their type of housing, almost 88% of the answers were people living in residential apartments, and 9% living in residential villas, and only 5% are living in golf villas, which reflect that the middle class who are living in residential apartments are of higher capacity than living in villas whether residential or golf villas. Starting to analyze the landscape views for the residents, 80% are overlooking green open spaces from their windows, 6% are overlooking golf courses, and last 34% are overlooking streets and parking spaces, and then translated into the next question whether all respondents like their current landscape view or not, and 10% responded no and justified their answer by some recommendations for a more preferable landscape views as; more trees and shrubs not just open green lawns, and adding water lakes to the scenery. The way of how people interact with their landscape, and surprisingly 40% replied it's just an aesthetic view, 38% like walking besides, 7% kids playing on the landscape, 9% like seating on, and last 6% like to walk their pets around. Zooming on the category of people who own private villas, and whether they have natural or artificial grass in their yard, 70% have natural lawn, while 30% have artificial lawns which is not a small value. And then evaluating the maintenance of both types of lawns with response to the previously mentioned processes evaluated in accordance with the current state in Egypt. The 70% having natural lawns in their yards were asked how often they maintain the lawn (Fertilizing and mowing), 40% (almost the quarter) maintain their lawns 1-2 times per week, 12% maintain their lawn more than 2 times per week and the other quarter about 45% maintain it 1-2 times per month, and only 4% maintain it more than 2 times per month, analyzing the hours spent to maintain the lawn within the community, the average gardener spends approximately 60 minutes manicuring and edging the natural lawn in each time, which means the quarter of people living in villas spend 2 hours per week for mowing their lawns only, adding the time needed to fertilize and remove weeds, that's too much time spent.

Besides the time spent, there's also much money needed for these processes, 60% of people when asked if they pay much money they replied with yes, and some mentioned the range spent yearly and monthly, the average spent was 1000-2000 monthly if it's a private yard for a villa, and 4000-5000 yearly if it's a public open space paid since buying the apartment, and only few mentioned a large amount spent 50,000 per year but this is not the majority. For the water issue, the residents were asked whether their lawn consume a lot of water, nearly 50% answered yes. Returning to the rest of private villas owners, where the 30% who have artificial lawns in their gardens, they were asked whether their artificial lawn increase the heat in the garden, and 40% replied yes which is a large percentage that could never be neglected. For both natural and artificial lawn owners they were asked if they faced any problems related to their lawns, and 30% answered yes and mentioned some problems as bugs, insects, which affect their health and helps in transmitting diseases. In accordance with the previously collected data some general questions were asked to all the categories to assess the current state in Madinaty, and whether the water cut off a lot or not, and 25% replied with yes. Ending the survey with a question if people knew about what's going on in Egypt from the water scarcity issues to the air pollution, would they mind replacing the current landscape if they do share in the two issues with other alternatives environmental friendly to save water and air, 65% showed a great understanding and agreement to the idea, and the rest declined, because they love what they're living in regardless what's happening on the outside. The 65% replied with yes were then asked if the replacements were done, what would be their priority of choosing the alternative, 48% answered that the aesthetic view is there to go issue, they would still want the same green feeling, 20% mentioned that they would still want the same type of interaction with the landscape whether walking, seating, or playing kids, and 30% mentioned the air quality as a priority issue in choosing the landscape alternative as they feel the green lawn provide a fresh breeze which helps them to breath better.

Finally, some alternatives with images were provided to people to vote which one do they like the best, they had the option to vote for more than one, and this could help in assessing the weights of alternatives later based on the people's preferences.

## 6.5 Findings

Socio-economic analysis finds that most of people likes the view of landscape lawns, and they only use it as an aesthetic view and the percentage of people interact with lawns are small in comparison with those who taken it just as a visual experience, so if they found the same green aesthetic view in other alternatives they would accept the alternatives, they also are complaining from the excessive costs they're paying for the maintenance of these lawns, so if they were to be provided with alternatives offering the same view with less maintenance costs to be paid, they would accept it.

# 7. Environmental Findings

## Lawns practices impact on the environment.

According to the previously studied physical survey for the lawn types in Madinaty, there are lot of maintenance processes needed for these types, and as studied in chapter 2, the environmental conditions of Egypt's related to the water scarcity issue and the air pollution from the increase of particulate matters in the atmosphere, and unfortunately these practices increase the worse of the situation as follow.

To keep lawns green and with a good looking, they need to be watered regularly as calculated in the previous section, the landscape lawns in Madinaty which is almost 4 million m2, needs almost 25,000 gallons of water weekly, which is a very large amount to be used weekly, in the circumstances we're living today in Egypt. Not only watering but also these huge area of lawns needs regular mowing and fertilizing as discussed and calculated in the previous section, which also have a diverse impact on the air quality and the increase of the particulate matters percentage in the atmosphere as discussed in chapter 2, and as a country we're suffering from air pollution and the air quality is getting worse, and on the long term it may have a severe health impact on the society.

# 8. Artificial turfs as an alternative to some of the homeowners

Artificial lawns in private gardens (SYNTHETIC TURF).

In some private garden spaces due to limited amount of water and the regular cut off of water many urban grassy surfaces degrade from trampling and extreme weather conditions in our country and thus quickly become brownscapes while also losing the ecosystem services and the aesthetic views that lawns typically perform.

This type of lawns appeared in some private gardens as a reaction to the degradation of natural lawns, as well as due to the high cost of maintenance needed to keep the natural lawns green all the yearlong.

