An-Najah University Journal for Research – A

Natural Sciences

Government's Effective Policies for Protecting Green Spaces in Urban Areas

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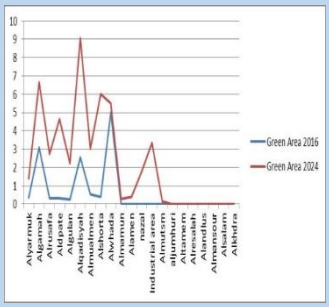
Type: Full Article. Received: 22nd Feb. 2025, Accepted: 16th Aug. 2025, Published: ×××× DOI: ××××

Received Accepted, In Press

Abstract: Green spaces are a vital component of urban planning and a fundamental element within the internal structure of urban areas due to their environmental, social, and aesthetic functions. Despite often being marginalized in favor of competing land uses, the protection and sustainable development of green spaces depend heavily on effective government policies. This study evaluates the impact of governmental strategies aimed at increasing and preserving green spaces in the city of Fallujah. Using ArcMap 10, green space areas were calculated for the years 2016 and 2024, and spatial distribution maps were produced for residential neighborhoods. The findings reveal a 2.7% increase in green space coverage over this period. Furthermore, the city's new master plan designates an additional 899 hectares for green areas, reflecting a deliberate policy effort to enhance the city's green infrastructure. These developments underscore the importance placed on green spaces for their psychological and environmental benefits to residents, as well as their essential role in advancing sustainable urban development.



Keywords: Green Spaces, Land Use, Sustainable Development, Government Policy, Master Plan.

Introduction

The strong relationship between humans and the natural environment is one of the primary factors that has driven attention toward the planning and organization of open spaces [1]. These spaces are structured to provide a healthy environment comprising green areas, paved walkways, and designated zones for gathering, play, and physical activities [2]. The importance of open and green spaces is particularly pronounced in cities—especially large urban centers—due to their role in offering relief from pollution and overcrowding caused by increasing population densities and built-up areas [3]. The rapid population growth and urban expansion have led to significant changes in land use patterns. In this regard, government policies play a vital role in maintaining a balance between preserving urban green spaces and meeting the demands of urban development and economic growth [4].

Research confirms that urban green spaces are essential for environmental sustainability, social welfare, and public health [5]. However, rapid urbanization often contributes to the degradation of these green areas, thereby increasing the risk of environmental imbalance and social inequality [6].

To address this challenge, policymakers must prioritize the integration of green spaces within urban planning frameworks, ensuring that a significant portion of the city remains covered with vegetation [7]. The preservation of green spaces is the responsibility of local governments and aligns with the broader national policies aimed at making cities greener and more sustainable.

Review of Literature

Green Spaces

Green spaces are not only defined as open cultivated land with a recreational character but encompass a broader concept [8]. They include various types of vegetated areas such as public parks, gardens, golf courses, and nature reserves, all of which provide numerous benefits to society [9]. Green spaces are also described as open cultivated lands primarily covered with greenery, flowers, and trees, devoid of buildings, and designated for recreational use [10]. They further refer to open and undeveloped urban areas without any constructions [11].

As well as land partially or fully covered with turf, trees, shrubs, or other plants that are easily accessible, including parks, public gardens, schoolyards, playgrounds, and recreational areas for children [12]. Additionally, the quality of green spaces is critically important, as factors such as maintenance, cleanliness, and public perception significantly influence their effectiveness and attractiveness to the local community [13].

The Importance of Green Spaces

Green spaces are of great importance, offering numerous benefits, foremost among them their environmental and climatic roles. It is well established that cultivated plants effectively purify the air by absorbing carbon dioxide, and many studies have confirmed the positive impact of urban vegetation on air quality through its contribution to air purification [14]. Additionally, green spaces help reduce levels of nitrogen oxides and sulfur oxides and remove significant amounts of airborne pollutants. They

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often serve as a partial solution, as leaves absorb gaseous pollutants through their stomata and trap particulate matter on their surfaces [15]. Furthermore, green spaces play a vital role in mitigating global warming, evidenced by temperature differences between asphalt roads and urban squares compared to green areas and rural zones [16].

