T.C.
BAHCESEHIR UNIVERSITY
GRADUATE SCHOOL
THE DEPARTMENT OF ARCHITECTURE

THE EFFECT OF URBAN EXPANSION ON GREEN AREAS, THE CASE STUDY OF AL-DORA MUNICIPALITY IN BAGHDAD

MASTER'S THESIS
SHAHAD AL-NUAIMI

ISTANBUL 2024

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

THE EFFECT OF URBAN EXPANSION GREEN AREAS, THE CASE STUDY OF AL-DORA MUNICIPALITY IN BAGHDAD

SHAHAD, AL-NUAIMI
Master's Program in Architecture

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Urban expansion is one of the problems facing cities worldwide. Urban expansion on agricultural lands and green spaces is one of the problems that most affect the environment, society, and climate. Removing vegetation and covering the soil with concrete and asphalt contribute to global warming and climate change. Iraq, in general, is witnessing a noticeable change in the rise in temperature recently, especially in Baghdad, due to the change in the land use of agricultural lands. In addition to the city's lack of green cover, in the case study, the research employs a descriptive and comparative method. The study focuses on analyzing the municipality of Al-Dora as a case study, using satellite images and the ARC-GGIS geographic analysis program to analyze the study area. Using Landsat 4 and 9 data, this research analyzed the study area to obtain detailed results about the extent of change and the percentages of change in land use. The study showed a noticeable transformation in land use during the period 2002–2023, with the loss of a massive of green and agricultural areas to urban expansion. This led to negative impacts on the environment, society, economy, and construction from an architectural standpoint. The study found widespread irregular construction.

Keywords: Urban Expansion, ARC-GIS, Land Use, Green Areas, Green Spaces, Urbanization.

ÖZ

KENTSEL YAYINLANMANIN YEŞİL ALANLAR ÜZERİNDEKİ ETKİSİ,

BAĞDAT AL-DORA BELEDİYESİ ÖRNEĞİ

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Kentsel büyüme, dünya çapında şehirlerin karşılaştığı sorunlardan biridir. Tarım arazileri ve yeşil alanlardaki kentsel büyüme; çevreyi, toplumu ve iklimi en çok etkileyen sorunlardan biridir. Bitki örtüsünün kaldırılması ve toprağın beton ve asfaltla kaplanması küresel ısınmanın ve iklim değişikliğin temel nedenlerindendir. Son dönemlerde, Irak genelinde ve özellikle Bağdat'ta tarım arazilerinin kullanımındaki değişiklikler sıcaklık artışına neden olmaktadır. Tez çalışmasında incelenen örnek betimleyici ve karşılaştırmalı bir yöntem ile ele alınmıştır. Tez çalısmasında incelenen alan, Al-Dora Belediyesi, uydu görüntüleri ve ARC-GIS coğrafi analiz programı kullanarak, bir vaka çalısması olarak analiz etmeye odaklanmaktadır. Landsat 4 ve 9 verileri, değişimin kapsamı ve arazi kullanımındaki değişim yüzdeleri hakkında ayrıntılı sonuçlar elde etmek için analiz edilmiştir. Çalışma, 2002-2023 döneminde kentsel genişleme nedeniyle büyük oranda, yeşil ve tarım alanın kaybıyla birlikte arazi kullanımında gözle görülür bir dönüşüm olduğunu göstermiştir. Bu durum mimari açidan çevre, toplum, ekonomi ve inşaat sektörü üzerinde olumsuz etkilere yol açmıştır. Araştırmada yaygın ve düzensiz yapılaşma tespit edilmiştir.

Anahtar kalimeler: Kentsel Büyüme, ARC-GIS, Arazi Kullanımı, Yeşil Alanlar, Kentleşme

To My lovely son: Fahad.

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Introduction

Urban expansion on the green is the most current critical issue that nations are paying attention to worldwide. This has altered land use patterns and landscapes, leading to environmental challenges. Urban expansion is a growing concern due to the continuous trend of global urbanization, characterized by rapid land use changes such as urban sprawl, farmland displacement, and deforestation. This leads to the loss of arable land and the decline of natural greenery (World Population Prospects 2022).

1.1 Background

Worldwide, over 56.2% of the world's population lives in urban (Asmael, 2015). Iraq has witnessed a population increase since 2003 and migration from rural areas to urban areas and city centers. The major affected city of this growth and migration is Baghdad city (Nussaif & Qamar, 2007). Baghdad is a historical city and the capital of Iraq, which is considered as important strategical location in the middle of Iraq with the total area of Baghdad Governorate reaching 5159 Km2 (Iraqi Central Statistics Organization, 2021). The urban planning of Baghdad is an organic urban fabric Figure 1 shows the urban design of Baghdad in 1854 (Nussaif & Qamar, 2007).

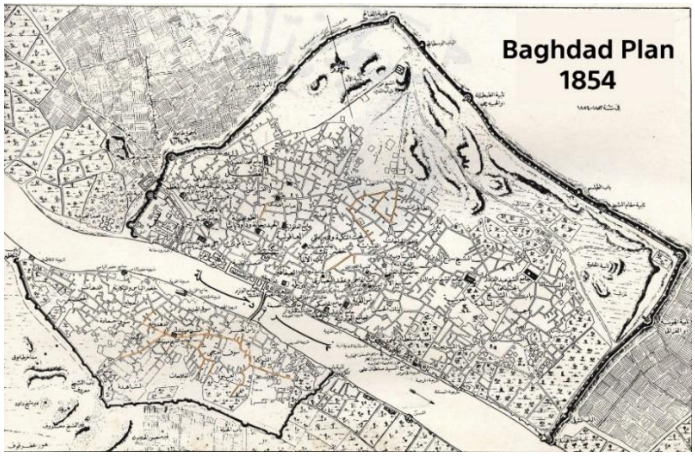

Figure 1. The fabric urban design of Baghdad in 1854. (Source: Municipality of Baghdad)

The formation of Baghdad's' streets has an organic appearance and interwoven fabric and narrow streets. The urban plan of the city Figure 1 was fundamental layout of the current urban plan Figure 2.

Figure 1. The current Baghdad urban plan (OpenStreetMap,2024).

Baghdad's population is approximately 8.7 million people according to the Central Statistics Organization in 2021. Baghdad, located in the middle of the sedimentary plain, where the Tigris River divides it into Karkh (west) and Rusafa (east). The city consists of 27 regions, which in turn are each divided into several districts comprised of residential areas, road networks, industrial areas, and agricultural areas. Figure 3a shows the land use of Baghdad in 1973, and Figure 3b shows green spaces and regions in the development plan of 1973 (Alobaydi & Rashid, 2017).

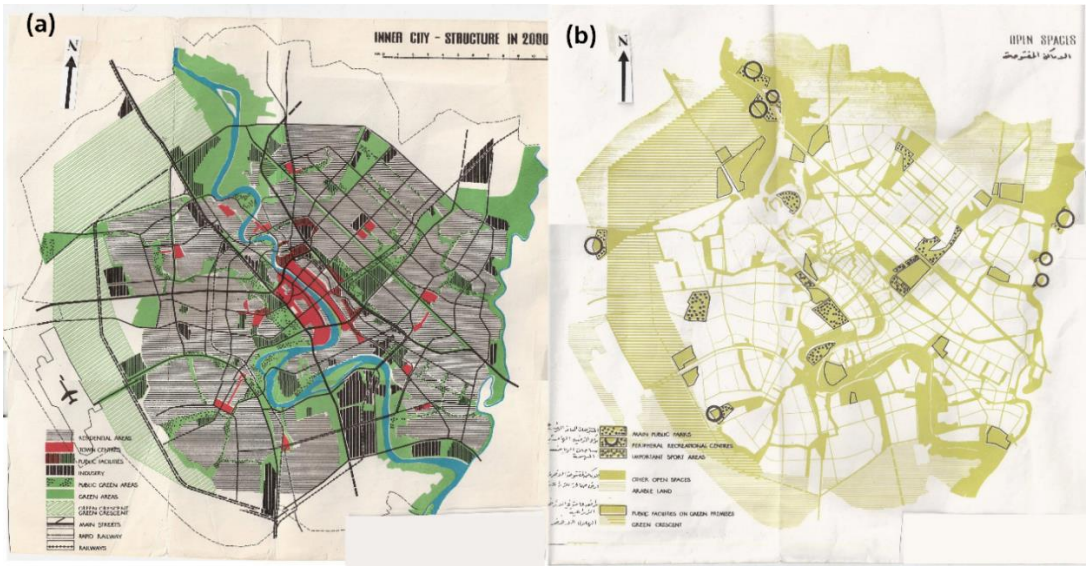

Figure 2. (a) land use of Baghdad in 1973, (b)Baghdad green spaces and regions in the development plan 1973. (Source: Municipality of Baghdad, 2014).

As a result of the Iraqi government's negligence after 2003, the urban expansion issue turns into one of the most essential problems in Baghdad due to the devouring of thousands of agricultural lands with endless expansion; and agriculture is no longer of commercial benefit as it used to be. The major increases in urban areas and population density, after 2003, have led to increasing environmental pressure on natural systems within Baghdad (Al-Akkam, 2012). Baghdad city suffers from random urbanized expansion and highly congested roads. The city environment has been badly affected by its air pollution and low green areas (Al-Yasiri, 1965). The shrinkage of green areas in Baghdad has led to changes in urban planning due to urban expansion on these green areas from 2003 to 2023; Figure 4 shows the Baghdad satellite map in 2002 with green spaces and less urbanism density. Figure 5 show the current Baghdad satellite map in 2023, where the increase of the density is obvious.

Figure 3. Baghdad satellite map in 2002 (Source: Google Earth Pro).

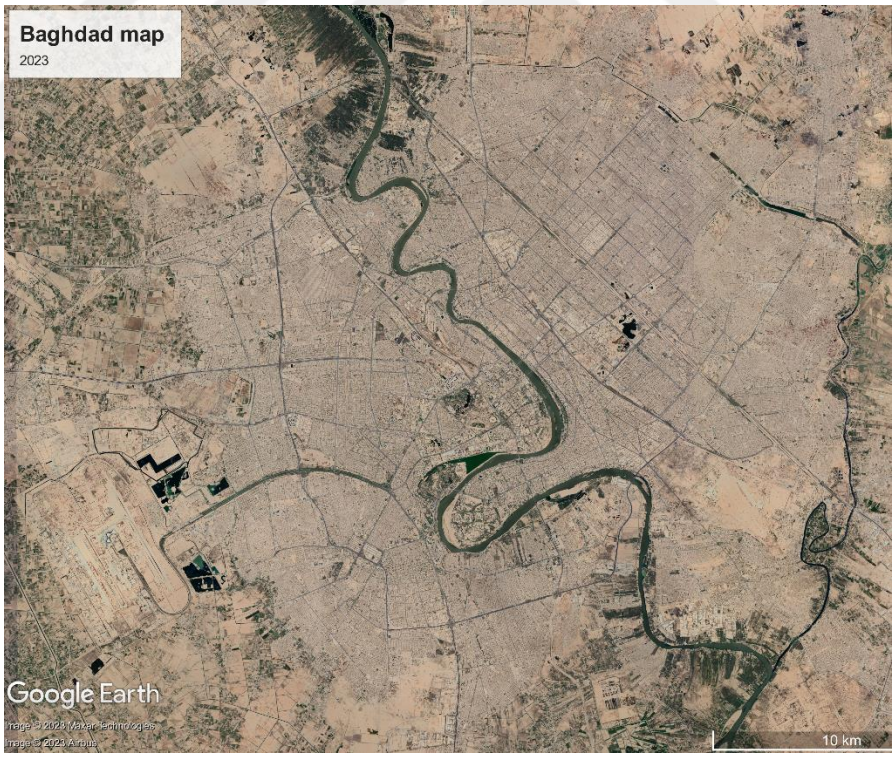

Figure 4. Baghdad satellite map in 2023 (Source: Google Earth Pro).

The Iraqi government issued the Agrarian Reform Law in 1970, considered one of Iraq's most influential laws. A few feudal lords owned the agricultural lands. Then the government distributed it equally among the farmers according to the land area, the soil fertility, and the irrigation system. The agrarian system deteriorated since then because the farmer cultivated the land for products according to their desire and not according to what the nation needed in an organized manner. Subsequently, the ownership of agricultural lands was distributed according to the inheritance system among the heirs of these lands from the first peasant fathers to whom these lands were distributed. This issue is one of the reasons for transforming agricultural lands into urbanism (Alwen, 2021).

After 2003, the majority of land uses in Baghdad were transformed, such as the transforming rural lands into residential lands. Which occurred as a result of population growth and a lack of well-thought-out alternatives for housing. One of the largest green spaces in downtown Baghdad is the part aligned to the Tigris River in the municipality of Al-Dora area, which is chosen as a case study because of its importance in terms of the area affected by this change (Ballester, 2021). Figure 6 shows the Baghdad satellite map in 2002 with green spaces and less urbanism density. Figure 7 shows the current Baghdad satellite map in 2023, where the urban expansion is obvious.

Figure 5. Al-Dora satellite map in 2002 (Source: Google Earth Pro).

Figure 6. Al-Dora satellite map in 2023 (Source: Google Earth Pro).