But do this type of lawns is environmentally friendly replacement for natural lawns in such private gardens? Let's discuss that issue.

Artificial lawns in private gardens (SYNTHETIC TURF).

Artificial turf is made from a mixture of polymers (plastics) + combined with infill of sand and/or ground-up rubber to make it soft and shock absorbent. Invented in 1964, it was first developed to be used for covered athletic fields in which sunlight wasn't enough to support natural grass

. While it continues to be largely used for athletic fields, with recent progress its use has moved quickly into commercial and residential landscaping mainly. With significant water conservation and low maintenance requirements, synthetic turf is increasingly promoted as a replacement for natural lawns for recreational purposes.

(Fig.32) __ Artificial lawn garden, (Web source).

However, there remains the main question of whether it is an environmentally friendly alternative to natural lawn, and what are the negative impacts that could be resulted from these synthetic turfs for environment and people. Synthetic turf is often visually indistinguishable from natural lawn when viewed from a distance; Both synthetic turf and natural grass can still offer a wide range of undesirable environmental effects, along with consumption of raw materials, water and energy, and adverse emissions to air, water, and land. Thus, taking decision of which form of lawn has a lower overall adverse environmental effect is not straightforward. But there are some highlighted adverse impacts of synthetic turfs that were previously studied and mentioned in some studies.

Fake synthetic grass weighs around 1.42kg/meter, Private villa's little urban garden is around 35 square meters so if we covered half of it in plastic fake grass, that would weigh 24.85kg of plastic.

Despite the claims said by manufacturers that the fake grass lasts for 10 – 20 years (which is still a short life span for some outdoor surfaces), but actually in reality the particles of plastic grass become worn out and squished as carpets. But does synthetic turf is environmentally friendly, or it has diverse impacts on the environment, (Watterson, A. ,2017) which can be as follow.

## Human Health

-Plastic turf is made of tire rubber crumb which contains a wide range of toxic uneven harmful chemicals that can be released into the neighboring environment, the potential health risk for the direct users has been a major concern. Kids playing on or people walking on can be exposed to the rubber particulates and their hazardous components through several ways, including ingestion, dermal uptake, and inhalation, as discussed in the above Figure 3.
-Fake plastic grass is obviously tougher for outdoor use, and it can cause injuries and bruising to kids playing on.
-The plastic turf is a basin for not only fungus and bacteria, but also harmful organic matter. The contaminations in plastic turf threaten our health whether via contact, consumption (via water), or inhalation. All these ways expose both humans and other living organisms to acetone, arsenic, benzene, chromium, halogenated flame retardants, lead, mercury, dioxin, carbon black, styrene, and Butadiene.
By the time, turf degrades over time, and so larger quantities of chemicals are released into the air. These chemical substances have been proven to cause cancer and other critical diseases.

## Heat issue

Synthetic turf can become much hotter than natural grass on a sunny day. Experts in the field noted that high surface temperatures may lead to likely life-threatening heat-related illnesses for users, especially kids. In some cases, this can make them so hot that you can't even walk on them. Several studies related to that issue have measured high temperatures on artificial turf, that may reach 160°F.

## Environmental issue

-Loss of wildlife habitat in the area, Plastic turf is most likely to reduce the biodiversity of your garden as it is made of plastic and is not a natural grass that habitats could live in.

-The processes of mixing, coloring, and molding the plastic synthetic grass releases carbon. In addition to the carbon released from transportation process of these heavy rolls by a truck from the manufacturing place to the customer.

-Installing fake grass into your garden will make it harder for rainfall to penetrate ground water, and as a result you'll be increasing your chances of garden flooding during much heavy rain.

-Artificial turf cannot be recycled in the present times. Here's a waste discharge in Dongen in the Netherlands showing dunes of plastic grass at the end of its life (Figure 29).

(Fig.33) __ Artificial lawn waste in Dongen in Netherlands, (Web source).

To conclude, artificial plastic grass leads to; a lack of biodiversity in your garden, increased flood risks due to extreme weather conditions, a potential health risks to humans utilizing it and a disconnection with the benefits of physically gardening, but that's not all, it also can't absorb CO2 and other air pollutants, so the air quality wouldn't get better as most people wish.
We may be nowadays swapping plastic bags for more sustainable ones, but then we're laying out thousands of tons of plastic into our own private gardens. I think that people don't even realize how hypocritical is this!
I can relate that people are busy with their life and cannot find time for naturally grown grass to maintain, but there are lots of replacements for lawns and artificial turfs that are more sustainable and need less maintenance. I believe that if the residents knew what plastic turf is really doing to the surrounding environment, they would reject it as soon as possible.

# 9. Conclusion to the case study

As a conclusion to the case study, we can see that the lawns used in Madinaty in residential zones and central park, are of a great area, which required excessive water consumption and fertilization requirements, which increase the issue of water scarcity in Egypt as well as, have a share in the air pollution that's increasing in Egypt nowadays, not only do lawns have negative impact on the environmental conditions of Egypt, but also, they have an economic impact, where people started to complain from the increasing maintenance costs they have been paying monthly, as mentioned in the online survey that was made, so people themselves started to re-think the natural lawns and some homeowners replaced their own with artificial grass for their gardens, but as we discussed artificial lawns are not the best option for the replacement issue, and there are other alternatives to be discussed in the coming chapter that was implemented in some residential developments in Egypt.