The importance of green spaces extends to maintaining physical health and psychological well-being by providing opportunities for outdoor sports and relaxation. These activities contribute to reducing the risk of weight gain, alleviating stress, and promoting increased physical activity [17]. Generally, visiting green spaces is associated with lower stress and tension levels, enhanced cognitive function, and overall improved well-being [18].

Green spaces are essential components of urban infrastructure and significantly contribute to the well-being of residents [19]. Particularly, urban green spaces located within residential neighborhoods that are accessible, inclusive, and attractive can enhance social cohesion, foster a sense of self-identity, and facilitate interaction with both the natural and social environment of the neighborhood [20].

Green Spaces and Sustainable Development

The concept of sustainable development represents the preservation of natural resources by meeting the needs of the present without compromising the ability of future generations to meet their own needs in the future. [21] The seventeen sustainable development goals represent a clear approach to ending the journey that the world began at the beginning of the third millennium to eliminate all forms and dimensions of poverty and improve the quality of life by 2030. [22]. Green spaces have a direct impact on the sustainable development goals, especially Goal 11 “Sustainable Cities and Communities”, Goal 13 “Climate Action”, and Goal 15 “Life on Land” [23], Goal 13 and Goal 15 include the sustainable use of ecosystems, forest management, combating desertification, reducing agricultural land degradation by increasing green spaces and plant diversity, sustainably managing forests, combating desertification, and halting biodiversity loss.[24] It is therefore useful to systematically explore vegetation cover, analyse the factors influencing changes in vegetation cover to achieve sustainable development and provide scientific guidance to policymakers. [25].

Urban green spaces are a vital element in sustainable development because they reduce noise, purify the air, improve the local climate and quality of water, and provide many recreational and relaxation opportunities for residents [26]. One way to support the sustainable practices is to provide green spaces and shift to green cities. Therefore, the concept of the green city is an opportunity for cities to transform into more sustainable development [27]. Green cities can be defined as the city that promotes energy efficiency and renewable energy in all its activities, invests in green solutions on a large scale, uses a mix of land uses and social planning practices in its system, and bases local development on the principles of green growth [28]. Green spaces also play an important role in environmental stability, which is an important factor for sustainability [29]. It can be defined as the ability of an ecosystem to resist change during periods of unrest, which is characterized by low variability, i.e. deviating slightly from the average, despite the continuous change in environmental conditions [30].

Government policies to preserve green spaces

Urban green spaces offer economic, social, and environmental benefits. However, these spaces are increasingly threatened by rapid depletion due to encroachments. In the city of Asokwa, Ghana, poor coordination between the local government and urban planners has led to a significant decline in urban green space over a 20-year period, from 49% to 16% [31]. Similarly, the rapid urban expansion in Baghdad, coupled with weak governmental oversight, has resulted in the conversion of many green areas into residential and commercial zones, negatively impacting the city's ecological balance [32]. In another case, the city of Lahore, Pakistan, has experienced a dramatic decline in vegetation cover—from 8% in 1994 to 0.38% in 2014—due to weak enforcement of environmental policies and non-compliance with sustainable urban planning principles [33]. Therefore, ineffective planning and implementation of governmental policies, poor coordination among relevant stakeholders and international organizations, and the lack of adherence to sustainable planning standards are likely to result in the loss of numerous green spaces and the degradation of ecosystems [34].

To address the unprecedented challenges of global climate change and environmental degradation, international cooperation on environmental governance policies aimed at protecting and restoring vegetation is being implemented worldwide [35]. Among these initiatives is the 2016 United Nations Desertification Initiative, which seeks to preserve ecosystem functions and services, ensure food security, combat desertification, and expand green spaces [36]. Additionally, governments—particularly in arid regions—have collaborated to support the UN’s actions against desertification and agricultural land degradation [37]. Examples include Australia’s biodiversity compensation policy for green space conservation [38] and the United States Urban and Community Forestry Act [39]. Meanwhile, the Chinese government has enacted multiple policies to safeguard ecologically fragile areas and has allocated increased funding to advance environmental improvements, striving to achieve sustainable economic development alongside environmental security [40].

Planning Standards for Green Zones

Planning green zones and public parks is one of the bases of urban planning to create a healthier, more sustainable and attractive urban environment [41]. Planning standards for green zones vary from one country to another, but there are planning standards agreed upon by urban planners [42], including the distance to access the green zones, especially in residential neighborhoods, not exceeding 500 meters to ensure fair access for all residents [43].