The municipality of Al-Dora is located in the southern municipality of the city of Baghdad, precisely at coordinates 33°13'31.9"N 44°24'00.3" E and 33°16'57.0"N 44°24'51.3"E, at an elevation of 33 meters above sea level. Situated on the western bank of the Tigris River, the location is characterized by its proximity to an expanse of land abundant with densely populated palm groves. The municipality comprises many residential and business complexes, including the Teachers' Neighborhood, the Al-Athuriyyin Neighborhood, and the Mechanics Neighborhood. The municipality of Al-Dora is regarded as a significantly populous urban center inside the capital, compared to other localities and urban areas. The municipality encompasses an area of 87 km2, with a population ranging between 500,000 and 750,000 individuals. Notably, the southern regions of the river are regarded as green spaces within the proposed design. The Al-Dora municipality exhibits a climatic pattern that is comparable to the climatic conditions observed in other regions of the city. Nevertheless, while conducting a comprehensive analysis of the meteorological patterns in the urban area of Baghdad and specifically the Al-Dora neighborhood, it becomes evident that a marginal disparity of around two degrees Celsius exists in the nocturnal temperatures over the span of one week. The observed disparity can be attributed to the inherent characteristics of the municipality of Al-Dora, namely the prevalence of verdant areas and its strategic positioning along the Tigris River, which plays a pivotal role in tempering the local temperature. After 2003 many green spaces and agricultural land were affected by urban expansion (Abbas, 2022). Figure 8 present the green spaces affected by urban expansion in Al-Dora city. All the colored areas were agriculture, green spaces, and green patches, most of it transformed into residential uses due to the increase in population and lack of a proper alternative.

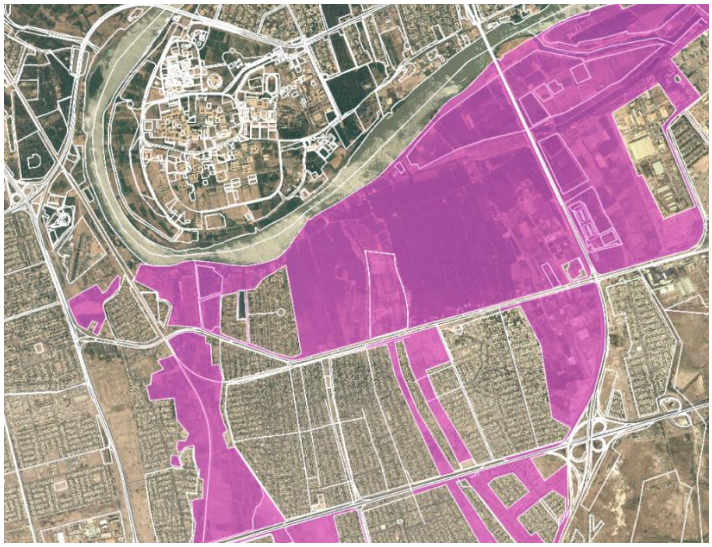

Figure 7. The green spaces affected by urban expansion in Al-Dora city. (Source: Google Earth Pro, and drawing by the author).

1.2 Research Problem

The foundational urban design of Baghdad originally allocated 40% of the city's area to green spaces, with the remaining 60% designated for residential housing. However, this balance has shifted significantly over time. The green spaces have drastically declined to only 10% of the total land area, representing a 75% reduction from the original allocation, with only 25% of the intended green space preserved. Table 1.9 illustrates the land use transformation values in Baghdad, Iraq, from 2002 to 2023, highlighting this significant change. According to the World Health Organization (WHO), urban areas should allocate at least 30% of their total land area as green space per capita, which includes parks, gardens, woodlands, and roadside trees (World Health Organization, 2017). The current situation in Baghdad, therefore, falls far short of these recommendations, indicating a pressing need for urban planning revisions to restore and preserve green spaces within the city.

Table 1

Land Use Transformation. Baghdad-Iraq 2002-2023 (By The Author,2024.)

	Green Areas Percentage (%)	Residential Percentage (%)
Baghdad 2020	40	60
Baghdad 2020	10	90
WHO Ratio	30	70

The city's growing population has driven the rapid urban expansion in Baghdad, necessitating the development of new housing to accommodate this demand. This expansion often occurs at the expense of agricultural and green spaces, as residential areas encroach upon these lands without sufficient consideration of urban planning regulations and the resulting negative impacts. As a result of this trend, several issues have emerged:

- The increasing population growth in Baghdad generated the need to find new housing. Consequently, the nearness of agricultural or green spaces to residential areas was a destination to absorb this need without taking into account the urban planning regulations and the negative effects that are generated from them.
- The issue of building on agricultural lands is one of the problems resulting from the Agrarian Reform Law of 1970, which led to the fragmentation of ownership of agricultural lands into small plots and distribution to farmers (Hasson & Dhumad, 2018).
- Building in the green zones of Baghdad is an issue that may affect the ecological system of Baghdad and its suburbs. The green municipality in Al-Dora is considered the pulsating lung of Baghdad city, where the study area is 6 million square meters. The urban expansion in this area negatively effects of the green regions and their scarcity in Baghdad (Vargas-Hernández & Zdunek-Wielgołaska, 2021).

- The distribution of lands in smaller areas among the farmers led to the generation of the problem of agricultural imbalance, decentralization in agriculture, and the right to dispose of the land as private property granted by the state.

1.3 Research question

Urban sprawl, the unregulated and extensive growth of cities into their surrounding environments, poses significant challenges for architects. Architects play a vital role in addressing these problems and designing a more environmentally friendly future for our communities. This study investigates the convergence of urban expansion and architectural design by questioning:

- How does architecture planning help to limit the problem of urban expansion on agricultural lands and green spaces?

1.4 The Aim of The Study

Based on the guidelines provided by the World Health Organization, it is recommended that individuals have access to a green space at a maximum distance of 300 meters from their residences. This ratio ensures that there is sufficient space for trees, plants, and other natural elements to thrive, providing numerous benefits for both physical and mental well-being (Alwan, 2019).

This study focuses on finding architectural solutions that contribute to reducing the impact of urban expansion on green spaces and organizing them in a way that is more suitable for living in an appropriate architectural environment as follows:

- Investigate how urban expansion affects agricultural lands and green areas.
- Draw attention to the environmental and social impact of urban expansion on green regions.

1.5 Methodology

This research mainly used descriptive research. The purpose of descriptive research is to precisely and methodically describe a population, situation, or phenomenon. Descriptive research can answer questions about what, where, when,

and how, but not why. Descriptive research entails the systematic collection of data about events, followed by the organization, tabulation, depiction, and description of the collected data (Planella, 2019). The case study is analyzed through a process of several steps. The first step is dealing with the satellite map timeline and comparing the changes for each zone inside the case study. The second step of the analysis process is a field survey and the collection of data on the ground, such as photos, to identify the functional situation of the current facilities. The third step is analyzing the data for the case study in terms of indicators such as infrastructural, environmental, economic, and social.

In summary, Chapter 1 laid the groundwork for this study by contextualizing urban expansion within the land use framework and its environmental implications. By defining the research problem and articulating the central questions and objectives, this chapter highlights the critical need for understanding the dynamics of urban growth. Building on this foundation, Chapter 2 will further explore the complexities of urban expansion, specifically addressing the concepts of land use, green spaces, and the environmental consequences of land-use changes. This progression will enhance our comprehension of the factors shaping urban environments and inform strategies for sustainable development.

Chapter 2

Urban Expansion

Urban expansion is defined as the continuous increase in population numbers, whether in regular or irregular housing, and this leads to an increase in demand for housing urbanization land, thus creating an imbalance in the environmental balance. In addition to the population increase, other factors help with urban expansion, most notably state policy through the creation of new residential neighborhoods on or near agricultural lands, in addition to the financial factor through which the owners of agricultural land located on the outskirts of cities are exploited for non-agricultural purposes (El-Kholei et al., 2019).

Urban expansion refers to the process of an increase in the geographic areas of cities and towns into surrounding rural areas. Also, urban expansion refers to the process of increasing the number of residential units as well as the establishment of more residential complexes around, closer to, or beside the cities. The increased demand to establish additional urban residential complexes led to an increase in the city's urban area continuously. The process of urbanization is not just a recent phenomenon; it is a quick and significant change in human social origins worldwide, where primarily rural culture is quickly changing into largely urban culture (Taha, 2005).

The problem of urban expansion at the expense of agricultural lands is one of the problems that everyone worldwide suffers from, especially those characterized by rapid population increases. Rather than being confined to a specific group of countries. This applies to the nations within the Middle East and North Africa, encompassing Iraq as well. Several studies have indicated that Bahrain has experienced a loss of around 8,000 dunams of its fertile agricultural land since 1976 due to its transformation for residential, industrial, and other public purposes, all of which do not necessitate the utilization of such high-quality land (Hareedy & Deguchi, 2008). The aforementioned analysis revealed that the urban area of Doha has encroached over three prominent agricultural properties in its vicinity, namely Al-Rayyan, Al-

Markabiy, and Al-Jarafa. Agricultural fields in the northern region of Doha have recently been the site of the emergence of residential developments (El-Kholei et al., 2019).

The phenomenon of urban expansion in Egypt has resulted in the conversion of agricultural fields in the vicinity of metropolitan centers, encompassing an estimated yearly area of 12530 acres. Research has demonstrated that towns with larger sizes or closer geographical proximity to major cities, as well as those with a greater scope of economic projects, experience higher rates of urbanization expansion compared to villages with isolated locations or smaller sizes (Brasuell, 2021).

2.1 Land Use Concept

The term "land use" may appear self-evident, but it possesses a highly precise definition that carries significant implications for peoples' lifestyles, occupations, and daily activities. The regulation of land use is pervasive in various domains. Planners use the term "land use" with great precision, but it has significant implications for the economy, the environment, and society. Even for non-urban planners, comprehending the concept of land use can significantly impact the perception of the town and the wider world. Crucially, the process of altering the world frequently starts with the ground right beneath. Land use changes based on the needs of society to serve different objectives. The land is exploited in various ways, such as for food, shelter, manufacturing and production, or recreation (Taylor & Hochuli, 2017).

Land use can be defined as all activities and processes related to the human use of an area or zone of land for a function. It also refers to how humans interact with the land or the environment. Land use depends on the mechanisms or practices used to manage the approach used to achieve the purpose of land use. The change in approach results in a change in activities and circumstances related to land use and is directly reflected in it. Land uses vary into several types, some natural, such as wilderness, and some that occur through human intervention, such as agricultural and industrial fields, residential cities, green spaces, and transportation (Dawood & Jassim, 2023).

Land use is subjected to several variables that directly or indirectly affect the formation of the structure of these uses, both spatially and over multiple and accumulated eras and periods. One of the factors affecting the use of land within cities is the economic factor. As in the competition to obtain a specific site for commercial use and be able to provide an economic return. Moreover, the value of land can be an important factor in land use, as is the case in industrial uses, where large areas of land are needed, so they are distributed on the outskirts of cities because the land is less expensive than in city centers. Another important determinant factor is the social factor and the tendency to concentrate within the city. Planning for cities and land in general represents the basis for forming a sound and carefully considered use structure, unlike without planning (Dawood & Jassim, 2023).

2.2 Definition of green spaces

Green areas can be defined as open, unbuilt spaces designated for public or private use, and they are a type of land use located within or beside the urban fabric of cities or neighborhoods. Additionally, they serve to illuminate or ventilate the surrounding urban buildings. The purpose of forming green spaces is to enhance the experience of sustainable living within cities from an aesthetic or functional perspective. Open lands such as squares, areas covered with plants, parks, gardens, reserves, and agricultural lands are all considered green spaces. It is essential for bridging the distance between the city's urban landscape and the natural environment's landscape, such as forests, jungles, and others. Green spaces are regarded from both social and environmental perspectives, as social and environmental aspects, including green spaces, are exposed to pressures associated with the urbanization process. (Laszkiewicz & Kronenberg, 2019). Historically, the notion of green space was associated with affluent and privileged communities, leading to a growing emphasis on environmental justice issues in urban greening and community involvement in this process (Al-Kubaisi & Al-Khateeb, 2010).

The importance of green spaces, particularly gardens, are crucial for a healthy environment and community ties in cities. They contribute to the visual appeal of residential landscapes and serve both aesthetic and functional purposes. The importance of green spaces increases daily and varies according to climate regions,

especially in dry and semi-arid cities. The use of afforestation in cities focuses on technical and aesthetic aspects, but functional city planning and development depend on appropriate land investment and a sustainable distribution between urban buildings and greening. For example, Dubai's criteria for selecting public parks include a minimum area of 5,000 to 10,000 square meters, walls, restaurants, kiosks, children's amusement parks, playgrounds, restrooms, and parking. This approach ensures a healthy environment for humans and contributes to the overall health of the city (Brookings Institution, 2011).

The significance of green spaces extends beyond their aesthetic and functional contributions; they are essential for promoting public health and well-being. According to the World Health Organization (WHO), urban residents should have access to a minimum of **9 square meters** of green space per capita to support physical and mental health. Green spaces provide opportunities for physical activity, reduce stress, and contribute to overall environmental quality. Furthermore, the Organization for Economic Co-operation and Development (OECD) emphasizes that well-maintained green areas are crucial for improving air quality, reducing urban heat islands, and fostering social cohesion. These spaces not only improve the livability of urban areas, but they are also critical for achieving sustainable urban development and addressing the health disparities exacerbated by unequal access to green spaces.