We don't really need these vast areas of green lawns. if we find other green alternative to overlook, it would be great, and we can only leave small areas of lawns to perform other functions of seating and playing on. The matter needs a rethinking to save as much water as we can and help lowering the environmental pollution that's happening, and mostly decrease the costs of maintaining processes for both the developer and the consumer.

And as for the golf course, it's a product we should think wisely before implementing, as it's a business matter rather than only implementing that green exclusive view for residential properties, developers need to forget the green dream, and started thinking about how they can reduce the costs of maintaining golf course, there are some practices which can help golf developers in controlling and reducing costs while providing an environmentally sensitive playing field for golfers. (Oatis, D. ,2017)

These include:

-Reducing Labor

This is an effective strategy because about 50 to 60% of a normal golf course maintenance budget is committed to labor.

-Fertilizer and Plant Protectants

Decreasing the amount of plant protectors and trying to find new alternatives less costly and less harmful to the environment.

-Alternative water resources, even treatment of recycled water and using it Madinaty already using this alternative; (The used water treatment plant with capacity: 40,000 m3/d was built and designed for sustainable water recycling. The treated water will be used for the watering of green areas and golf courses.

By that way we can decrease the costs of golf course practices as well as save the environmental resources in terms of water and air quality.

# 4

# TOWARDS ALTERNATIVES

Now in Egypt, customers link residential compounds preferable landscape lawns with a significant higher cost, while researchers link it to consuming much water that is not available. In general, residential landscape design and plant selection depends basically on three factors: aesthetics, function, and maintenance. While there is a basic need now to decrease the water consumption rate for residential landscaping, there is an equal need to do so while preserving the mentioned three factors as well.
There are many approaches and alternatives that could achieve that nowadays, one of the biggest trends is NBS (nature-based solutions).

# 1. Towards NBS (Nature-Based Solutions).

Due to the current state of Egypt regarding water scarcity as mentioned in chapter two, it's a must to find new alternatives to the existing green lawn as the main landscape element for the residential compounds and start developing new environmental sensitive solutions. Nowadays there are some trends regarding that issue, which started to rise in some residential compounds in different countries called "Nature based solutions".

"Nature-based Solutions—Potential Alternatives to Lawns "

Our perception of the nature-based solutions approach is that it depends on three main principles: "Actions and Solutions to societal challenges" (where landscape design and planning of lawns can help to achieve sustainable solutions); "Inspiration from nature" (inspiration for lawns in local native ecosystems or in self sustained urban plant communities); Providing environmental, social, and economic assets for people (Ignatieva, M. and Haase, D. and Dushkova, D. and Haase, A. , 2020)

Alternatives to lawns are usually inspired by various grassy ecosystems or from habitats with low growing vegetation that can tolerate heat and drought. Most existing substitutes, though, are not like common turf; enduring sod that tolerates recreational pressure (Trampling). The aim of such alternatives is to decrease the number of non-utilized turf surfaces (urban planning) and to avoid repetition (visually and ecologically) by engaging different landscape design patterns (color, smell, and texture) as well as offering more biodiversity, and thus ecologically friendly, wildlife habitats and a healthier fresh environment (decreased mowing, fertilizing emissions, and thus fewer greenhouse gases). These natural based solutions include the following:

-Go Spontaneous Meadows Grass-free (tapestry lawns)
-Pictorial meadows
-Naturalistic plantings
-Prairie gardens
-Swale and rain gardens plantings
-Xeriscape dry gardens
-Verge gardens and woody meadows
-Use of appropriate native groundcovers instead of turfs in private gardens

There is a new landscape architecture approach referred to as “biodiversinesque”, which encourages a special design style for sustainable landscape design. It is based on multiscale design with specific focus on the mesoscale, or the community or park level, and is a detailed design in which biodiversity and dynamic ecological processes can be achieved and controlled. One crucial difference of this new landscape design from other styles is the appreciation of the complexity of biodiversity rather than the narrower native vs. exotic plants argument. This new design style includes the dynamic character of urban biotopes and is believed that it makes a difference perceived and appreciated by people (Ignatieva, M. and Haase, D. and Dushkova, D. and Haase, A. , 2020).

When developing a new generation of nature-based lawns, such new alternatives to lawns should be extremely different from traditional lawns in terms of cost, biodiversity, trample-resistance, and stability under extreme weather conditions. At the same time, they should still fulfil the social needs of the users such as certain lawn visual qualities, amenities of the green space and various recreational activities. Such new lawns' alternatives should act as important and resilient parts of urban green infrastructure in residential areas. Each new nature-based approach should be based firstly on natural sequential processes that occur within the lawn plant communities and local domestic plant communities, secondly from surrounding already designed ecosystems.

The vision of sustainable lawns 'replacements for the future (according to Maria Ignatieva, Dagmar Haase, Diana Dushkova and Annegret Haase) is based on a structured hybrid approach figure 30. Such type of lawns would hold their quality—their durable surface (Same as turfs) but be formed by plants (grasses, herbaceous species and/or ground covers) that can tolerate the recreational pressure from humans. At the same time, replacements for lawns should also be based on a wide range of sustainable planning, design, and management guidelines. Most likely lawns alternatives will have a long life in future urban ecosystems.

| Urban Planning | Landscape Design | Ecological Design | Maintenance Approach |
|---|---|---|---|
| Reduce conventional lawns by sustainable planning of green areas and green infrastructure and new design styles | Rethink spatial composition (avoid the homogenous mono-species approach), choice of appropriate, site-related plants | Mimic spatial structure and composition of existing resistant biodiverse lawns and surrounding native ecosystems that can be used as inspiration | Self-sustaining system, locally driven (climate, culture and economic appropriateness) cutting the regime approach by reinforcing local biodiversity. Sustainable management (appropriate soil preparation, appropriate mowing regime, use of electric or robotic mowers and smart irrigation schemes) |

(Fig.34) __ Redesigning lawns, a complex approach towards sustainable lawns.
Source: Lawns in cities, March 2020.



