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Sustainable Development of Investment in Residential Complexes in Baghdad - Iraq

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ABSTRACT

This research paper discusses the sustainable planning and design principles in the investment in residential complexes in Iraq, especially the five principles of UN-habitat. The research problem emerged in the lack of knowledge and local studies in Iraq about sustainable approaches to investment in residential complexes at the planning and design level. This research aims to shed light on the application of the five principles of UN-habitat to residential complexes, and proposes treatments to achieve integrated environmental sustainability for investment in residential complexes. The current research focuses on environmental sustainability of the proposed new residential investment projects in Baghdad [Iraq Gate Residential Complex (high-rise residential complex) and Badour Residential Complex (low-rise residential complex)]. Indicators were extracted from previous literature and selected samples, and the research investigated the extent to which these indicators converge with the five principles of UN-habitat adopted. The results indicated that each of the two complexes achieved only one of the five principles, which requires highlighting the importance of applying the concepts of sustainable development in residential investment complexes in Iraq.

Keywords: Environmental sustainability, UN-habitat principles, Residential investment complexes, Iraq gate residential complex, Budour residential complex, Iraq.

INTRODUCTION

There is an increasing global interest in the concept of environmental sustainability in various sectors, including the construction and urban development sectors. Sustainable residential complexes have become an important part in achieving a balance between human needs and the protection of environmental resources (Salem, 2008; Shaheen & Khalaf, 2009).

Sustainable residential complexes are characterized by reducing the depletion of natural resources and reducing the consumption of depleted energy and water resources. These advancements enhance healthy indoor environments and social interaction, and encourage social communication by providing shared-use areas that serve users. They also support public transportation, walking, and cycling. In order to ensure the application of sustainable development concepts to residential complexes, there are standards and principles that can be applied to verify the sustainability of these residential complexes (Al-Khafaji & Kamoona, 2015).

There is no doubt that there is a pressure on the planet's natural resources because of the global population growth, as well as the continuous increase in consumption that has caused a remarkable deficit in

natural resources. The urban sector is considered one of the largest sectors constituting energy and resources (Abdulateef & Al-Alwan, 2021; Zahraa Abd Al-Salam Sabeeh et al., 2018).

In general, the world is trying to address the problem of energy and climate change mainly at the level of individual buildings, while the main problem lies in urban complexes (Ali & Al-Bazzaz, 2022), especially residential ones, which requires meeting the sustainability approach and energy conservation in contemporary residential complexes (Hassan & Al-Kindy, 2023; Wisam Ali Kadhim & B.R.S., 2017).

In the report of the World Conference on Environment and Development "Our Common Future" (1987), the concept of sustainability was defined as development carried out to meet current needs, without diminishing the ability of future generations to meet their own needs in social, economic and environmental aspects (Nainggolan et al., 2020). The ultimate goal of sustainable development can only be achieved through the decision-making process by integrating and recognizing economic, environmental and social problems (Emas, 2015; Mahdavinejad et al., 2014). In general, Arab cities usually face many sustainable challenges, such as rapid urbanization, lack of energy resources and basic services, insufficient infrastructure, and environmental pollution (Issa & Al Abbar, 2015; Shaheen, 2016).

Contemporary neighborhoods in general suffer from the weak application of sustainability concepts in urban environments as a result of the adoption of an inefficient spatial organization in which the physical aspect (mass) dominates the moral aspect (space) (Al-Kindy, 2012). The neighborhood is an area characterized by being the arranging unit of the city; so, the planning and design of the residential neighborhood create a specific physical and social reality that greatly affects the environment and the residents. The characteristics of residential neighborhoods contribute to shaping the city and affecting the residents' sense of satisfaction. The mechanism by which these components are distributed also affects the sustainability of the neighborhood (Chookah et al., 2021). A specific definition of sustainable neighborhood can be derived from sustainability shared by the Brundtland report, as "development that responds to local needs without compromising individuals at the global level" (Alanbari et al., 2022; Dehghanmongabadi et al., 2014).

The Five Principles of Sustainable Residential Neighborhoods for UN-Habitat

These five principles are (UN-Habitat, 2015):

Establishing an efficient and effective street network: This principle aims to develop an adequate network of streets, where the percentage of streets must occupy at least 30% of the total area and not less than 18 km of street length per km^2.