For example, the housing projects standards in England stipulate a distance of 300 meters to access the green zones, while the 2014 spatial planning regulation in Turkey requires that green spaces be located 500 meters from the houses, reflecting a different approach to accessibility to these areas [44]. In the city of Frutswaf in Poland, the rapid urbanization has led to insufficient public green spaces, which highlights the need for established standards to ensure accessibility and sustainability in urban planning [45], while the Urban Housing Standards Booklet in Iraq has determined a distance of 500 meters to reach green zones [46]. On the other hand, the percentage of green zones, including playgrounds and public parks, varies from one city to another based on factors such as urbanization, population density, environmental aspects, and government policies [47]. In Linz, Austria, the percentage of green spaces is 27.14 square meters, and in Helsinki, Finland, the percentage is 25.51 square meters per person, while the percentage of green areas in Amsterdam, Netherlands, is 17.62 square meters per person [48]. While the urban and rural housing standards for Iraq for 2018 specified that the per capita area of green areas in the

residential neighborhood is 0.75-2.25 square meters and that it should be at a distance of 800 meters to reach it. [49]. Studies indicate that the minimum percentage of green spaces in cities is 25%, which is a necessary percentage to maintain environmental balance, reduce global warming and desertification, thus leading to sustainability [50].

Study Area

The city of Fallujah is one of the cities of Anbar Governorate, located (60) km northwest of the capital Baghdad, between latitudes (33°21'09" - 33°17'47") north, and longitudes (43°49'33" - 43°44'58") east. The most important feature of the city of Fallujah is its location on the banks of the Euphrates River, which gives it a distinctive shape and a diversity of land uses and increased percentage of green and open areas.

The city had seen to many military and terrorist operations, the last of which was in (2014), which led to a delay in the planning process and the development of basic plans, in addition to the complete destruction of the infrastructure. The last basic design for the city of Fallujah was done in (2000) with a total area of (2586) hectares, distributed over (21) residential neighborhoods.

Methodology and Data Sources

The study was divided into three main phases, namely the preliminary phase, the implementation phase and the final phase. The preliminary phase included a presentation of the literature on green spaces, their importance and their relationship to sustainable development and the planning standards followed , while the second phase included the practical aspect of the research paper through the use of the GIS program to identify green spaces in the base plan of the study area for the year 2000 and the special maps to compare the two time periods (2016-2024), i.e. after the end of the military operations of the city and compare the reality of the situation and what should be implemented.

While data sources were used by creating a database based on Geographic Information Systems (GIS), and when building a GIS database for mapping, a series of steps must be followed systematically and correctly consisting of several stages in order to reach accurate and correct positive results to avoid confusion and errors that may occur, as it begins to collect, process and analyze data, and GIS is the basis for managing databases for mapping. Thus, the study relied on the Arcmap10.7 program.

The process of entering, processing and analyzing the data represented by the satellite visualizations obtained based on the 2016 satellite visualization from the American satellite (8Land Sat) with a coding accuracy of (10 meters), and the 2024 satellite visualization from the American satellite (8Land Sat) with a coding accuracy of (10 meters), in order to show the geographical maps of the two time periods, while the spatial data of the base plan was relied on from the data of the Directorate of Fallujah Municipality, and finally the final stage included the conclusions reached by the research paper based on the data and results in the practical aspect.

The maps were also prepared through the establishment of linear and spatial shapefille layers, which represent the basic database of green spaces and knowledge of the levels of green areas of residential neighborhoods. The most important uses within the city, especially green spaces, were coded, through which the areas were calculated for the two periods and knowledge of the completion rates compared to the basic design.