2.4 Characteristics of Urban Green Spaces

The structure of urban green spaces differs in its planning and design characteristics. The properties of the green areas are open to various events and activities that suit all age groups and serve the largest segment of the community nearby. Green spaces serve several residential areas and often contain playgrounds rather than those that serve one residential area. It includes public gardens containing trees and shrubs, water fountains, walking paths, and yards designated for rest (Al-Ali, Z. 2014). The main characteristics of urban green areas are divided into four major aspects as follows:

The first one is the area of green areas varies from one city to another and depends on many factors, such as population density, city area, and type of urban planning. The second one is biodiversity, urban green areas are characterized by their rich biological diversity, as they include various types of plants, trees, and animals, which contribute to maintaining the environmental balance. The third aspect is Aesthetics, where urban green areas add an aesthetic touch to cities and improve their overall appearance, resulting in a comfortable and attractive environment for residents. The final aspect is the functions where green areas serve a variety of crucial purposes, including:

- Air purification: Plants contribute to purifying the air from pollutants and improving air quality.
- Climate regulation: In the summer, green areas help regulate and reduce temperatures.
- Rainwater absorption: Green areas help to absorb rainwater and reduce the risk of flooding.
- Providing entertainment: Green areas provide suitable places for entertainment, relaxation, and practicing various sports activities.
- Promoting mental health: green areas contribute to enhancing mental health and improving people's mood.

Green areas: Parks, gardens, forests, and grassy areas all fall under the definition of "green areas," which include vegetation. They are typically open areas created for public use, recreation, or environmental preservation. The public parks, typically decorated with plants, trees, and flowers, serve as open green spaces for entertainment and recreation. These green spaces serve as venues for entertainment, recreation, and the practice of various sports. They usually include sports facilities and playgrounds. The forests are vast expanses of trees and natural plants that serve as habitats for a variety of animals as well as sites for entertainment, recreation, and scientific research. Last but not least, open green spaces: People typically use these unused areas for recreation, such as empty lands or river banks. Figure 9 shows an example of these aspects such as Central Park, one of the world's most visited tourist attractions, is surrounded by the skyscrapers of Manhattan in New York City.

Figure 9. Central Park, of Manhattan in New York City (Ann Shields, 2014).

2.5 Effects of Land Use Change on The Environment

Population divisions, non-population divisions, agricultural divisions, industrial development, and other factors are some of the recent major pressing influences on land use change. Urban development often takes over the city's green spaces, sacrificing the environment in the process. In developing countries, urban expansion and expansion persistently encroach on designated open areas and green spaces, often remaining undefined as unexploited spaces until they become occupied. Several factors contribute to the deterioration of the condition of the land, including the lack of necessary planning for its use, the lack of organized implementation of planning, and the overuse of land resources for economic reasons. This often results in harm for a significant portion of the population and negatively impacts societal values. Therefore, the result is harmful to the residents and the environment, as the planning process must take into account the interests of the land as a whole and the quality of human use in the long term (Meerow & Newell, 2017).

2.6 Land-Use Changing Mechanisms

Land use changes in green areas are divided into two categories: planned mechanisms, and unplanned mechanisms.

- **Planned mechanisms**

Planned mechanisms It is a positive planning mechanism that enables land use to change in a coordinated and regular manner. This mechanism relies on integrated planning and community involvement to avoid negative impacts on the environment and society, based on sound scientific methodologies for finding design solutions for a specific area. Planned mechanisms could contain these aspects:

1. **Urban Redevelopment Projects**: Cities transform dilapidated industrial areas into mixed-use developments through urban planning, community consultations, and environmental assessments, benefiting the community and preserving green spaces. For example, Hudson Yards in NYC transformed an industrial area into a mixed-use neighborhood through extensive planning and sustainable design. (Davidson & Poorvu, 2019).
2. **Agricultural Land Preservation**: Rural regions prevent unchecked urbanization by using zoning laws, land-use planning, and community engagement to designate areas for farming, residential development, and commercial activities, ensuring sustainable growth and supporting local farmers. For instance, Ontario's Greenbelt Plan protects agricultural lands and natural heritage systems through zoning regulations and land-use planning. (Ontario Ministry of Municipal Affairs and Housing, 2017).
3. **Smart City Initiatives**: Metropolitan areas become smart cities by integrating technology with urban planning, using data analytics, IoT devices, and community feedback to optimize traffic flow, reduce energy consumption, and improve public services for a livable and environmentally friendly urban environment. For example, Masdar City in Abu Dhabi is a smart city project focused on sustainability and technology integration, featuring energy-efficient buildings and advanced transportation systems (Harrison & Donnelly, 2011).

4. **Green Infrastructure Development**: Cities combat flooding by incorporating green infrastructure such as parks, green roofs, permeable pavements, and rain gardens, managing stormwater, reducing heat islands, and enhancing urban biodiversity to create a resilient cityscape. For instance, Copenhagen is a leading example of green infrastructure development, implementing green roofs, permeable pavements, and bike lanes to manage stormwater and enhance urban green spaces (Meerow & Newell, 2017).

- **Unplanned mechanisms.**

It is a phenomenon of random, irregular growth that lacks the most basic requirements of urban design and planning, resulting from urban expansion. Random changes in land use occur for a variety of reasons, including economic reasons and the large demand for housing in city centers without planned alternatives. Urban expansion occurs in green areas, unexploited areas, or areas designated for purposes other than residential use. In these areas, urban expansion causes environmental, recreational, social, economic, aesthetic, and urban damage. Slum areas frequently lack formal housing requirements, such as proper planning and adequate services, leading to a decline in the standard of living for residents in these areas and their neighboring areas. Therefore, there is sudden and significant pressure on services such as water, roads, electricity, schools, and hospitals due to the sudden increase in population in a given geographical area (International Crisis Group, 2013).

Rapid population growth is the primary cause of this phenomenon, with people constructing homes without official licenses to meet increasing housing needs due to a shortage of affordable housing units. Population pressure is a significant factor contributing to this issue. (Retalis, A. 2005).

In summary, Chapter 2 has provided an in-depth exploration of urban expansion, focusing on the concepts of land use, the definition and characteristics of green spaces, and the environmental effects associated with land-use changes. This comprehensive analysis establishes a theoretical foundation critical for the subsequent examination of the Al-Dora Municipality. Chapter 3 will apply these theoretical insights through a detailed case study, encompassing the research design, data collection methodologies, and spatial analysis of land use in Al-Dora. By utilizing satellite imagery and GIS tools, this chapter aims to elucidate the patterns of urban expansion in the municipality and assess the resultant environmental consequences. This progression contextualizes the theoretical framework and emphasizes the practical implications of urban growth in a specific geographic area.

Chapter 3

Case Study of Al-Dora Municipality-Baghdad

3.1 Research Design

This thesis used both qualitative and quantitative methodologies to analyze urban expansion in Al-Dora municipality. The qualitative approach involved reviewing historical data and field visits to understand land use changes. The quantitative approach used Google Earth Pro, Landsat 5, and 9 data in ArcGIS Pro. This mixed-methods approach provided a comprehensive understanding of urban expansion dynamics, capturing both historical trends and current spatial patterns. The integration of these methods ensured a robust analysis. The methodology consists of three primary steps. The first step involved examining on-site photos of the current conditions and facilities within Al-Dora Municipality. The second step involves utilizing Google Maps to illustrate the historical and present land use in Al-Dora Municipality, highlighting the locations of various built facilities, including residential, commercial, and educational areas. The third step involves using Landsat 5 and 9 data in ArcGIS Pro to obtain precise and accurate results, as well as calculating the ratio of land use changes between 2003 and 2024. Comparing all the changes gives a full-view image of the urban expansion in Al-Dora municipality. In the following part, we explain the rationales for data collection and time selection.

3.2 Data Collection

The data-gathering process for this study utilized a multifaceted approach to guarantee a thorough investigation of land use changes. The main source of data for this study was high-resolution satellite imagery obtained from Google Earth Pro, Landsat 5, and 9. This imagery provided detailed and current views of the study area, as well as the coordinates needed for analysis. The Land-Sat 5 and 9 photos were imported into ArcGIS Pro for georeferencing and analysis to identify geographical and temporal differences. To strengthen the reliability of the analysis, data from the Al-Dora municipality archive was gathered. The archival data consisted of historical

maps, documents, and demographic information. This data enabled a comparative analysis of land use patterns and population dynamics between the past and present.

Furthermore, the archival records not only contained geographical data but also offered significant insights into the historical changes in population size and distribution within the Al-Dora municipality. The demographic information was essential for understanding the impact of population growth and urban expansion on land use changes. An in-depth analysis was conducted on the study area and its adjacent regions, with a specific focus on various land utilization patterns, including residential, commercial, industrial, and agricultural zones. The incorporation of population data with land use statistics provided a holistic perspective on the impact of human activities on the landscape.

In addition, field excursions were made to the research area to get ground-truth images, which were essential for confirming the satellite data. The on-site observations yielded contextual insights and corroborated the alterations identified in the aerial imagery. By combining satellite images, historical records, population data, and field observations, it was possible to gain a more dependable and thorough understanding of the land use patterns in the research area. The use of this multi-source data-gathering technique guaranteed the precise representation of both temporal changes and current conditions in the study.

3.3 Time Selection Rationale

The time range from 2003 to 2024 was selected to analyze urban expansion and land use changes in the Al-Dora municipality due to its significant historical, economic, and regulatory shifts. The rationale for this time range is outlined below, addressing the broader impacts of the Iraq War and its specific effects on architecture, urban planning, and urban expansion. The Iraq War, which began in 2003, had extensive repercussions across multiple sectors. Economically, the conflict led to major disruptions in the country's infrastructure and markets. The destruction of economic assets, interruptions in trade, and reallocation of national resources toward military efforts contributed to a pronounced decline in economic stability. This instability triggered widespread poverty, unemployment, and a general deterioration in living standards for many Iraqis. (Al-Kubaisi & Al-Khateeb, 2010).

The 2003 invasion of Iraq significantly impacted the country's urban development and economic situation. The immediate aftermath of the invasion saw widespread destruction of infrastructure, including housing, commercial buildings, and essential services, which necessitated extensive reconstruction efforts (UN-HABITAT, 2006). This reconstruction period attracted domestic and international investments, aiming to rebuild the war-torn urban centers, particularly Baghdad (World Bank, 2018). However, the ongoing instability and security concerns hindered consistent economic growth, leading to a fragmented urban development process (International Crisis Group, 2013). Many urban areas experienced rapid, unplanned expansion as internally displaced persons (IDPs) flocked to cities seeking safety and economic opportunities (UN-HABITAT, 2006). This influx strained existing urban infrastructure and services, resulting in the proliferation of informal settlements and substandard living conditions (UN-HABITAT, 2006). Oil price fluctuations, corruption, and ineffective governance further complicated the economic situation and hampered sustainable development (Al-Ali, 2014; Dodge, 2012). Due to the significant socioeconomic disparities and ongoing difficulties in achieving long-term stability and growth, there were pockets of economic revitalization and urban reconstruction, but overall progress was uneven (Brookings Institution, 2011).

The selection of the time range from 2003 to 2024 is particularly significant for studying urban expansion in Al-Dora due to the substantial changes in land use and urban growth patterns during this period. Population growth and displacement, along with inadequacies in regulatory enforcement, drove an increased demand for housing, resulting in significant transformations in the urban landscape. By analyzing historical data from before and after the war, this study aims to highlight shifts in land use, the emergence of unplanned neighborhoods, and the overall impact on urban expansion. Such an analysis provides critical insights into the long-term effects of conflict on urban development and informs strategies for future planning and reconstruction efforts. (Al-Kubaisi & Al-Khateeb, 2010).

3.4 Al-Dora Municipality and Surrounding Areas

Al-Dora municipality is located in the southwest of the Iraqi capital, Baghdad. The municipality is characterized by its high population density.[8] The case study area "Al-Dora municipality" is located in the in the southern region of the city of Baghdad Figure 10, precisely at coordinates 33°13'31.9"N 44°24'00.3" E and 33°16'57.0"N 44°24'51.3"E, at an elevation of 33 meters above sea level. Situated on the western bank of the Tigris River, the location is characterized by its proximity to an expanse of land abundant with densely populated palm groves. The municipality comprises many residential and business complexes, including the Maoulimen' Neighborhood, the Al-Athuriyyin Neighborhood, and other Neighborhood. The municipality of Al-Dora is regarded as a significantly populous urban center inside the capital, compared to other localities and urban areas. The municipality encompasses an area of 87 km2, with a population of 500,000 and 750,000 individuals. Notably, the southern regions of the river are regarded as green spaces within the proposed design.