High density: This principle aims to promote sustainable urban expansion and avoid urban sprawl.

Mixed land-use: At least 40% of the total land area must be allocated for commercial purposes in a sustainable neighborhood, which allows for the provision of a variety of activities to achieve a balance between economic use, residential use and other public services in a sustainable neighborhood.

Social mix: By providing a variety of housing at different prices, which ensures the diversity of community groups within the neighborhood, 20%-50% must be allocated to low-income people, and the housing percentage of any category must not exceed 50%.

Limited land-use specialization: That is, the neighborhoods are not single-functional.

Table 1 shows the five principles for UN-habitat mentioned above.

Table 1. The five UN-habitat principles of the United Nations in percentages

Source: (UN-Habitat, 2015)

Formula	Unit	10	20	30	40	50	60	70	80	90	100	No.
$\frac{\text{Street land} - \text{use}}{\text{Total floor area}}$	30-45%											"Principle 1"
Population density	15-60k people/km^2											"Principle 2"
$\frac{\text{Economic floor area}}{\text{Total floor area}}$	40-60%											Principle 3"
$\frac{\text{Residential floor area}}{\text{Total floor area}}$	30-50%											

Single tenure / Residential floor area	0-50%											Principle 4"
Affordable housing / Residential floor area	20-50%											
Single function block / Neighborhoods ar	0-10%											Principle 5"

LITERATURE REVIEW

literature will be reviewed in a way that is appropriate to the topic of the research. Dehghanmongabadi et al. (2014) provided a comprehensive study of sustainable neighborhood features, applying UN-habitat's principles to two case studies in Sweden. The findings confirmed that the integrated application of the five principles enhances environmental performance. In the Arab region, El-Khateeb (2019) conducted a systematic analysis of Dubai sustainable city , showing strengths in density and land-use mix, but limited diversity, Ibrahim (2020) reached similar conclusions in a study of Sharjah sustainable city, Chookah et al. (2021) applied the same principles to the old neighborhoods of Sharjah, revealing partial achievement of mixed land use and social mix, due to spatial and functional limitations. In Iraq, Raswol (2019) evaluated neighborhoods in Dohuk, identifying strengths in street layout and density, but week land-use integration.

Khedr et al. (2022) found that urban neighborhoods in Cairo had good street networks, but lacked diversity and social inclusion.

On a technical level, Abaas (2020) and Ali and Al-Bazzaz (2022) studied urban heat impacts in Baghdad, emphasizing the importance of sustainable materials and planning. Other studies, like Shok et al. (2023), used LEED rating system to evaluate a residential complex in Iraq.

Labin et al. (2022) compared two neighborhoods in Jordan using urban design-based sustainability criteria and noted variable performance across the eight measured indicators. On another level, Tanguy et al. (2020) emphasized the importance of involving public and private sectors in the early planning stage.

Moreover, Moroke et al. (2020) developed a comprehensive framework for evaluating neighborhood sustainability in developing countries in the Arab region. Caccam and Furlan (2018) examined the feasibility of applying sustainable principles in a historic district in Qatar, finding potential, but also structural, limitations technically.

Table 2 compares the current research with the most important previous literary studies that dealt with the principles of UN-habitat in terms of their achievement of those principles.

Table 2. Comparison of the UN-habitat literature review

Literature Review	**Realized Principles**
Current research	- Street network - High density
(Khedr et al., 2022)	- Street network
(Chookah et al., 2021)	- Mixed land-use- Partially - Social mix - Partially
(Ibrahim, 2020)	- Street network - Social mix
(Raswol, 2019)	- Street network High density
(El-khateeb, 2019)	- Street network - Mixed land use - Land-use specialization
(Dehghanmongabadi et al., 2014)	All principles

RESEARCH METHODOLOGY

This study evaluates the sustainability of contemporary residential complexes in Baghdad using the UN-habitat principles in sustainable planning for sustainable neighborhoods. These principles include five main principles:

- Establishing an efficient and effective street network.
- High density.
- Mixed land use.
- Social mix
- Limited land-use specialization.