Green spaces in the study area

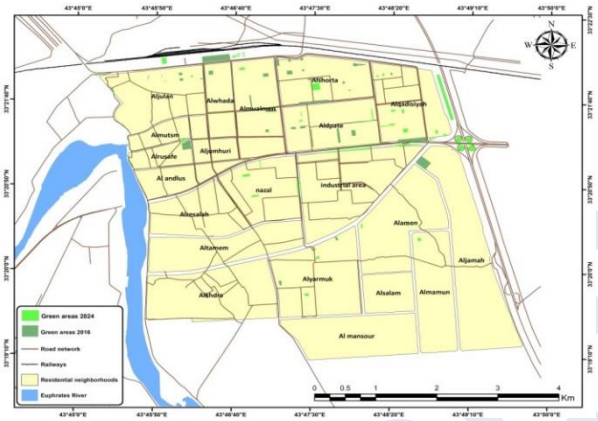
Because of the terrorist operations and the exposure of the city to a process of mass displacement that led to the complete destruction of the city's infrastructure, including green areas, especially in the residential neighborhoods of the city. The research aims to find out the effectiveness of the government policy of the city of Fallujah in terms of increasing the area of green areas in the city and thus improving the quality of life, by calculating the area of the city and its residential neighborhoods according to the base plan for the year (2000), as well as calculating the area of green areas according to the base plan for the year (2000), which amounts to (169.2) hectares, as shown in Map No. (1), as well as calculating the area of green areas in the residential neighborhoods of the city for the year (2016-2024) by relying on the satellite visualization of the two cities using the program (Arc map 10). The results showed that the area of green areas in the residential neighborhoods of the city in the year (2016) was (12.8) hectares, as shown in Map No. (2), while the results of the area of green areas in the residential neighborhoods of the city for the year (2024) were (47.24) hectares, as shown in Map No. (3), Table 1 presents the area of green spaces that were calculated for the purpose of increasing green coverage in the city.

Table (1): Area of green areas in the city of Fallujah/ hectare.

Master Plan 2000	The situation in 2016	The reality of the situation in 2024
169.2	12.8	47.24

Map (1): Green spaces according to the Master Plan of Fallujah City for the year 2000.

Map (2): Green spaces of Fallujah city 2016.



Map (3): Green spaces of Fallujah city 2024.

By calculating the areas of green spaces in the study area, it was found that there was an increase in green zones between the two time periods by (34.44) hectares, i.e. an increase of (2.7%) as shown in Table No. (1), which is a good indicator of the keenness of the local government of the city to increase the percentage of green zones in residential neighborhoods and in the city in general.

Table (2): Area of residential neighborhoods and area of green zones in the city of Fallujah for the period (2016-2024).

#	Nneighborhoods	Area of the neighborhood / hectare	Green areas\hectare 2016	Green areas\hectare 2024
1	Alyarmuk	180.3	0.34	1.3
2	Algamah	240.9	3.08	6.6
3	Alrusafa	38.3	0.3	2.7
4	Aldpate	123.5	0.3	4.6
5	Algulan	144.6	0.2	2.2
6	Alqadisyah	140.6	2.5	9
7	Almualmen	126	0.5	3
8	Alshorta	115.7	0.4	6
9	Alwhada	58.2	4.9	5.5
10	Almamun	133.6	0	0.2
11	Alamen	172.1	0	0.3
12	Nazal	119.7	0	1.7
13	Industrial area	207.6	0	3.3
14	Almutsm	35.8	0	0.15
15	aljumhuri	40.7	0	0
16	Altamem	137	0	0
17	Alresalah	112.9	0	0
18	Alandlus	59.3	0	0
19	Almansour	149.8	0	0
20	Alsalam	57.8	0	0
21	Alkhdra	191.4	0	0
sum		**2586.8**	**12.5**	**46.5**

Despite the increase in green areas in some neighborhoods of the city, especially in the neighborhoods of (Al-Qadisiyah, Al-Jamiah, Al-Shorta, Al-Wahda, Al-Dhobbat and the industrial neighborhood), still there are neighborhoods to date that have not seen any work on preparing the green zones. They are (7) neighborhoods out of (21) neighborhoods of the city, as shown in Figure No. (1). This is a problem that the local government in the city must address and expedite the implementation of plans and programs to increase green areas despite the low population density of these neighborhoods.