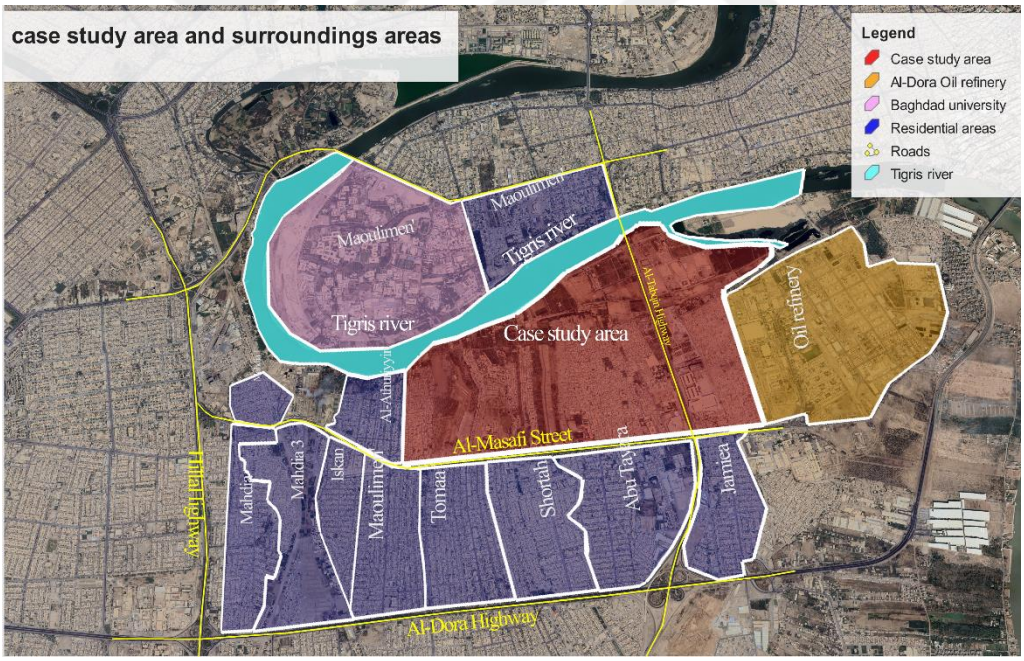

Figure 10. The roads, neighborhoods, and facilities surrounding the study area *Al-Dora municipality*. (Edit by author, map source: Google Earth Pro,)

The areas adjacent to the study area are densely populated and lack green spaces to cover the residents' needs. The lack of green spaces such as parks, gardens, and playgrounds has led to a need to study and research the changes that have occurred in the area and possible architectural recommendations for it. The study area's surroundings consist of residential neighborhoods, universities, and commercial shopping centers. Main streets and highways also encircle the area, including Al-Dora Highway from the south, Al-Masafi Street from the middle, Al-Tabqin Highway from the right, and Hilla Highway from the left (Alwen, 2021). The area next to these main roads represents an important strategic location in Baghdad, which has led to an increase in the desire for real estate ownership and urban expansion in this area. It occupies an important location south of Baghdad, adjacent to the Tigris River, with clear natural borders on the riverside and close proximity to the surrounding residential neighborhoods, roads, and highways.

3.5 Study Area Analysis

On-site appraisals of the current situation help to get more details about life's nature, building types, and land uses. The gathered photos from visiting the case study area show a closer understanding of the case study area from architectural aspects such as the green spaces, houses, streets, and aesthetics. In addition, the current land use, such as residential, commercial, educational, and other uses, should be studied. Site visits explain the facilities in several aspects, such as housing, streets, pavement,

The initial section consists of residential houses Figure 11, characterized by narrow streets, many of which remain unpaved. Also, the street's width is between 6 and 8 meters, and some streets are not more than 5 meters. Furthermore, there are no sidewalks, and other factors will explained in detail through architectural analysis of the Images. The Figure 12, and Figure 13 This image shows a narrow residential street lined with mid-rise buildings under construction or recently completed. The scene raises several architectural and urban design issues, particularly regarding unplanned development in green spaces or agricultural areas.

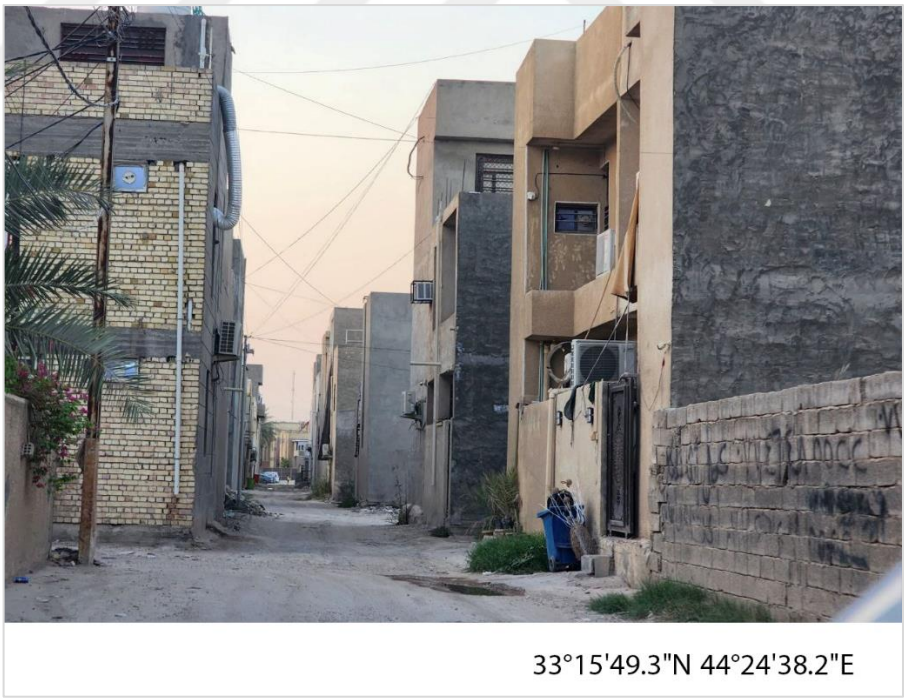

Figure 11. Street situation in the case study area Al-Dora municipality (By the author).

Key Observations:

- Building Density: The buildings appear closely packed with little to no setback from the street. This results in a high building density that limits natural ventilation and sunlight, which is essential for health and comfort. This unregulated development pattern can strain infrastructure and create congested, less livable environments (Farr, 2012).
- Narrow Street: The street is notably narrow, possibly less than the recommended minimum width for urban streets, which ranges from 6 to 10 meters in most guidelines (Calthorpe, 1993). Narrow streets reduce the capacity for both vehicular movement and pedestrian access. There is also a lack of designated pedestrian sidewalks, forcing people to share the road with vehicles, which poses safety hazards (Jacobs, 1993).
- Parking Issues: The parked cars along the street suggest inadequate parking space. This is a common issue in unplanned developments where zoning laws or urban planning guidelines are either absent or unenforced. Adequate parking and traffic management systems are crucial in ensuring accessibility and reducing congestion (Gehl, 2011).
- Building Construction and Materials: The visible construction materials (cement, brick) suggest the use of conventional building methods. There is no indication of sustainable or energy-efficient building practices such as green roofs, passive solar design, or the use of local, eco-friendly materials. These factors are important when considering the environmental impact of developing former agricultural or green spaces (Farr, 2012).
- Electricity and Infrastructure: The exposed electrical wiring above the street is a sign of unregulated development. Proper urban planning and infrastructure systems are essential to ensure safety and reduce visual clutter. The current state of the infrastructure suggests ad-hoc installations, which are common in areas that develop without formal urban planning (Beatley, 2011).
- Environmental Impact: The razing of agricultural or green spaces to make way for these developments leads to several environmental issues. The removal of natural vegetation increases the urban heat island effect, decreases biodiversity, and reduces opportunities for urban agriculture or green spaces,

which are critical in maintaining ecological balance within cities (Calthorpe, 1993).

Figure 12. Street situation in Al-Dora municipality (By the author).

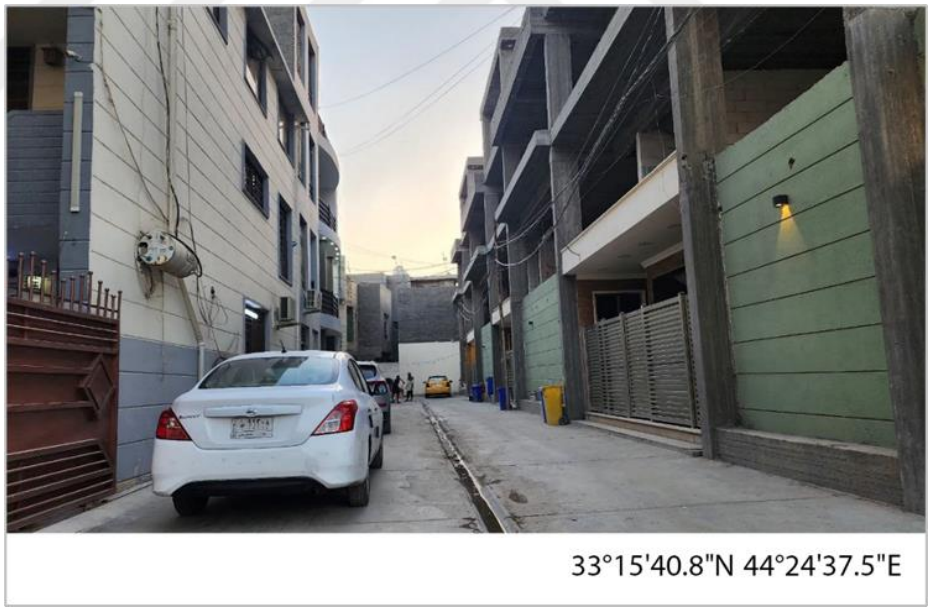

Figure 13. Houses situation in Al-Dora municipality (By the author).

The facades in the Figure 14 are notably narrow, with an estimated width of around 5 meters. This tight spacing between buildings indicates high-density development, a common characteristic of unplanned urban expansion. Such narrow

facades limit design flexibility, often resulting in monotonous streetscapes with minimal architectural diversity. The use of materials appears to be primarily concrete, brick, and some decorative stone cladding, which, while durable, contributes to the urban heat island effect due to the lack of greenery and shading. The close proximity of buildings leaves little room for natural light and ventilation, reducing the overall quality of life for residents. The reliance on external finishes like stone tiles seems to prioritize aesthetics over environmental considerations, lacking sustainable features such as insulation or energy-efficient materials.

Figure 14. Street without walkways in the Al-Dora municipality (By the Author).

Commercial land use in the area, particularly along Masafi Street, has undergone significant development. Due to the construction of two well-known shopping malls, Iraq Mall Figure 15, and Hayat Mall Figure 16, this street has become a hub for commercial activity. These malls are strategically located to cater to the needs of the surrounding residential communities as well as attract visitors from other areas. These shopping malls have had a significant impact on the local economy and urban landscape. They have become central hubs for retail,

entertainment, and social interaction, contributing to increased pedestrian traffic and economic activity along Refineries Street. These commercial establishments have impacted nearby property values, infrastructure development, and traffic patterns, reflecting broader trends of urbanization and commercial expansion in the area. These commercial centers have increased the demand for housing near these malls, which has led to increased urban expansion in the area.

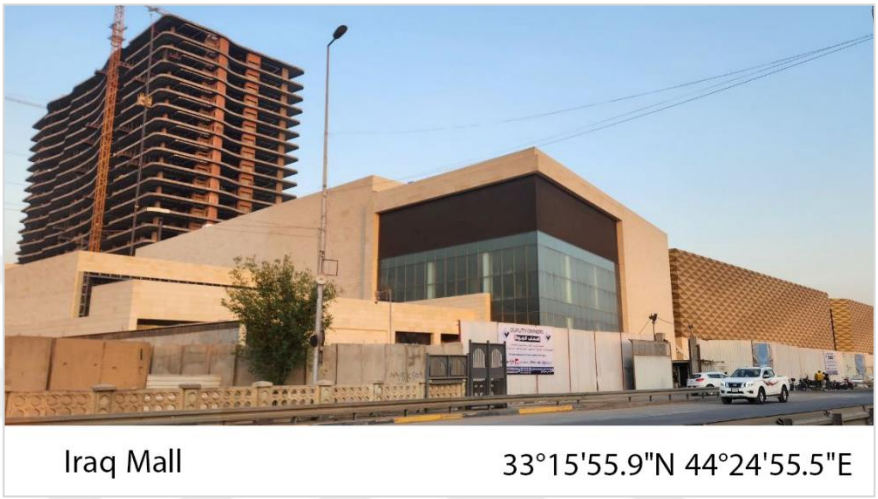

Figure 15. Iraq mall in the Al-Dora municipality (By the Author).

Figure 16. Hayat mall in the Al-Dora municipality (By the Author).

The increasing presence of commercial buildings on Almasafi Street, Figure 17, and Figure 18 further exacerbates the unplanned urban expansion in the area, contributing to a denser and more congested environment. The commercial shift has transformed what might have been residential or green spaces into mixed-use developments, increasing foot and vehicle traffic as well as the demand for infrastructure. The proliferation of retail outlets and service-based businesses,

while beneficial for local commerce, puts additional strain on an already overcrowded urban fabric. This commercial expansion highlights the lack of planning regulations, leading to haphazard building practices, limited space for green infrastructure, and increased urban sprawl. As commercial activity continues to grow, it accelerates the transformation of the surrounding agricultural and green areas into dense, concrete-dominated spaces, further reducing the area's ecological balance and livability.

Figure 17. Commercial buildings in the Al-Dora municipality (By the Author).

Figure 18. Commercial buildings in the Al-Dora municipality (By the Author).

One more aspect is that those two universities, Al-Farabi University Figure 19, and Dijlah University Figure 20, were built on Masafi Street too. The existence of two universities, in addition to the previous one, created a huge demand in the real estate market for students' residential units or university staff. At the same time, population growth generates huge demand for the area. This led to an increase in land market

values in comparison with agricultural revenue, which encouraged the owners to sell the land.

Figure 19. Al-Farabi university in the Al-Doha municipality case study area(By the Author).

Figure 20. Dijlah University in the Al-Doha municipality case study area (By the Author).

The provided image in Figure 21 clearly shows the expansion of urban into agricultural lands, particularly highlighting the razing of orchards to build residential construction. This behavior presents notable environmental difficulties. The continued existence of such actions highlights the immediate necessity for increased endeavors

to alleviate the detrimental impacts on the environment. The visual evidence serves as a powerful reminder of the necessity to find a balance between urban expansion and the protection of natural environments, highlighting the vital importance of sustainable development methods.