In this research, two selected residential complexes (Iraq Gate Residential Complex and Budour Baghdad Residential Complex) are analyzed and evaluated using indicators linked to the UN-habitat principles of sustainable neighborhood planning. The challenges and benefits associated with this sustainable approach will be discussed.

DATA ACQUISITION

The data collection methodology included two important stages:

- Direct field work: Brief on-site observation at Iraq Gate and Budour Baghdad complexes documented street layouts, land uses and available services through photos and notes, as well as nformal discussions with site staff.
- Document review: Analysis of master plans, architectural drawings and municipal reports from government publications, scientific articles, and relevant online repositories.

CASE STUDIES

The study will evaluate achieving the planning principles of UN-habitat for the United Nations by analyzing both the Iraq Gate residential complex and Budour Baghdad residential complex in Baghdad - Iraq, with the aim of raising recommendations that can be used for these current and future investment housing projects in Baghdad - Iraq.

Iraq Gate Residential Complex

The basic information of the project is summarized in Table 3.

Table 3. Project information of Iraq Gate residential complex
Source: Authors based on (Al Sayyid & Ali, 2022)

Project		Iraq Gate Residential Complex
Year		2010 - present
Project area		305274 m^2
Architectural design		Consolidated Consultants Group (CCG)
Construction		Almco Group
Accommodation type		Multi-storey residence
No. of units		4750 housing units
(49) Towers	**Empire Tower**	(31) residential towers containing (6) residential units of multiple floors
	Royal Tower	(14) residential towers containing (5) residential units of multiple floors
	Old model	(4) residential buildings containing (5) residential units of multiple floors

The project is located in Baghdad, on the Karkh, near to Al-Zawraa Park. It is located on Damascus Street from the southern side and July 14 Street, opposite to the International Station from the northern side. It is a complex under construction. Part of the housing units has been delivered to users, with (6) buildings for beneficiaries and (4) buildings ready for delivery out of (49) buildings for the project.

Figure 1. Model of the Iraq Gate residential complex after modification
Source: Authors

Figure 2. Land use plan for the Iraq Gate residential complex before modification
Source: Authors

The project includes (49) tower residential buildings of varying heights, including (35) buildings with (18) floors, (11) buildings with (17) floors, two buildings with (22) floors, and one building with (25) floors. The project also includes educational, social, and other services, such as (a hospital, schools, a commercial boulevard, a mosque, a social entertainment club, a theater, a cinema, playgrounds, public parks, gyms, and green spaces), as shown in Figure 1 and Figure 2.

The hotel's design was canceled from the project's basic plan and replaced with two residential towers, bringing the number of residential towers to (49) instead of (47). The project's residential buildings fall into three main designs, as shown in Table 3. After

studying the project plans, the land use areas can be clarified. Their percentages in the Iraq Gate residential complex are shown in Table 4.

Table 4. Project areas and percentages

Land use	Area	Percentage %
Residential use	146531.52 m^2	48%
Mixed land use	97687.68 m^2	32%
Street area	61054.8 m^2	20%
Total area	305274 m^2	100%

Budour Baghdad Residential Complex

The basic information of the project is summarized in Table 5.

Table 5. Project information of Budour Baghdad residential complex

Project	Budour Baghdad Residential Complex
Year	2020 - present
Project area	4000 km^2
Architectural design	MANHAL HABBOBI
Construction	AL GADEER REAL ESTATE INVESTMENT
Accommodation type	Residential houses
No. of residential units	7210 housing units

The project is located in Baghdad in an important strategic location near Baghdad International Airport, at a distance not exceeding 5 km, and near the American University, at a distance of 6 km, in addition to being located on a highway, which facilitates access to the heart of the capital, Baghdad. It is a complex under construction. Part of the units have been delivered for beneficiaries in stages. Figure 3 shows the site plan of the complex.

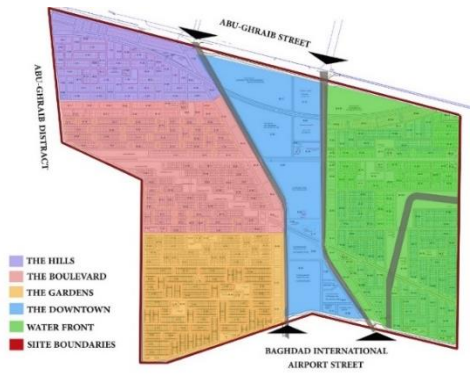

Figure 3. Budour Baghdad residential complex site
Source: Authors

The project includes (7210) residential units, two floors high, with different areas from 160 m^2 to 800 m^2, classified into 10 categories, as shown in Table 6.