(Fig.35) __ Tapestry Lawns / (Fig.36) __ Dry Landscape / (Fig.37)__ Woody Meadows.
Source: Wikepedia.org

In the coming part, we're going to discuss some scattered trials in different cities in Egypt, to replace the grassy lawns with other natural based solutions to keep up with the current environmental condition of the water scarcity issues, and the air quality as well. As we discussed in the previous chapters the choice of green lawns in the residential compounds in Egypt, had a negative impact on the air quality due to the fertilizers and pesticides needed to keep it green, not only that but it consumes much water which is not suitable for our case nowadays due to the water conflicts that was discussed previously, so overall, we needed to think for other suitable alternatives for our Egyptian residential compounds , that could adapt to our environmental conditions, and that's what was achieved by some developers as follow.

## 1.1 AlBuruj Compound, East Cairo

If we have a look on some new residential developments in Egypt nowadays, we can find that some real estate developers started to rethink the idea of using green lawns in their residential compounds, due to the high costs of water after the removal of subsides from the government on water and electricity in 2020, they started to consider other alternatives for residential landscape rather than using vast amounts of lawns, to save money not only for the developers but also for the residents in different zones who started to complain about paying much money for the gardens maintenance in the residential compounds which is double increased each year.

From these real estate developers is Imkan Misr, they developed a new compound called “AlBuruj”, it’s located in east Cairo, near Al-Shorouk city.

The landscaping plan doesn’t consume the resources of the natural environment, instead it utilizes it carefully to create minimalistic yet green residential views to connect the residents with the surrounding environment.

An interview was made with a salesperson in Al Buruj named “Abdelrahman Abo El-Shoq” works in sales department in Al Buruj compound, he mentioned that the landscape company responsible for the landscape of the area called “Curve landscape”.

He mentioned that most people who reserve units in the area, make sure the maintenance expenses for the landscape would be low as they suffered from paying much amount for maintaining the landscape types in other compounds, and that was one of the main reasons they went for this dry landscape type, to decrease the costs for green lawns maintenance for both the developer as well as the consumers.

As we can see they are planning some forms of dry landscapes, as rock garden shown in figure 38.

(Fig.38) __ Rock Garden at AlBuruj Compound, East Cairo.
Source: Al-Buruj compound brochure.

Instead of having green lawns on the semipublic spaces between residential units, they developed ground covers with vivid colors, and only leave green pathways for people to walk on, to give an aesthetic beauty as shown in the following figure 39.

(Fig.39) __ Villas zone at AlBuruj Compound, East Cairo.
Source: Al-Buruj compound brochure.

For the backyards of private villas, they developed some cacti and drought tolerant plants, to still give the visual impression without needing so much effort and water to maintain, as shown in the following figure 40.

(Fig.40) __ Villas zone at AlBuruj Compound, East Cairo.
Source: Al-Buruj compound brochure.

Instead of creating a large central park with vast green lawns, they created the so called “Orchard Park” which will provide a diverse of trees producing food and crops to be sold later in a social market inside the compound with discounted prices for the residents, where people can enjoy the green views of diverse trees with the ground covers as a setting for the trees, while benefited from the crops produced. They were inspired from a similar park called “Bustan Aquaponics farm” constructed in 2011 in Sheikh Zayed city, west of Cairo, and was the first of that idea in Egypt, it’s specialized in desert farming to help building a sustainable environment and strengthen our local food production.

(Fig.41) __ Orchard Park at AlBuruj Compound, East Cairo.
Source: Al-Buruj compound brochure.

## 1.2 ElAin Bay Resort, Sokhna.

Not only new developments who started to rethink the ideas of green lawns and go for other options, but also old developments switch from green lawns to environmental sensitive alternative, from these developments is ElAin bay resort in el Sokhna, in which they replaced the lawns in backyards of the chalets with ground covers and cacti to decrease the cost of maintenance and water for the lawns, as they thought lawns are not needed in the backyards as shown in figures 42, 43, and 44.

(Fig.42__ ElEin Bay resort, Ain el Sokhna. Source: Taken by Eng. Mohamed, Project manager

(Fig.43) __ ElEin Bay resort, Ain el Sokhna. Source: Taken by Eng. Mohamed, Project manager

Not only that, but also, they also replaced lawns in the semipublic spaces between chalets with sand and ground covers as shown in the following figures, as one of the managers there mentioned that residents started to complain about the increase of money paid on maintenance yearly double and triple the amount of the previous years, therefore the developers thought of replacing lawns as it considered the most water and money consuming form of a landscape in the area

(Fig.44) __ ElEin Bay resort, Ain el Sokhna.
Source: Taken by Eng. Mohamed, Project manager

So, Grass is considered one of the largest water consumers in the landscape, requiring a high level of maintenance as well. Using NBS instead of normal greenery or lawn has a good financial and ecological impact. It consumes less water and uses every drop without compromising the aesthetics of the landscape design besides various environmental and biological benefits. In addition to conserving water, NBS can reduce the need for chemical fertilizers, which makes a healthier environment and lower the maintenance costs.
Some other countries adopted such solutions in their landscapes to cope with their environmental conditions, from these countries is UAE and Cyprus, which will be discussed briefly in the coming part.