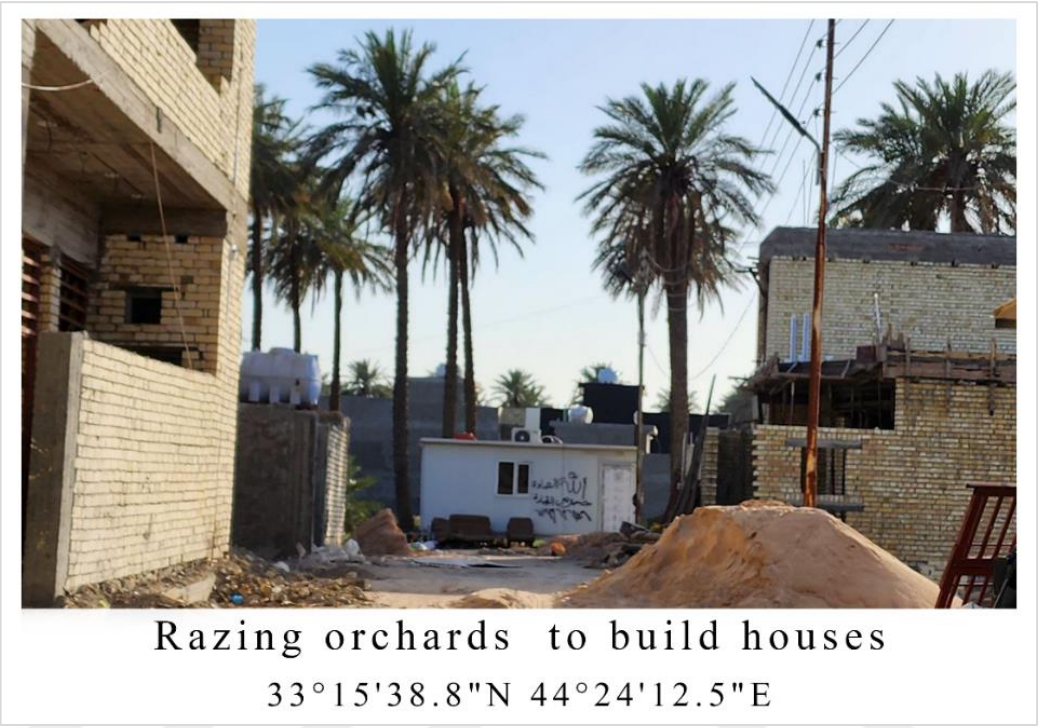

Figure 21. Razing orchards in the Al-Doha municipality case study area (By the Author).

3.6 Land Use Analysis

After 2003, urban expansion had an impact on many green spaces and agricultural land. Urban expansion has affected areas such as Al-Dora municipality. Due to population growth and increased residential unit requirements, the municipality lost many green spaces, resulting in unplanned areas that did not consider the negative effects of slums on the environment and society. Urban expansion has caused many changes in land use from its original characteristics to other characteristics, such as switching from agricultural to residential or commercial. Land use is constantly changing due to internal and external forces and factors that lead to its change, such as population increase, level of income, technological progress, real estate competition, climate change, political changes, and globalization. The economic factor and the growing demand for real estate ownership increase the pressure on natural resources.. The analysis divides the land use analysis into two phases: before 2003 and in 2024. For both phases, the analysis uses three types of satellite images:

3.6.1 Satellite data analysis. Data were collected using the Google Earth engine to analyze and study the study area and neighboring areas. In 2003, the study area encompassed agricultural lands with diverse orchards, including numerous types of dates, making these green spaces crucial as an environmental outlet for agricultural production. Notably, the study area boasts the highest percentage of green spaces. The study area encompasses a diverse range of properties, both public and private, due to the presence of several important institutions, such as the Al-Dora oil refinery, which occupies an area of 2500 dunums to the east, and the Al-Dora power generation station to the west. This could potentially increase the level of environmental contamination in the region. The presence of other educational institutions, such as the Technical University, and the presence of residential neighborhoods to the south of the study area, could potentially contribute to the increase in environmental pollution. The study area contained a large percentage of orchards and other agricultural types, which would reduce the percentage of pollution and purify the air as air efficiency increases by increasing agricultural and open spaces. The configuration of the study area and its surrounding areas in 2003 is shown in Figure 22.

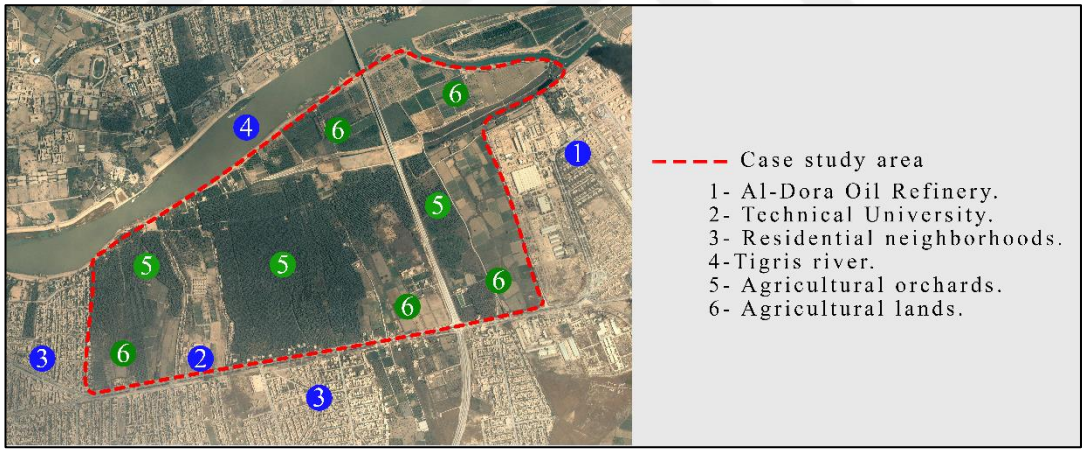

Figure 22. The configuration of the study area and its surrounding areas in 2003. (Edit by author, map source: Google Earth Pro,)

After 2003, the increase in construction activity and population growth led to massive changes in the study area. On the map, Figure 23 shows land use changes and diversification in 2023 in the study area, from agricultural lands to residential, commercial, and educational lands. where new facilities were constructed as follows:

- New residential houses.

- Multi-story building complex.
- Malls.
- Two new universities.
- Villas complex.
- Privet school.
- Warehouses.
- Cumercial shops.

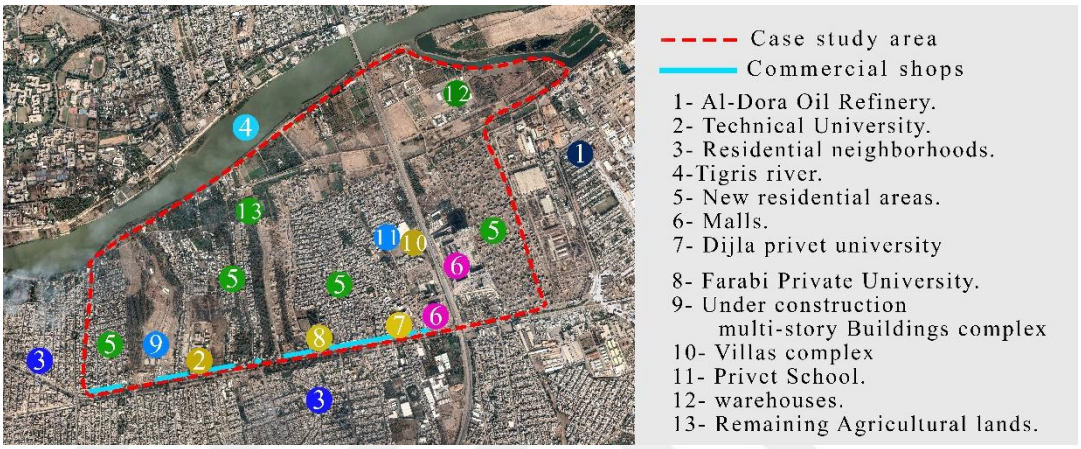

Figure 23. The configuration of the study area and its surrounding areas in 2023 (Edit by the author, map source: Google Earth Pro).

Only a few green areas remain from the original ones. The new constructions reflect the current land use pattern. Without considering urban planning techniques that could protect the environment by establishing explicit plans that allow for the coexistence of houses and green areas. The configuration of the study area and its surrounding areas in 2024 is shown in Figure 24. The reduction of green spaces is not only in the study area but also in surrounding residential areas. As the green spaces inside homes also decreased, the gardens of homes turned into miniature homes. The transformation of the house's gardens into crowded houses almost without gardens is shown in Figure 24. The rise in real estate prices and residential plots of land led to the division of homes into small houses. This created a situation resembling desertification, even within residential neighborhoods, in addition to the increase in the residential units on one street. In addition, the increase in population has led to an

inflated population density within residential neighborhoods and created pressure on the area's infrastructure, such as water and electricity. The situation continues to spread without any action.

Figure 24. The transformation of the houses' gardens into crowded houses in Al-Dora – Baghdad. (Source: Google Earth Pro, 33°15'02.0"N 44°24'35.3"E)

3.6.2 Arc-GIS Pro and Landsat analysis. Landsat 6 and 9 data were used to analyze land-use changes in the case study area. USGS provides the data to study and monitor various times or historical data on land, therefore, ArcGIS pro (Geographic Information System) processes Landsat data and measures the changes between different datasets. ArcGIS provides tools to estimate change detection in land use, specifically from one use to another, such as the changes from agriculture to urban, commercial, and educational. The analysis of study area using ARC-GIS between 2002 and 2023 is shown in Figure 25.

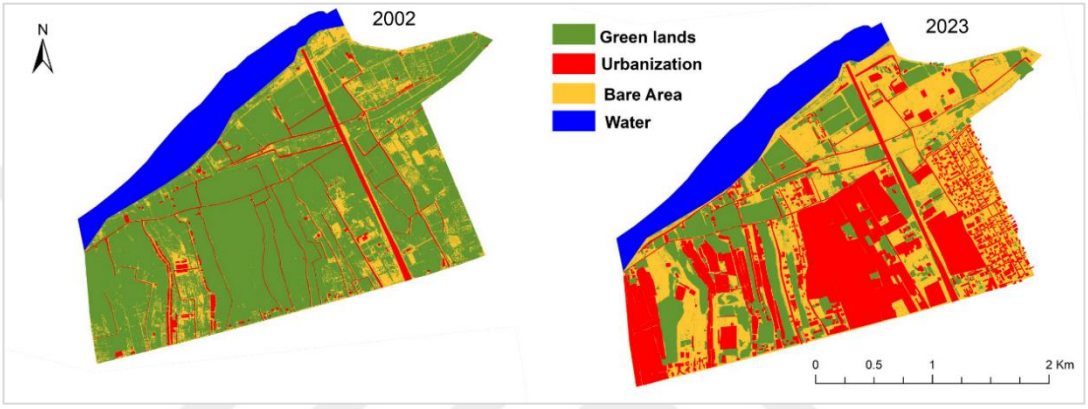

Figure 25. The analysis of study area using ARC-GIS between 2002 and 2023. (By the author,2024.)

ArcGIS analysis for the case study demonstrates that the area of green spaces in 2002 occupied 83.4% of the total area. As for the urban built-up areas, they occupied only 4.47% of total area only. and the other is non-use lands, or soil, which occupied 12.13% of the total area. Thus, the majority of case study land uses were green spaces. Table 2 shows the areas of each land use for the year 2002 and 2023.

Table 2

Study area land use changes between 2002 and 2023. (By the author)

Land use	Area/m^2 in 2002	Area/m^2 in 2023
Green	5,029,309	1,182,707
Urban	269,612	1,965,774
Soil	731,426	-
Under Constrution	-	2,881,866

The study area's ArcGIS analysis revealed a significant increase in urban areas, leading to the transformation of orchards and green spaces into residential areas. The analysis results for 2003 show that green spaces decreased to 19.6% of the total area, whereas they occupied 84.4% of the college area in 2002. In addition, the actual built urban area is 32.6% of the total area, while the remaining areas under construction or abandoned without clear use occupy 47.79% of the total area of the study area. Table 2 shows the areas of each land use for the year 2023. The percentage of land use changes in the case study area between 2002 and 2023 is illustrated in Figure 26, the cooperation shows the effects of transforming the land.

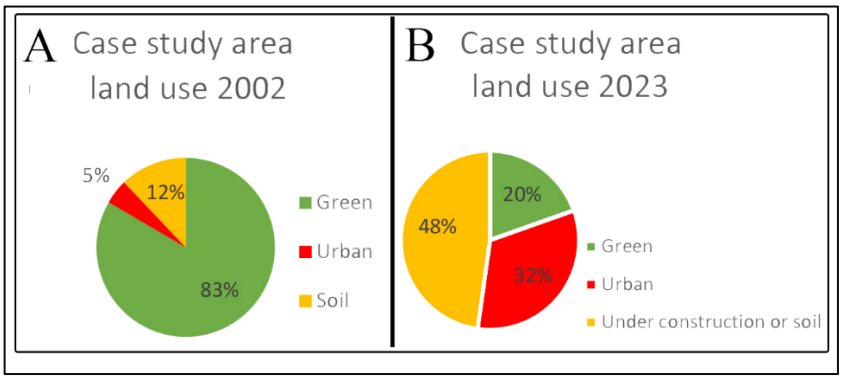

Figure 26. Percentage land use changes between 2002 and 2023 of study area. (By the author,2024.)

3.7 Urban Expansion Consequences in Al-Dora Municipality

Nature at the edges was the Tigris River, and towards the center, they turned into urban areas; that is, there are common borders and a natural separation between urban and rural areas, such as orchards. The study area played an important positive environmental role in regulating the local climate by lowering the temperature, providing shade, moisturizing, freshening the atmosphere, and directing the wind's movement. However, violations continue to occur despite the study area's proximity to the Tigris River and its approximate 6 square kilometers. The agricultural lands were teeming with palm and citrus trees as a supply of dates, and vibrant nurseries served as a source of seedlings for other crops within and outside Baghdad. All that remains of this use in the region is scattered land. The investment in it has become limited, and the production does not exceed only a few small areas, even though the basis of the life of most of the population is their dependence on agriculture. Many obstacles, such as the low financial return from agricultural revenues, led them to build residential homes and either rent or sell them, providing them with a reliable financial resource.