Table 6. Project information for Budour Baghdad residential complex

House type	Land area	Cons. area	No.
Town housing	500 m^2	1030 m^2	229
Type A	400-800 m^2	285 m^2	465
Type B	300 m^2	247 m^2	862
Type C	250 m^2	204 m^2	1378
Type D	200 m^2	175 m^2	2008
Type E	200 m^2	168 m^2	240
Type F	200 m^2	140 m^2	281
Type K	160 m^2	156 m^2	124
Type K+	160 m^2	177 m^2	1259
Type BCX	240 m^2	251 m^2	364
Total			7210

The project also includes educational, social and other services, such as (kindergartens, schools, international schools, health services, a gas station, a mosque, open green spaces, a police station, an educational hospital, commercial services, recreational services, a civil-defense center and other administrative services).

Basically, the project is divided into five main areas:
The hills area includes (1113) residential units.
The boulevard area includes (2074) residential units.
The gardens area includes (2180) residential units.
The waterfront area includes (1843) residential units.
The downtown area includes educational, commercial, and other services.

After studying the project plans, the land use areas can be clarified their percentages in Budour Baghdad Residential Complex are as shown in Table 7.

Table 7. Project areas and percentages

Land use	Area	%
Residential use	1523.77 km^2	38%
Mixed land use	892.788 km^2	22%
Street area	1583.442 km^2	40%
Total area	4000 km^2	100%

RESULTS

After studying the case studies according to the five principles of UN-habitat, the following results were achieved.

A. Establishing an Efficient and Effective Street Network

- The Iraq Gate Residential Complex: The first principle has not been achieved, as the percentage of streets is about 20% of the total area. In general, the project depends mainly on private cars, but the nearby walking distances can be considered to encourage walking to some extent. The project is also characterized by its strategic location linked to two important centers for public and private transport, which are the International Railway Station, and the Al-Alawi garage from which public and private transport vehicles depart.
- Budour Baghdad Residential Complex: The first principle has been achieved, as the percentage of streets is 40% of the total area of the project.

B. High Density

- The Iraq Gate Residential Complex: It is noted that the project serves the multi-family type only, as there is no single type in the project. Since the average Iraqi family consists of (6) people, the residential density of the project can be calculated to be:

4750 x 6 = 28,500 people on a site area of 305,274 m^2.

That is, approximately 57,000 people per square kilometer, which achieves the second principle of 15-60 thousand people/km^2.

- Budour Baghdad Residential Complex: It is noted that the project serves the multi-family type only, as there is no single type in the project. Since the average Iraqi family consists of (6) people, the residential density of the project can be calculated to be:

7210 X 6 = 43260 people on a site area of 4000 km^2 which does not achieve the second principle.

C. Mixed Land Use

- The Iraq Gate Residential Complex: The mixed use of land (such as a hospital, a commercial complex, a mosque, amusement parks, and playgrounds) was 32% in the Iraq Gate project, which does not comply with the standards of the third principle of UN-habitat.
- Budour Baghdad Residential Complex: The mixed use of land (such as a hospital, a commercial complex, a mosque, amusement parks, and playgrounds) was 22% in the Budour Baghdad residential complex project, which does not comply with the standards of the third principle of UN-habitat as well.

D. Social Mix

- The Iraq Gate Residential Complex: The fourth principle was not achieved, as the residential units are not characterized by diversity in terms of income and type of housing (the project serves the vertical housing type only). The project also serves the multi-family type only with the number of bedrooms (2-4) in the residential units. It is also characterized by relatively high prices, because of its location in the heart of the capital, Baghdad, 100% of the project's residential units can be considered one type with a relatively high cost.
- Budour Baghdad Residential Complex: The fourth principle was not achieved, as the residential units are not characterized by diversity in terms of income and type of housing (the project serves the horizontal housing type only). The project also serves the multi-family type only with the number of bedrooms (3-4) in the residential units. 100% of the project's residential units are of one type with similar costs.