# 2. Some Applications of NBS

## 2.1 NBS in UAE case study.

Over a short period of time, a lot of areas in the UAE have been changed from deserts into green lands by the creation of residential areas with open public spaces and recreational facilities in the cities (Yearbook, 2010). After greening the Emirates, the urban Landscape of the UAE appears hard to handle with the ecological, social, and economic conditions of the country (Bolleter, 2015). Most of the residential landscapes are inspired by western landscape lawns which focuses mainly on the aesthetics. These green lawns have introduced many new species to the country. According to Al-Mashhadani (2014) greenery at UAE consisted mainly of non-native species which are used mostly in the landscape. These non-native plant species need high maintenance and need high resources base to keep them green and alive. Moreover, these unusual plants are mostly introduced from the moderate and semi-moderate regions to the arid environment of UAE which have high water requirements (Alam, H. and Khan, J. and Babu, Sh. and Kurup, Sh. and Ksiksi, T. ,2017)

Landscaping with native plants can be the other alternative for a sustainable green space under extreme conditions of the country with many other ecological and economic benefits.
Excessive use of water for irrigation and increasing population demand on residential areas with green open spaces can be the reasons of extreme water scarcity in UAE in the near future. This water scarcity is the limiting consideration for the landscaping and greenery. Native plants have different aspects which can contribute to sustainable green open spaces and maintaining unique and traditional desert landscape character of the UAE. Using native plants will not only decrease water requirement but also the maintenance, fertilizer and pesticide cost of any landscape project, as well as the emittions from these fertilizers. More studies must be performed to determine the best suitable local plants and techniques for their commercial production and recommendation should be based on a social base. Thus, Educational programs should start to increase the awareness among the public about native plants and provide info to Landscape architects and developers through nursery catalogs, plant lists etc. to guide them in their landscape designs.

## 2.2 NBS in Cyprus case study.

Cyprus has a moderate climate, with long, dry summers and short, cold winters. The water supply in Cyprus is both insufficient and irregular, with low annual rainfall, and that leaves the island quite dry. A water scarcity, one of the key problems in Cyprus, has become more clear in the last five years due to the drought conditions.
The residential gardens design in Cyprus is very interesting as gardens are part of people's everyday lives. Climatic conditions are helpful to cultivating gardens, and the island context provides a totally safe environment,

which allows people to sit outside in the garden while eating and relaxing. Cypriots usually use their outdoor gardens for their daily activities. Unfortunately, most Cypriots were forced to minimize their gardening or do not garden at all due to the drought of the last five years (Georgiou, E. ,2002).

As they thought that these water limitations hinder them from having an attractive garden, they relate the attractive garden with the aesthetics of a green open lawn. This is fine, because a lawn is an important component of a garden that acts as a recreational and a visual element. Even though lawns look nice, Cypriots started believing in Xeriscaping as one of the NBS which means less lawn areas with a combination of native shrubs and groundcovers that can be as attractive as with the use of the traditional large lawn area.


(Fig.45) __ Before and after replacing lawns in Cyprus.

Also, these Xeriscape residential gardens look nicer in their country due to their desert climatic conditions and at the same time they will save resources, time, and cost. An alternative solution to lawn also that can be creative and good looking too; is the use of different textures and colors of gravel that will enhance the character of each site. In addition, the area of lawn can be replaced by a patio which can be function as a place for relaxation or for taking meals in good weather as shown in the following figure.

(Fig.46) __ Villa with lawn in Cyprus.

(Fig.47) __ Patio wooden deck, in Cyprus.

# 3. Reflection on Madinaty Case study.

After reviewing some NBS alternatives and trials that were implemented in some countries as Cyprus and UAE, and some in our country by Al-Buruj and Al-Ain Bay, we proposed a green restructuring in residential zone 1 which could be environmental sensitive landscape design, Water saving up to 50%, in comparison to the original design, see the figure bellow.

As instead of having a large area of green lawn with no functions, as people only use a small area pf it to perform their activities, we can cut the percentage of these lawns by half or by 75% to save more water resources, save the environmental air quality, and the most significantly to save the people's lives on the long term, we tried to make 3 proposals one by reducing the lawn area by 50%, one by reducing it by 75% and one by removing it all and replace it with other plants that could give the same aesthetic view and allow people to perform their functions as well. The three proposals have different water requirements, different fertilizers requirements, as well as different maintenance costs, by that way we're not trying to only save the environment, but also save the effort and the money that is put to maintain such types of landscape lawns.

## 3.1 Landscape proposals, water use, and keep up costs.

Type A: The traditional Lawn landscape
Description: Composed mainly of high water-consuming seashore paspalum lawn, trees, and flowers.
Characteristics:
Lawn's area: 300k m2.
Water-Use: 96,000 Galloon/year
Water Cost: 5000 egp/year

Type B: 1/2 traditional Lawn + ½ Water conserving
Description: For this alternative, Lawn area is cut in half and replaced by some drought tolerant plants.
Characteristics:
Lawn's area: 150k m2.
Water-Use: 48,000 Galloon/year
Water Cost: 2600 egp/year

Type C: 1/4 traditional Lawn + 3/4 Water conserving
Description: For this alternative, Lawn area is cut by 75% and replaced by some drought tolerant plants.
Characteristics:
Lawn's area: 75k m2.
Water-Use: 24,000 Galloon/year
Water Cost: 1350 egp/year

Type D: No traditional Lawn + 100%Water conserving
Description: For this alternative, there's no lawn area only conserving types, some shrubs and drought tolerant plants, and rocks.
Characteristics:
Lawn's area: 0m2.
Water-Use: Depending on plant types used
Water Cost:

# 5 CONCLUSIONS

# Conclusion

The appearance of landscape lawns is much related to the emergence of gated communities in Egypt, developers of residential compounds with their marketing materials, they claim to offer ‘a sustainably green exclusive lifestyle’ that could benefit the health of human and integrate humans with nature, they used green lawns as their main landscape element, and throughout the research it was proved that this claim is not suitable in all the cities, the landscape lawn which was adopted from the western culture is not suitable to our environmental conditions.