- **Environmental consequences**

The continuation of the unplanned division of agricultural land in the city, the uprooting of orchards and palm trees, and the erosion of the soil lead to the gradual loss of these important lands, thus affecting sustainable development. Moreover, the transforming of agricultural lands into urban areas without considering afforestation has major environmental impacts such as desertification and negatively impacts ecological diversity and air quality. The open space areas, especially the remaining agricultural lands in the area, suffer from the constant uprooting of trees, which has led to soil erosion, loosening, and desertification. Population overcrowding resulting from unplanned and random expansion leads to the failure to provide major corridors for wind movement, air stagnation, the accumulation of toxins and pollutants, and high temperatures in the city. In addition, the erosion of the river banks and their lack of vegetation lead to the deterioration of the quality of the rivers' water.

- **Social consequences**

The decrease in parks affects the decrease in entertainment places allocated to residents, as it is assumed that each geographical area has specific green spaces as a type of green land use. The violations create multiple social and economic problems, disrupting the balanced social and economic environment that previously characterized the neighborhood's residents. A significant percentage of this area's residents are from outside the city. Future complications include an increase in the establishment of slums and illegal settlements, which will affect the balance of population ratios and densities. In addition, rapid population growth without a corresponding increase in food production leads to a change in population characteristics and an increase in poverty rates. The fragmentation of residential land ownership into areas not exceeding 50 square meters per house and the decrease in the per capita share of spaces of different uses and functions lead to a violation of the conditions of health and human well-being through a decrease in the quality of life and have major and serious social repercussions on the balanced social and economic demographic structure. And the urban fabric of Baghdad.

- **Economic consequences**

As previously mentioned, there are now fewer employment opportunities in the agricultural specialties that differentiate the people of the area. Previously, due to the lack of financial return value, the increase in residential density was reflected in the impact on the local land market, which was represented by an increase in the value of the land, demonstrated by the rate of the cash recovery value in exchange for the exploitation of the land. The value is relatively elevated considering its proximity to the city center. The increase in residential and population density has had a negative impact on the efficiency of the area's services. The infrastructure could not keep up with the growing number of residents, leading to performance shortcomings. As the number of serviced housing units was less and the occupancy rate was lower, the consumption of infrastructure became evident in the stores due to the encroachment on the water, electricity, and sewage networks of the majority of the modern construction on agricultural land, which is without licenses from the secretariat or the municipality, which affected the residents of the old stores. The presence of green

areas was critical to maintaining the efficiency of architectural buildings' work. Biodiversity in rural and urban areas is key to providing local ecosystem services. Most often, suburban areas (between rural and urban areas) contain high vegetation cover. People started moving onto waterways and the banks of the Tigris River, changing the uses of productive agricultural lands. These lands, which are natural biological habitats, were destroyed and turned into deserts or other uses of the land. The loss of diversity disrupted the ecosystems' ability to clean and filter the air, as well as provide food, plants, and animals.

- **Urban consequences**

The case study survey found that the existing open green areas did not align with the number of buildings in each locality, leading to a sense of disintegration and visual distortion due to incorrect proportions. It is also possible to sense the poor general configuration of the space formed, the poor components of the outdoor spaces, and the poor services, as there is no street furniture and open spaces such as seating terraces, landscaping, planting of sidewalks, and lighting poles. Violating the river flow and throwing waste into the river from the banks led to environmental and visual pollution. The residential encroachment also affected the direct visual connection that was open to the river bank, which is now devoid of plants and trees. The land use change has spoiled the beautiful view that nature provided for the neighborhood. Slums and large encroachments on plots of land and important areas of the city's urban fabric lead to an imbalance in the foundations of land use. Encroachments cause the urban fabric to deteriorate and have a direct impact on the city's basic design plans. Greening and landscaping, if present in residential buildings and houses, could have addressed this issue because of their major role in concealing structural defects and giving an architectural aesthetic character to a residential neighborhood. Random settlement and lack of planning led to the establishment of residential blocks and units encroaching on agricultural land, leading to an increase in residential block density, causing urban overcrowding and a lack of coordination between the blocks and the spaces surrounding them, thus affecting the spatial organization of the urban environment.

In overview, Chapter 3 has presented a thorough case study of Al-Dora Municipality, detailing the research design, data collection methods, and land use analysis through satellite imagery and GIS techniques. This chapter has highlighted the consequences of urban expansion, underscoring the pressing need for effective interventions. In light of these findings, Chapter 4 will focus on key strategies for promoting sustainable urban environments. By leveraging the insights gained from the case study, this chapter will propose practical recommendations aimed at mitigating the negative impacts of urban expansion and fostering sustainable land use practices, thereby enhancing the resilience and livability of urban areas.

Chapter 4

Findings

The green areas percentage in cities is an important environmental aspect to measure sustainability in addition to the other social, and economic. Green spaces are among the most important components of urban blocks component for the continued quality of urban life and environmental and social sustainability. Urban sprawl, marked by the uncontrolled growth of cities into surrounding agricultural lands and green spaces, presents significant challenges for sustainable urban development, particularly in balancing urban expansion with environmental preservation. This study highlights key architectural and planning strategies that can mitigate the detrimental effects of urban sprawl on these valuable ecosystems. One such strategy is "Spreading the Green Patch," which emphasizes incorporating green spaces within urban designs to enhance ecological integration. Additionally, "Taking Advantage of Opportunities" refers to utilizing underdeveloped or abandoned urban areas to reduce expansion pressure on rural lands. The use of "Quantitative Indicators for Population Size" is critical in forecasting urban growth and ensuring that planning efforts align with the area's capacity to sustain development without harming agricultural lands. Furthermore, adopting innovative green environmental building techniques, such as eco-friendly materials and energy-efficient designs, supports more sustainable urban development. The concepts of "Sustainable Urban Development" and "Green Urbanization" further stress the need for comprehensive planning approaches that prioritize environmental conservation while meeting the demands of growing populations. By integrating these strategies, architects and urban planners can significantly reduce the adverse impacts of urban sprawl on green spaces and agricultural land. Below results of this research are explained then the suggested strategies as follows:

- Green spaces in Baghdad experienced a significant decline due to a variety of factors and variables economic, social, security, and demographic, as the study area's neighborhood, also reflected this.

- The multiplicity of human activities to increase the need for housing and its services has led to an obvious encroachment on green areas, due to their poor exploitation or lack of exploitation of these spaces.
- The study area's land uses showed high occupational mobility and an increase in land value due to the need for residential functions. Decrease the use of green and fertile agricultural land, its percentage is 19.6% currently, compared to what it was before 2003, when it occupied more than 83% of the study area.
- Unplanned buildings caused urban chaos, a severe shortage of infrastructure services, and pressure on neighboring areas' infrastructure, such as water, electricity, and the road system.
- Orchards on the outskirts of urban communities serve as indirect representations, transforming productive lands into areas with non-economic returns. The lands in Iraq in general and the city of Baghdad in particular are experiencing an increase in desertification as a result.
- Encroachment and changes in use in the study area caused the spaces left over from unplanned tearing apart plots of land to be arranged in any way that didn't take into account the number of buildings in the area or the best way to position buildings to minimize the effects of wind and heat, which changed the climate of the city.
- The change in green use and misuse resulted in numerous negative effects and problems, including:
    - The first category is environmental, which includes issues such as biodiversity loss, environmental imbalance, and microclimate regulation of temperature, humidity, and wind movement.
    - Second: social, affecting the effectiveness of entertainment and recreation in addition to disturbing the balanced demographic composition.
    - The third factor is the disruption to the local economy, as well as subsequent economic losses.
    - Fourth: an imbalance in the urban balance, in addition to the randomness and abuses caused by cultural change, as well as legal issues that will be challenging to resolve in the future.

- Greenery and greening and their visual impact in adding beauty to the neighborhood landscape can only be observed in what remains of agricultural use, in the beds and orchards, most of which are private property that does not include the general population in benefiting from their functions.
- The neighborhood's private garden area shrank due to the division of homes into smaller spaces, their absence on most floors, and the lack of public parks. Additionally, the neighborhood's recreational and green areas have limited space and budget, failing to serve the residents effectively.
- The streets and alleys in these shops, although functionally incompetent and irregular, played an important role in the lives of children and youth, as these narrow streets form an architecturally inconsistent landscape.
- Commercial use with the presence of universities and shops has led to great momentum in the area, creating a need for student housing behind the universities, which gives investment opportunities to land owners by selling or renting them in the absence of agricultural use of the land.
- Floor construction activities encroaching on agricultural land and slum housing are still ongoing, and this situation extends to the rest of the green use in Baghdad. Despite the lack of infrastructure services in the adjacent areas, the neighborhood's social attractiveness is high, and this is due to several factors, including location, which play a major role in keeping you safe.
- Developing a specific strategy is one of the most important proposals and solutions to address the problems of green areas. Also, introducing some laws to protect green areas and setting standards for environmental performance, particularly in green areas.

4.1 Key Strategies for Sustainable Urban Environments

Urban planning, particularly green area planning, requires effective and purposeful strategies to achieve sustainability. The implementation of sustainable strategies not only improves the sustainability of cities, but also fosters environmental effectiveness, social justice, and economic development. Some of the experiences of global countries are mentioned, which had a great opportunity and a clear impact on their cities in achieving the sustainability of green areas. After reviewing these strategies and global experiences, a set of indicators emerged that encompassed various environmental, economic, and social aspects. The urban environment employs strategies and main axes to achieve the concept of sustainability. The four main axes (movement systems, green fabric, economy, and social structure) form the basis of the sustainable planning process, which links to three planning levels (neighborhood, residential complex, and movement corridors). Many strategies emerge from it that aim to achieve the concept of sustainability. Figure 27 below shows the strategies and mechanisms directed towards sustainability, as new concepts and methods of urban planning have emerged that were not familiar before. Among these concepts are sustainable urban planning, sustainable construction, green construction, and the sustainable city. All of these concepts reflect the growing interest in urban planning and design issues in terms of environmental protection, reducing energy consumption, and optimal exploitation of natural resources.

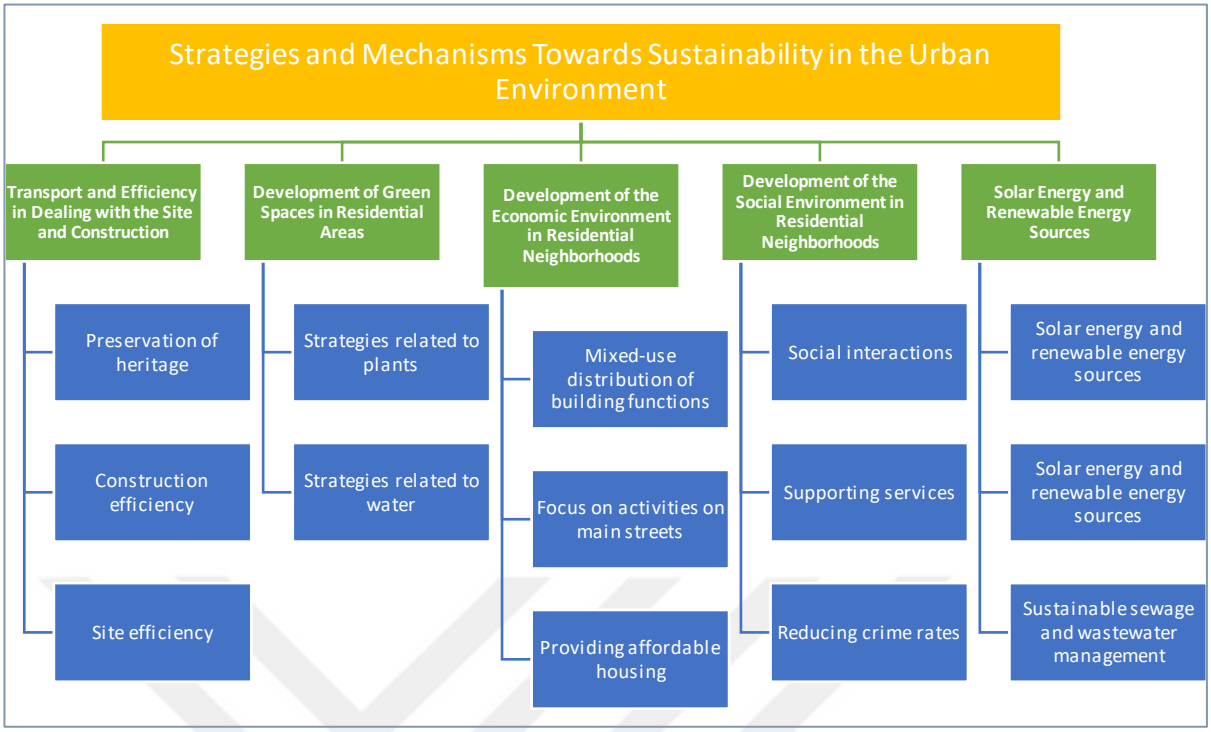

Figure 27. An analytical drawing showing strategies to achieve the concept of sustainability in the urban environment (By the author).