E. Limited Land-use Specialization

- The Iraq Gate Residential Complex: The percentage of neighborhoods with a single function reached 40% in the Iraq Gate Residential Complex, which is greater than the percentage specified in the fifth principle.
- Budour Baghdad Residential Complex: The percentage of neighborhoods with a single function reached about 80% in the Budour Baghdad residential complex, which is greater than the percentage specified in the fifth principle.

In general, the study showed that both of Iraq Gate residential complex and Badour Baghdad residential complex achieved only one of the five principles. A comparison is summarized in Table 8.

Table 8. A comparison of the five principles of UN-habitat in the Iraq Gate Residential Complex and the Budour Baghdad Residential Complex
Source: Authors

Formula	Unit	10	20	30	40	50	60	70	80	90	100	No.
$\frac{\text{Street land} - \text{use}}{\text{Total floor area}}$	(30-45%)											Principle 1 UN-habitat
	20%											Iraq Gate
	40%											Budour Baghdad
Population density	(15-60 k people/km^2)											Principle 2 UN-habitat
	58 k people/km^2											Iraq Gate
	Less than 1000 people/km2											Budour Baghdad
$\frac{\text{Economic floor area}}{\text{Total floor area}}$	(40-60%)											Principle 3 UN-habitat
$\frac{\text{Residential floor area}}{\text{Total floor area}}$	(30-50%)											
$\frac{\text{Economic floor area}}{\text{Total floor area}}$	32%											Iraq Gate
$\frac{\text{Residential floor area}}{\text{Total floor area}}$	68%											
$\frac{\text{Economic floor area}}{\text{Total floor area}}$	22%											Budour Baghdad
$\frac{\text{Residential floor area}}{\text{Total floor area}}$	78%											
$\frac{\text{Single tenure}}{\text{Residential floor area}}$	(0-50%)											Principle 4 UN-habitat
$\frac{\text{Affordable housing}}{\text{Residential floor area}}$	(20-50%)											
$\frac{\text{Single tenure}}{\text{Residential floor area}}$	100%											Iraq Gate
$\frac{\text{Affordable housing}}{\text{Residential floor area}}$	zero											
$\frac{\text{Single tenure}}{\text{Residential floor area}}$	100%											Budour Baghdad
$\frac{\text{Affordable housing}}{\text{Residential floor area}}$	zero											
$\frac{\text{Single function block area}}{\text{Neighborhoods area}}$	(0-10%)											Principle 5 UN-habitat
	40%											Iraq Gate
	80%											Budour Baghdad

Finally, the proposed framework can be applied in similar contexts within the Middle East, particularly in countries with hot and dry climates (the Arabian Gulf) or densely populated areas (Cairo and Damascus). It can also be used to provide practical solutions for developing regions facing similar environmental challenges.

CONCLUSIONS AND RECOMMENDATIONS

This research demonstrated that both the Iraq Gate and Budour Baghdad residential complexes achieve only one of UN-habitat's five sustainability principles, revealing significant gaps in comprehensive sustainable planning. While Iraq Gate meets the density criterion,

Budour Baghdad excels in street network efficiency. However, both projects fall short in mixed land use, social diversity and limiting single function areas.

These findings highlight a systemic issue in the design of residential projects in Baghdad: an over-emphasis on individual principles rather than on an integrated approach. To address this issue, we recommend:

- Establishing a legal framework to implement the five UN-habitat principles of sustainable neighborhoods.
- Updating construction legislations to align with the international standards for sustainable development.
- Providing diverse housing options, in terms of type and size, to accommodate all social groups and promote social inclusion.
- Encouraging mixed land use within neighborhoods to support access to housing, employment opportunities, and walkability.
- Enhancing street efficiency and adapting street networks to support sustainable transportation modes, such as public transit, cycling and walking.

Limitations of the Study

The study was conducted on two residential complexes within the city of Baghdad; therefore, the results may not be generalizable to other cities. The study used the UN-habitat's five principles of sustainable neighborhoods as a criterion for evaluating the two selected residential complexes, but there may be other classification systems that are more appropriate for evaluating sustainability in different contexts.

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