By using Madinaty as a case study and assessing the types of landscape lawns used in the residential zones, the central park, and the golf courses, it was proved that the landscape design suffers from defects, and most of the lawns present within the compound are just achieving the scenery landscape design which is nonfunctional. Not only that but also these huge lawns areas needed many practices to survive in our arid climate from watering, mowing, fertilizing, which all had a diverse impact on the water scarcity issue, as well as the air quality in the atmosphere.

The redesigning of the green spaces within the residential compound of Madinaty is a must, taking some of the measures of the natural based solutions that was applied in some places here in Egypt as al-Burouj compound and el-Ein bay resort, could be beneficial to the future of Egypt’s water resources as well as the air quality, as these NBS uses less water, no need for mowing or fertilizing, thus saving the environment from the deterioration.
We’re not saying to replace all the lawns with NBS, but locating the lawns whenever needed with a reasonable percentage, which serves the needs of the society, but without compromising the environmental quality.

People must be aware of the diverse impacts of lawns, in order to stop demanding the green image of lawns without knowing what' s behind and what's waiting for their health on the long term, they already started to change their mind from an economical point of view, as the found lawns need alot of money to be maintained as mentioned in the survey, but we need more, we need people to think wisely from a socio-economic yet environmental point of view.

So, the measures to save environment already exist, but it needs to be promoted to the public in an economic mean where they can enjoy the same quality view and pay less, by that way real estate developers will rethink their designs according to the promoted alternatives that was already agreed from the public, and they also would save the costs of maintenance of the old landscape lawns.

Calculations within the thesis for water consumption and fertilizers consumptions are based on assumptions from myside and people who works for the company, Further research needs to be done to reassess these values. Generally, the assessment made in this thesis could be used to assess different residential compounds cases in Egypt and different parts, however the different socio-economic and environmental conditions should be identified for each case. Landscape architects could have a big role towards an environmental sensitive and sustainable landscape design, if only a comprehensive integrated approach is developed with other disciplines, including environmentalists to design according to the current environmental situation and available resources, as well as social studies to understand people's interests and needs.

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Figure 17,18 __ Yang, F. (2019) *Historical Development and Practices of Lawns in China.*

Figure 19__ Diester, L. (2013) *Designing landscape as infrastructure water sensitive open space design in Cairo.* IUSD journal.

Figure 20__ U.N.

Figure 21__ Google earth.

Figure 22__ Google earth.

Figure 23__ Google earth.

Figure 24__ http://www.madinaty.com/en/project.aspx

Figure 25__ Own on google earth.

Figure 26__ https://www.troon.com/locations/madinaty-golf-cub/

Figure 27__ Own.

Figure 28__ Creed, R. (2001) *Golf course construction costs.* https://archive.lib.msu.edu/tic/holen/article/2001may24.pdf

Figure 29__ Own.

Figure 30__ Own.

Figure 31__ http://spacerealestate.net/maps/madinaty/buildings

Figure 32__ Olx.

Figure 33__ https://www.ydr.com/in-depth/news/2019/11/18/old-artificial-turf-fields-pose-huge-waste-problem-environmental-concerns-across-nation/2314353001/

Figure 34__ Ignatieva, M. and Haase, D. and Dushkova, D. and Haase, A. (2020) *Lawns in Cities: From a Globalised Urban Green Space Phenomenon to SustainableNature-Based Solutions.* Germany. Land journal.

Figure 35,36,37__ Ignatieva, M. and Haase, D. and Dushkova, D. and Haase, A. (2020) *Lawns in Cities: From a Globalised Urban Green Space Phenomenon to SustainableNature-Based Solutions.* Germany. Land journal.

Figure 38__ AlBuruj brochure.

Figure 39__ AlBuruj brochure.

Figure 40__ AlBuruj brochure.

Figure 41__ AlBuruj brochure.

Figure 42__ Own by Mohamed, EinBay project manager.

Figure 43__ Own by Mohamed, EinBay project manager.

Figure 44__ Own by Mohamed, EinBay project manager.