These are the most important mechanisms and strategies for planning green areas:

- Transforming land into green spaces at a reasonable cost.
- Dual use lands with important urban uses, such as parking lots and cemeteries, can be made green without dispensing with their original use.
- Utilizing water bodies by improving and developing important areas within them, where plants grow or are covered with waste, through planting and afforestation.
- Exploitation and access strategy: This model depends on the ease of access to green areas, their proximity to users, and the diversity of urban activities available within these paces.
- The green city strategy focuses on green buildings and architectural designs that consider environmental conditions while also being in harmony with nature. This includes reducing energy consumption, relying more on alternative energy, reducing emissions and waste, using recycling processes, and other factors.

- A strategy to establish green areas within the outer belt, where construction is not permitted, consists of farms and forests around the proposed city boundaries. This strategy is important in dealing with the phenomenon of uncontrolled growth.
- A strategy to deal with the increase in areas allocated for entertainment, while seeking areas to connect green areas in a coordinated manner.
- A strategy to increase the green area and improve its quality, to benefit from the city's social, economic, aesthetic, and natural benefits, entails increasing green spaces, developing them, and ensuring their preservation.
- A strategy to seize opportunities involves acquiring land by seizing various opportunities and benefiting from them.
- A strategy based on quantitative criteria for population size is presented. This strategy relies on the ratio of one number to another.

The population and the minimum space required for each individual are crucial factors to consider. Adopting green environmental foundations is considered a crucial part of planning strategies to achieve urban sustainability.

Sustainable urban development strategy at the level of open spaces and green areas requires preserving site landscaping methods according to the nature and privacy of the area while using Local sources are available. (Kardosh, 2014, p. 53)

The strategy relies on the environmental factor, particularly urbanization, as a basis for its achievement (Murabit, 2019, p. 1).

The research focused on a set of suggested strategies for the following reasons.

1. It promotes sustainable planning for green areas to enhance city sustainability.

2. Compliance with local laws.

3. Providing natural resources, such as water and suitable soil.

4. Providing unused or encroached areas.

The Strategy are explained in detail as follows:

❖ **Strategy to increase green area:**

This is done through a set of objectives:

1: Increasing and developing green spaces, ensuring their preservation, and working to achieve several goals through

- Emphasis on development activities for current and future green spaces, which play a role in preserving the environment and improving its quality to benefit from social, economic, and aesthetic benefits and the nature of the city.
- Deployment should be in parallel with population and urban growth by standards to achieve environmental, economic, and social needs.

2: Working to implement an integrated system for the prevention and preservation of plants and the green patch by ensuring the provision of treated water to implement this.

3. ensuring the continuity of planting trees in the local environment for future generations.

4. Providing the necessary resources, such as plants, fertilizers, soil, etc., at the lowest possible cost.

5. Enacting legislation and policies, conducting periodic monitoring, and implementing awareness and guidance programs for groups the society. (Darwish, 2006)

❖ **Opportunity Seizing Strategy:**

Opportunity seizing involves taking advantage of opportunities, not planning them, by acquiring land and reaping benefits from them. This depends on seizing opportunities by acquiring land for the public good or converting it into green areas. Donations or conversions of land from non-green areas to green areas, like abandoned squares, training grounds, and equestrian fields, generate opportunities. Green spaces in the city may be rare and competitive for other uses, making it difficult to invest in them as green areas.

❖ **Develop a strategy for quantitative population size criteria**.

This strategy is determined by the ratio between the population and the minimum area required for each resident. The nineteenth century saw the adoption of this model in urban planning, and various countries around the world adopted it as a standard. It depends on fixed proportions of garden areas, as well as their distribution and connection within the urban environment.

❖ **Strategy for adopting inter-anchoring infrastructures**

Many cities have begun adopting green environmental infrastructures, which are considered an essential part of planning strategies to achieve urban sustainability. There are two types of inter-anchoring infrastructures:

- Blue environmental infrastructure: a group of water bodies, rivers, and lakes that penetrate or surround the city
- Green environmental infrastructure: a group of green areas and public and private parks that penetrate or surround the city.

The focus is on water treatment, management, and planning green areas for their significant environmental role. The climate, with its capacity to lower temperatures and boost positive emotions in a citizen's mind, plays a crucial role. By allocating areas for agriculture within cities, residents and visitors will get immediate purification of the air around them. It will create green areas for raising pets and provide many basic goods and services, as well as social and cultural benefits.

❖ **Sustainable Urban Development Strategy:**

This strategy pertains to open spaces and green areas, and it necessitates the maintenance of methods that coordinate sites based on the nature and specificity of the area while utilizing locally available resources to meet the requirements of development projects. It also considers the provision of spaces designated for green areas, playgrounds, and parks that are compatible with the total land area and population density. It also aims to achieve integration in the design and coordination of sites with buildings and other uses, classifying them according to hierarchical levels.

The strategies are based on the cities' environmental factors.

Several strategies have emerged for urban design for sustainable cities that rely on the inter-factor as a basis for achieving them, the most important of which is green urbanization. Green urbanization is a proposed model for urban designs that generate zero energy from gases and waste. Since the nineties of the last century, green urbanization has emerged to encourage integrated and efficient urban development in the field of energy use. It aims to re-engineer existing city sectors and recreate city centers for the post-industrial era, a factor that helps develop city sectors from a social and environmental perspective. The two most significant trends in green urbanization are as follows:

- Green development and green infrastructure.
- Low Impact Development (LID).

Both trends target green urbanization to transform existing cities from energy-consuming cities to energy-producing cities. In addition to softening and purifying the atmosphere, lowering the temperature, and encouraging driving without a vehicle, green infrastructure consists of a variety of public and private green spaces open to various uses. This reduces fuel consumption and pollution from vehicle traffic.

The most prominent conditions and trends for implementing a sustainable strategy is:

1. Linking land use and green areas so that they form a lung for residential complexes and other uses.

2. Classifying all urban areas and green areas according to climatic conditions, location privacy, and social privacy.

3. Separating residential buildings from streets with green areas to mitigate their negative impact.

Table 3 summarizes the green area planning strategies:

Table 3 (cont.d)

Green Area Planning Strategies

Strategy	Environmental Aspect	Social Aspect	Economic Aspect	Institutional Aspect
Spreading the Green Patch	1. Modify and improve the climate by reducing temperatures. 2. High beauty and environmental awareness of preserving green areas. 3. Create a natural environment that stimulates social interaction.	1. Create a natural environment that encourages social interaction. 2. Safety for children and women and increased social interaction.	1. Increase land prices due to increased agricultural production and marketing of commercial products. 2. Projects close to green areas benefit from increased land prices.	1. Enact laws and regulations to protect green areas and monitor their implementation by responsible authorities. 2. Coordination between local government and organizations to preserve the area. 3. Work on setting plans to preserve green areas regardless of their costs and contractual obligations.
Taking Advantage of Opportunities	Mitigate the decline of the places that were not utilized, leaving them exposed to limited or abandoned use.	Safety in areas previously not used agriculturally; there is a possibility of finding suitable areas to be preserved based on planning foundations.	Increased cost due to the change in the use of non-agricultural land; there is a need to find suitable areas to be preserved on a planning basis.	Difficulty in coordinating between specialized authorities responsible for the area; a law is needed to prohibit the acquisition of abandoned land.

Quantitative Indicators for Population Size	Commitment to giving the population the opportunity to preserve a healthy environment by creating appropriate green spaces.	The possibility of social interaction through planning that ensures everyone has sufficient space to move and communicate with nature without affecting others.	1. Economic incentives to promote agriculture and preserve green areas without harm to neighboring areas. 2. Easy control of necessary water quantities and commitment to preserving green areas.	Actions taken by local government bodies to preserve areas, set laws to protect and preserve green areas.
Adopting Innovative Green Environmental Building	Reduce temperatures and improve climate.	Positive impact on the psychological well-being of citizens through the combination of aesthetic and health factors.	Control the necessary water quantities, thus reducing costs resulting from increased agricultural production and continuous control.	Clear coordination between the specialized bodies for green area planning, including water, waste management, and agriculture.
Sustainable Urban Development	Urban development can contribute to climate preservation by maintaining the environment as a working part of the climate. It requires consideration of the population's impact on the climate.	Create a relationship that integrates site design with other building uses, ensuring fairness for all parts of the community according to relative standards.	Find strategic ways to control energy resources, thereby reducing costs and developing green areas that fit within urban development plans.	There is a need for laws or other mechanisms that regulate and maintain control over resource utilization and urban development.

Green Urbanization	One of the key factors for achieving green urbanization is through reducing gases and emissions, promoting renewable energy, and improving public health.	Transforming cities into energy-efficient areas that contribute to renewable energy production.	Integrated urban development, increasing density, ease of movement in green areas.	Coordination between related entities to achieve environmental, social, and economic goals through sustainable planning.

Global experiences in implementing green sustainability strategies

The economic and social significance of parks and green spaces in urban areas stems from their influence on psychological and environmental aspects. The establishment of these parks, in turn, generates economic benefits for individuals and society by creating job opportunities within these parks and their associated activities. On the other hand, the social return is demonstrated by the provision of affordable entertainment areas for the Arab family, along with a suitable psychological and health environment that fosters the development of positive health and psychological behaviors. These spaces and parks, being private properties of individuals, must be preserved. An example of worldwide green areas strategies implementation in Dubai and Oslo as they explained in detail as follows:

- **Dubai City:**

Dubai, the second-largest emirate in the federation after Abu Dhabi, boasts an area of 4,114% km2, matching 5 of the country's total area. With a population of 2,262,000, it stands out for its diverse economic income, primarily derived from trade, real estate, financial services, and tourism, with gas and oil revenues accounting for 6% of its total income. Over the past decade, Dubai has emerged as a modern urban area with diversity and a wide range of complex aspects. Since 1950, Dubai's hybrid population has grown approximately 100-fold, while its urban fabric has expanded approximately 400-fold. The Dubai Plan 2020 provides a flexible strategy to guide Dubai's urban development in 2020 and beyond. It is based on a background analysis and synthesis of the prevailing environmental aspects and urban contexts, including history and thresholds for urban development.

The network of parks and green spaces in Dubai began and has expanded rapidly, to the point where it now includes the largest number of parks in the UAE, including six major public parks and 13 residential parks, spread over an area of 500 hectares. Dubai exemplifies city design with parks and green spaces. In 1974, Dubai Municipality established Mushrif Park, the first public park in the city, unlike other cities, where urban expansion often compromises green spaces. Dubai currently boasts the highest number of parks in the United Arab Emirates, and its officials have devised

a long-term plan to ensure that green spaces occupy 8% of the city's land, in line with international green standards Figure 28. This plan aims to provide recreational facilities for residents, a task they consider accomplished, as evidenced by the main parks' high visitor numbers, which exceed 3 million visitors annually. Urban planners consider parks and green areas as essential components of urban planning, and Dubai's greenery significantly contribute to reducing air pollution, particularly given the city's desert character. Maintaining green areas and greenery is not an easy task in an area where temperatures rise to more than 50% C. A large group of workers, including those from institutions, are required to perform cleaning services and manage approximately 11 million cubic meters of water annually. Dubai's lack of rainwater and natural freshwater sources necessitates a sophisticated irrigation system that utilizes dripping and automatic irrigation. This system proves to be highly efficient, as it selects plants that align with the local environment to maximize water efficiency.

Figure 28. The green parks in Dubai *(Lloyd, 2021)*

Dubai's green spaces include green areas, soil covers, and flowers. In addition to date palms, the table below also displays trees and shrubs. Due to the increase in dates and other plant exports, Dubai now holds the top spot in the world. As a result, it has helped to increase green space and support the city's economy. The Dubai Grand Park, located 5 km from the city center, is one of the parks that has received care and expansion. After expansion and development, the park's area increased to 400 hectares

from its original 125. It has become one of Dubai's largest parks, with an area of 5,250,000, of which 42,500 are green lawns and about 30,000 are trees and shrubs Figure 29.

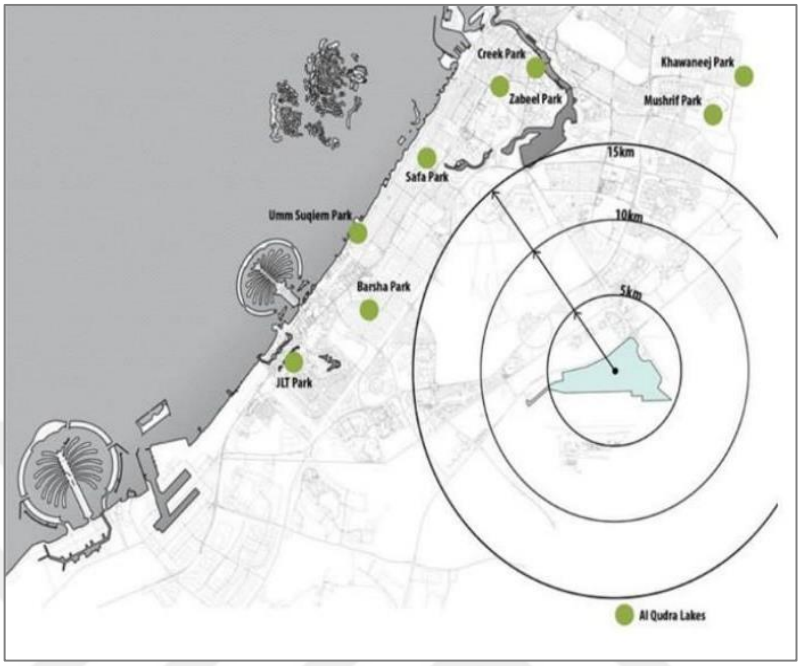

Figure 29. The Dubai Grand Park Zoning in Dubai *(Lloyd, 2021)*

Mushrif Park Figure 30, Dubai, is a significant tourist destination offering a wide range of recreational activities. Other large parks in Dubai include Al Mamzar Park, Mushrif Park, Creek Park, Zabeel Park, and Safa Park. After Mushrif Park, Creek Park stands out as one of Dubai's largest parks due to its proximity to the city center. These parks showcase the beauty of urban planning by strategically utilizing their unique and efficient locations near residents, enabling them to provide optimal services while also being close to natural water sources.