Figure 45,46,47__ George, E. (2002) *Xeriscape guidelines adapted to residential gardens in Cyprus.*

# A

# APPENDICES

## Appendix (A) Social online survey form on survey monkey.

### تقييم مدي ملائمة المناظر الطبيعية في المجمعات السكنية في مصر، مع اختيار مشروع مدينتي السكني كمثال للدراسة

هذا الاستبيان خاص لسكان مدينتي، و الغرض منه تحليل المناظر الطبيعية المستخدمة و مدي ملائمتها مع الوضع الراهن للمياه و جودة الهواء في مصر، و هدفه المساعدة في رسالة الماجستير الخاصة بي لكلية الهندسة جامعة عين شمس، برنامج التكامل العمراني و التنمية المستدامة، و تستخدم هذه البيانات لأغراض اكاديمية فقط

* 1. What's your age range ? / اختار الفئة العمرية

- [ ] 15-24 / ١٥-٢٤
- [ ] 25-64 / ٢٥-٦٤
- [ ] 65 and over / ٦٥ و اكثر

* 2. For how much have you been living in Madinaty ? / منذ كم سنة تعيش في مدينتي

- [ ] 0-5 years / اقل من ٥ سنين
- [ ] 5-10 years / من ٥ - ١٠ سنين
- [ ] over 10 years / اكثر من ١٠ سنين

* 3. In which prototype are you living ? / في اي نموذج تعيش

- [ ] Residential Apartments / شقق سكنية
- [ ] Residential Villas / فيلات سكنية
- [ ] Golf Villas / فيلات منطقة الجولف

* 4. What's your landscape view ? / ما هو المنظر الطبيعي الذي تعيش امامه

- [ ] Green open spaces / مناطق خضراء مفتوحة
- [ ] Golf courses / منطقة الجولف
- [ ] Streets and parking / شوارع و اماكن انتظار سيارات

* 5. Are you living nearby your preferable landscape ? / هل تعيش بجوار المنظر الطبيعي الذي تتمناه

- [ ] Yes / نعم
- [ ] No / لا

6. If No, which landscape view do you wish to live nearby ? / إذا كانت الإجابة لا ، فما المنظر الطبيعي الذي ترغب في العيش بالقرب منه

* 7. What's your way of interaction with the landscape ? /
ما هي طريقتك في التفاعل مع المناظر الطبيعية

- ◯ Walking
- ◯ Seating
- ◯ Picnic
- ◯ Just an aesthetic view
- ◯ Pets walking
- ◯ Kids playing

8. If you own a private villa which lawn type you have in your private garden ? /
إذا كنت تمتلك فيلا خاصة ، ما نوع النجيلة الموجود في حديقتك الخاصة

- ☐ Natural lawn / نجيل طبيعي
- ☐ Artificial lawn / نجيل صناعي

9. How often do you maintain your lawn (Fertilizing + Mowing) ? / كم مرة تحتاج حديقتك للصيانة سواء تسميد او تقليم العشب

- ☐ 1-2 times per week / من ١-٢ مرة في الاسبوع
- ☐ More than 2 times per week / اكثر من مرتان في الاسبوع
- ☐ 1-2 times per month / من ١-٢ مرة في الشهر
- ☐ More than 2 times per month / اكثر من مرتان في الشهر

10. Do you pay much for maintaining your lawn ? / هل تدفع الكثير من المال لصيانة النجيلة

- ☐ Yes / نعم
- ☐ No / لا

11. Mention the range of money spent on maintaining your lawn monthly or yearly / اذكر نطاق الأموال التي يتم إنفاقها على صيانة حديقتك شهريًا أو سنويًا

12. Does your lawn consume a lot of water ? / هل تستهلك مياه كثيرة لري النجيلة

- ☐ Yes / نعم
- ☐ No / لا

13. Does Artificial grass increase the heat in your garden ? / هل يزيد النجيلة الصناعي من الحرارة في حديقتك

- ☐ Yes / نعم
- ☐ No / لا

* 14. Have you experienced previous problems with your lawn ? / هل واجهت مشاكل سابقة بسبب النجيلة

- [ ] Yes / نعم
- [ ] No / لا

* 15. If you experienced health or environmental related problems because of your lawn mention it please /
إذا كنت تعاني من مشاكل صحية أو بيئية بسبب حديقتك ، أذكر ذلك من فضلك

* 16. Do you feel different air quality with differing landscape types ? /
هل تشعر باختلاف جودة الهواء مع اختلاف المناظر الطبيعية

- [ ] Yes / نعم
- [ ] No / لا

* 17. Do you suffer from water cut off in some times ? / هل تعاني من انقطاع المياه في بعض الأوقات

- [ ] Likely
- [ ] Unlikely

* 18. If you knew about the new Nahda dam by Ethiopia, would you mind replacing current landscape views with other environmental friendly green options for the sake of saving water ? /
إذا كنت تعرف عن سد النهضة الجديد لإثيوبيا ، فهل تمانع في استبدال المناظر الطبيعية الحالية بخيارات اخري خضراء صديقة للبيئة من أجل توفير المياه

- [ ] A great deal / موافق بشدة
- [ ] A lot / موافق
- [ ] A little / موافق قليلا
- [ ] None at all / غير موافق تماما

* 19. If the landscape is to be replaced, what will be your priority in choosing it ? /
إذا كان سيتم استبدال المناظر الطبيعية ، فما هي أولويتك في اختيارها

- ( ) Price value for the nearby unit / سعر الوحدات المجاورة
- ( ) Air quality for the surrounding / جودة الهواء المحيط
- ( ) The aesthetic view / المنظر الجمالي
- ( ) The interaction type with the landscape / التفاعل مع المنظر الطبيعي

* 20. Please choose one or more of the following replacements for the current landscape types that would best fit your preference /
يرجى الاختيار من بين البدائل التالية لأنواع المناظر الطبيعية الحالية التي سوف تناسب رغباتك

Prairie gardens / حدائق البراري

Natural meadow like / مغطيات التربة

Tapestry lawns / نسيج المروج

Xeriscaping / مناظر طبيعية جافة

## Appendix (B) Surveying residential compound in Egypt.

(Fig.48) __ Hyde Park, New Cairo.
(Web source).