Figure 30. Mushrif Park Dubai *(Lloyd, 2021)*

These parks are part of sustainable cities' strategic directions, which prioritize Dubai's various aspects:

- Protecting and facilitating economic opportunities.
- Providing flexibility for growth.
- Supporting development projects:
- Conserving natural systems.
- Facilitating social needs.
- Improving infrastructure and services.
- Expanding the scope of communication, accessibility, and movement
- Enhancing the sustainable open space system.

❖ **Oslo City**

The municipality of Oslo is located in southeastern Norway on the Oslo Fjord (5559, north, 45–10 east). It has a population of 693,491, an area of 5732 km2, and 1,205,126 people (Statistics Norway, 2019). It is divided into Oslo and Akershus counties, with 23 municipalities in Oslo and 22 municipalities in Akershus county. Oslo is the most densely populated city, with a population of 681,067, or 1,597 inhabitants per km2. Oslo is surrounded by forested hills. The blue and green areas (waterways, parks, recreation areas, and green corridors) account for 100% of the built-up area, and Oslo County Administration is involved in regional planning. With a population growth of 20% over the past 15 years and an expected increase of more than 800,000 by 2040, Oslo is one of the fastest-growing capital cities in Europe Figure 31.

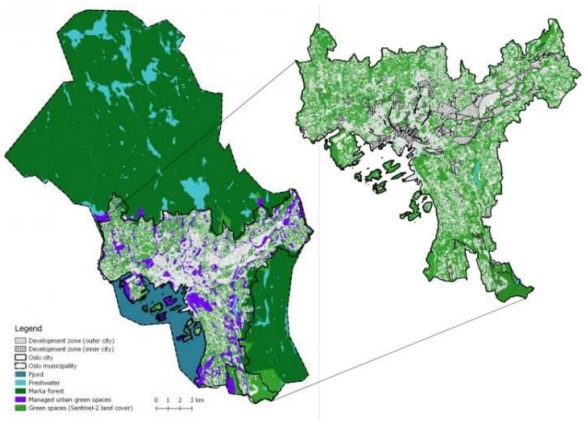

Figure 31. The development in the city of Oslo is bounded by the Marka protected forests in the north and east and by the fjord in the south. (Suárez et al., 2020)

In Oslo, the protected Markka Forest in the north and east, as well as the fjord in the south, limit development. Managed urban green spaces account for 18% of the city's urban area, while land cover maps derived from 2-S estimate that up to 47% of the city is green. Statistics Norway (2019) predicts the construction of approximately 100,000 new homes over the next 16 years, a development that will inevitably increase the pressure on green spaces. Moreover, Oslo is host to increasing cultural diversity (first- and second-generation immigrants make up 33% of its population, and this number continues to increase). Demographic trends and growing cultural diversity present challenges related to inequality in access to green products and space, suggesting that urban policy and planning should pay more attention to recreational opportunities and preferences across social groups.

The strategy followed in Oslo to map the supply of outdoor recreation opportunities in the Oslo metropolitan area, the ESTIMAP (Ecosystem Services Mapping at European Scale) model version was adopted. The ESTIMAP model evaluates the potential supply, which refers to the amount of ecosystem and service available for use; the flow, which represents the population's actual daily use of outdoor recreation areas; and the demand, which is the population's perception of their daily recreation needs. The assessment concentrates on terrestrial ecosystems, and due to their connection with water, it solely evaluates terrestrial ecosystems that encompass water. Potential supply is defined as the ecosystem’s ongoing capacity to

generate services regardless of demand for them. Such service capacity is “the ability of an ecosystem to generate a service under current conditions, and uses only appear when there is a demand for the service." Finally, flow is defined as “the amount of service that people receive in a given period." Different professionals' recreational needs are defined in terms of potential or expected visits. To apply the above definitions to the ESTIMAP outdoor recreation model, potential supply is assigned based on the ecosystem Figure 32.

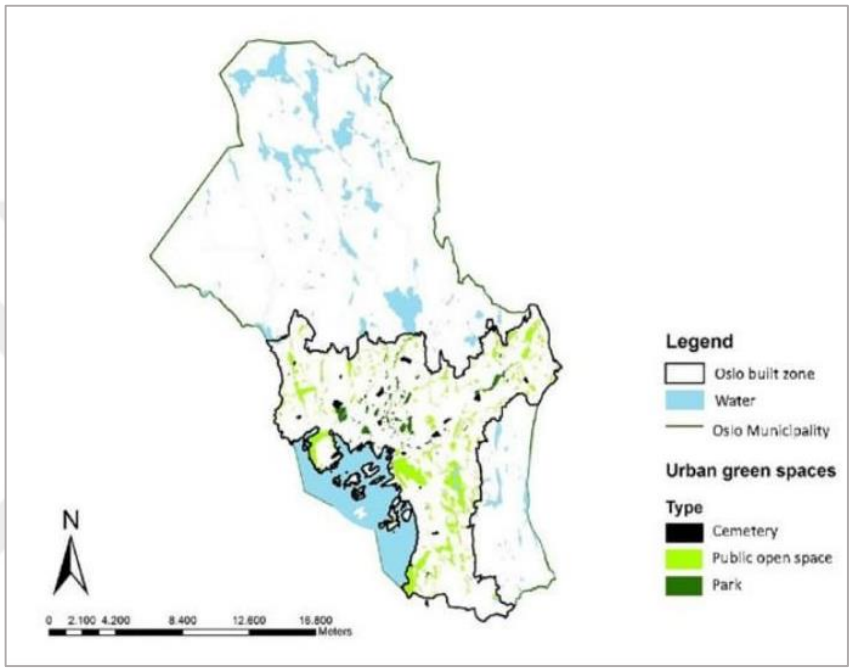

Figure 32. Green spaces within the built-up area of the municipality of Oslo (Suárez et al., 2020).

Table 4 summarizes and compares the differences between Oslo and Dubai in the green areas strategies implementations.

Table 4

Indicators of Global Urban Strategies

City	Population / Percentage	Strategy	Percentage of Green Areas
Dubai	3.3 million	Strategy based on investment in income and adding green areas to increase green spaces	8% of Dubai's land
Oslo (Norway)	693,491	ESTIMAP strategy, which relies on the supply (quantity of green and blue zones) and the demand (actual use by the population) for recreation	11% green and blue zones

❖ **Proposed Strategy**

This part of the research presented strategies that support the planning of green areas to achieve the sustainability of cities, along with their environmental, social, economic, and institutional dimensions. Based on these indicators and the experiences of Arab and international countries, the proposed mechanisms to implement these strategies and their aspects.

Proposed strategy from the environmental-aspect:

1. Relying on the environmental factor as a basis for achieving the strategy and moving towards green urbanization.

2. Adopting a database that organizes preparation using the 8% program allows us to follow up on problems and develop immediate solutions to limit their exacerbation.

3. The Ministry of Environment, on behalf of the relevant authorities, suggests presenting an environmental sustainability award as a motivating measure. The departments should cultivate a competitive spirit among themselves and local

municipalities to strive towards achieving and implementing the best practices. Environmental conservation entails the preservation of green spaces. The stages of preparing this award are intellectual and psychological preparation, preparing society, organizations, and individuals to accept sustainability, and preparing the requirements for its implementation by implementing the standards of the Inter-Action Best Practices Initiative, which is considered the basic rule.

4. When setting environmental performance standards to increase awareness, consider increasing the green area as one of the most important of these standards.

5. Implementing municipal departments' environmental performance standards

For example, consider planting large trees with a horizontal area similar to the total green area.

exposed to light. There are more intricate benchmarks, such as quantifying the amount of carbohydrates or oxygen generated by the city's trees.

The Baghdad Municipality, which represents the authorities responsible for developing green areas in municipal departments, announced the Distinguished Environmental Performance Award.

Proposed strategy from the social aspect:

1. Organize the database for semi-annual updates and the potential locations for green spaces, maximize their presence, determine what services they can be offered, and take measures to ensure their minimum reduction.

2. Activating the role of youth circles through work teams in preventing encroachment on and damage to green spaces to increase greening.

Proposed strategy from the institutional aspect:

1. Obtaining approvals to stop granting horizontal and individual building permits and coordinating with the relevant authorities to provide plots of land to be built vertically and at high densities to provide green spaces and at rates consistent with population densities.

2. Adhering to the quantitative standards for the individual share is crucial.

3. Impose symbolic administrative fees on the residents of the area to encourage them to participate in environmental preservation and increase the afforestation of as many areas as possible within their residential neighborhoods. This will serve as an incentive to prevent vandalism and increase their sense of public participation in preserving their city.
4. Communicating the strategy to the parties involved in the municipality, such as agriculture, water resources, and community health, in order to coordinate and work to facilitate its implementation.

Proposed strategy from the economic aspect:

Using locally available resources to adopt quantitative standards for population size, take into account urban development, and preserve site coordination methods according to the area's nature and specificity.

Allocate spaces for green areas that align with the overall land area and population density. These mechanisms stem from experiences and strategies aimed at addressing the scarcity of green spaces. If they receive the necessary approvals for implementation, they can serve as a guide for addressing the degradation of green areas within the study area. To implement the proposed strategy's mechanisms, the research team conducted a questionnaire with specialists in planning and environmental aspects, as well as relevant parties, and analyzed the results to determine the feasibility of their implementation.

This part of the research is concerned with presenting many strategies that support the concept of sustainable development and focusing on the strategies that are most likely to be implemented by drawing indicators for each strategy as stated in Figure 3.12 to indicate the extent of its suitability locally from an environmental, social, and economic standpoint and institutionalism, the indicators of which can be used to make suggestions. An appropriate strategy for the study area, in terms of the following:

- Environmental impact and temperature reduction.
- Taking advantage of the presence of water sources, controlling them and increasing agricultural production.
- Achieving justice for all segments of society based on standards.

- Increased biomass and ease of movement in green areas.
- Interconnected work between relevant parties.

There are several pioneering and inspiring countries in the field of applying the concept of sustainable development in planning green spaces by developing plans and strategies that take into account the individual's share of green space and its impact on the health and life of the population by providing the necessary spaces in line with population density and achieving blending in design to suit all age groups. And it is the most important

Strategies that can be implemented:

- Strategy for annexing green spaces to increase the green area.
- B Relying on technology and using monitoring systems such as GIS as it provides. High transparency increases the effectiveness of collecting information on the ground.
- The strategy depends on determining the offer, the quantity of the service provided, and the flow from actual use, demand, and need for recreation.

The economic and social importance of parks and green spaces within cities lies in their impact on the psychological and environmental aspects of individuals who visit these spaces. These spaces significantly contribute to increasing economic returns for both individuals and society by providing job opportunities in parks and related activities.

On a social level, the benefits include providing affordable recreational spaces, creating a suitable psychological and health climate, and fostering positive health behaviors. Additionally, there is a growing recognition of the need to treat these parks and green spaces as essential assets that require proper care and maintenance.

Chapter 5

Conclusion and Recommendations

The study emphasizes the need for urban planning and design to prioritize environmental considerations, especially in combating desertification and dust storms. It calls for a renewed focus on green spaces for sustainable development. The study recommends careful planning of residential areas to accommodate future growth, as well as exploring alternative solutions such as affordable housing complexes. Municipalities should enforce architectural planning standards, promote afforestation, and prevent illegal encroachments on green and agricultural land. Comprehensive guidelines should be created to support sustainable strategies in long-term planning, focusing on Baghdad's environmental assets. The study also calls for increased academic and public research to address environmental challenges.

- This research recommends giving priority to planning and design to environmental issues that have a major role in eliminating desertification and dust storms and improving and reviving the city's environment. This necessitates more attention to green areas.
- Study and plan current residential areas for future expansion, as well as develop organized design strategies that contribute to a sustainable environmental presence.
- Explore alternative solutions, such as building affordable complexes outside city centers, to lessen the effects of population growth and urban expansion on green spaces.
- Municipalities must pay more attention to environmental issues and their impact on climate and sustainability by preserving green areas because of their significant impact on people’s lives.
- Control the construction of new housing according to architectural planning standards, including setbacks from the street, street width, sidewalks, spaces, and green spaces, to avoid a negative visual impact on the neighborhood or street.

- Increase awareness of afforestation inside and outside houses, as well as planting sidewalks with evergreen trees, because of their important aesthetic, environmental, and climatic benefits.
- Municipal administrations must enforce the law to limit encroachment on land uses, particularly open, green, and agricultural.
- Prepare a guideline for following sustainable strategies in the long-term plans prepared by municipal departments that support green areas.
- To develop the city environmentally, the study suggests investing in Baghdad's high environmental potential, which includes the river, landscapes, and agricultural lands. The new development strategies for Baghdad encompass the study area that possesses this attribute.
- Trying to re-plan some residential areas and redistribute the green areas.
- Respecting Baghdad's urban and architectural identity through comprehensive and environmental design principles is essential for the city's environmentally, socially, and architecturally sustainable development.
- Intensifying academic and public studies and research and study curricula at various levels concerning addressing environmental problems, especially the problems of overcrowding and the scarcity of open and green areas in urban areas, as a comprehensive sustainable framework.

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