(Fig.49) __ Sodic, West Cairo.
(Web source).

(Fig.50) __ Katameya Plaza, New Cairo.
(Web source).

(Fig.51) __ Beverly Hills, 6th of October.
(Web source).

APPENDIX B

(Fig.52) __ Mivida, New Cairo.
(Web source).

(Fig.53) __ Retaj city, New Cairo.
(Web source).

(Fig.54) __ AlRehab, New Cairo.
(Web source).

As we can see in most of residential compounds in East and West Cairo, it's obvious that Lawns (which my research is based upon) are the main landscape element in all of them,

# نبذة

**سلمي محمد عبد المنعم محمد**

**تقييم مدى ملاءمة المناظر الطبيعية في المجمعات السكنية للسياق المصري**
**استخدام المروج الخضراء بين القوى الاجتماعية والاقتصادية والبيئية**

يرتبط انتشار مناطق العشب الأخضر ارتباطًا وثيقًا بظهور المجتمعات المسورة في مصر. يمكننا أن نرى مساحات شاسعة من المروج الخضراء في معظم المجمعات السكنية في مصر، فهي تعتبر نقطة البيع الرئيسية التي يستخدمها معظم المطورين العقاريين لبيع مشاريعهم، والتي يمكن أن تكون نقطة صالحة في الوقت الحاضر، لان معظم الناس في الوقت الحالي يبحثون عن المناظر الخضراء الواسعة للعيش بالقرب منها والاستمتاع بها، ولكن هل هذه المناظر الخضراء تحقق الوظائف المطلوبة والتوازن لكل من الجوانب الاجتماعية والاقتصادية والبيئية، ام تؤثر سلبا علي احد الجوانب.

حجتي هي أن المناظر الطبيعية في المجمعات السكنية يُنظر إليها الآن على أنها تصميم مشهد غير وظيفي مع العديد من العمليات اللازمة للحفاظ عليها والتي بدورها تؤثر على التوازن البيئي. في هذا البحث، سيتم تقييم هذا النوع من المروج الخضراء باعتباره النوع الرئيسي للمناظر السكنية بين القوى الاجتماعية والاقتصادية والبيئية لتقييم مدى ملاءمتها في السياق المصري وأيضا يمكن تطبيقها على العديد من الحالات السكنية.

يمكن القيام بذلك عن طريق اختيار مدينتي كمجتمع سكني يحقق الاستدامة كدراسة حالة في سياق مصر، مع تقييم أنواع المروج المستخدمة لوظائف مختلفة داخل الكمبوند من وجهة نظر الأشخاص الذين يعيشون في المنطقة، والفوائد، والتكاليف التي يتحملها المطورون، فضلاً عن الوضع البيئي الحالي في مصر فيما يتعلق بندرة المياه وتحديات تلوث الهواء الرئيسية في ذلك الوقت. إنهاء البحث بتقييم وإدخال بدائل جديدة لمروج المناظر الطبيعية حساسة بيئياً، والتي يمكن استخدامها لتحقيق التوازن بين القوتين.

**كلمات البحث:** المروج الخضراء، القوى البيئية، الاقتصاد المتعلق بالمناظر الطبيعية، المناظر الطبيعية الحساسة بيئيًا، ندرة المياه، المناظر الطبيعية السكنية، مصر.

# إقرار

هذه الرسالة مقدمة في جامعة عين شمس للحصول على درجة العمران المتكامل والتصميم المستدام.
إن العمل الذي تحويه هذه الرسالة قد تم إنجازه بمعرفة الباحث سنة ٢٠٢١

هذا ويقر الباحث أن العمل المقدم هو خلاصة بحثه الشخصي وأنه قد اتبع الإسلوب العلمي السليم في الإشارة إلى المواد المؤخوذه من المراجع العلمية كٌل في مكانه في مختلف أجزاء الرسالة..

وهذا إقرار مني بذلك،،،

التوقيع:

الباحث: سلمي محمد عبد المنعم محمد عبد العال

التاريخ: ـــ / ـــ / ـــــ

# تقييم مدى ملاءمة المناظر الطبيعية في المجمعات السكنية للسياق المصري
## استخدام المروج الخضراء بين القوى الاجتماعية والاقتصادية والبيئية

مقدمة للحصول على درجة الماجستير في العمران المتكامل والتصميم المستدام.

أعداد: سلمي محمد عبد المنعم محمد عبد العال

**لجنة أشراف**

أستاذ دكتور محمد صالحين
جامعة عين شمس

أستاذ مساعد آيات إسماعيل
جامعة عين شمس

**لجنة الحكم**

أ.د. ..... الممتحن الخارجي
أستاذ .....
جامعة .....

التوقيع

أ.د. .....
أستاذ .....
جامعة .....

أ.د.....
أستاذ .....
جامعة .....

الدراسات العليا

تاريخ المناقشة: .....

ختم الإجازة
موافقة مجلس الكلية: ـــ / ـــ / ـــــ

أجيزت الرسالة بتاريخ: .....
موافقة مجلس الجامعة: ـــ / ـــ / ـــــ

ـــ / ـــ / ـــــ

جامعة عين شـــمس

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## استخدام المروج الخضراء بين القوى الاجتماعية والاقتصادية والبيئية

رسالة مقدمة للحصول على درجة الماجستير في العمران المتكامل والتصميم المستدام

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**أغسطس ٢٠٢١**