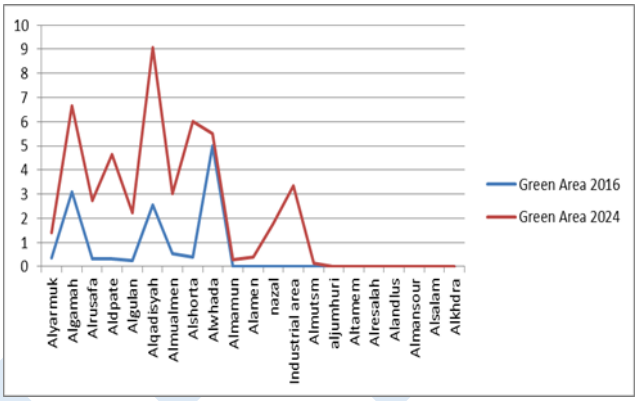
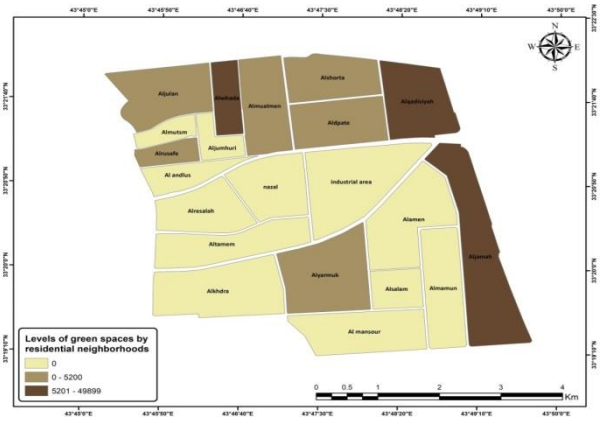


Figure (1): Levels of green zones in residential neighborhoods for the period (2016-2024).

Levels of implementation of green spaces

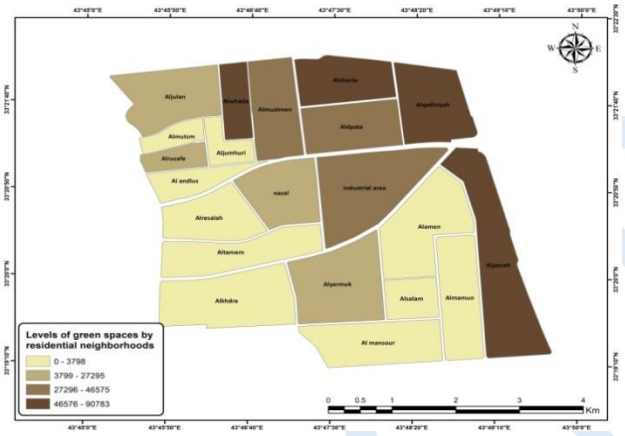
The practical aspect of the research was based on the Shapefile polygon layer of the city in classifying neighborhoods at different levels on the Arcmap10 program. This program provides us with the possibility of classifying residential neighborhoods according to the area of green areas occupied by those residential neighborhoods through the tools (Symbology > >Categories > > > Unigue Values), to determine the amount of increase in the area of green areas of the residential neighborhoods of the city.

Through the above maps of green spaces for the period (2016-2024) and according to the areas mentioned in Table No. (2), three levels can be determined according to the residential neighborhoods that occupy the largest amount of green spaces. Therefore, the city was classified into three levels. Through the map No. (4), which represents the reality of green spaces in 2016, it fell within the first level (Alqadisyah, Alwhada and Algamah), while the second level included residential neighborhoods (Alshorta, Aldpate, Almualmen, Algulan, Alrusafa and Alyarmuk). The third level, which determines the neighborhoods that are devoid of green spaces during the specified period of time.



Map (4): Green zones levels 2016.

In 2024, as shown in Map No. (5), the classification was adopted on four levels in order to highlight green areas. It was noted that there was an increase in the number of green areas and thus the levels within which residential neighborhoods are located. The first level included residential neighborhoods (Alshorta, Alqadisyah, Alwhada and Algamah), meaning that there was an increase in the area of green areas of areas that were located within the second level during 2016. In addition, the second level changed a lot, as it included areas in which the areas increased, which are only residential neighborhoods (Aldpate, Almualmen, and Industrial area). It is worth mentioning that the responsible authorities worked to establish green areas surrounding the industrial zone, unlike the previous period, where they were previously devoid of this. The third level included residential neighborhoods (Algulan, Alrusafa, Nazal, and Alyarmuk). Here it appeared to us that (Nazal) witnessed the construction of new green areas during the last years, unlike the fourth level, which includes the rest of residential neighborhoods and did not witness any new works to establish green spaces according to the design of the city, this indicates an increase in green spaces across several residential neighborhoods in 2024 compared to 2016.



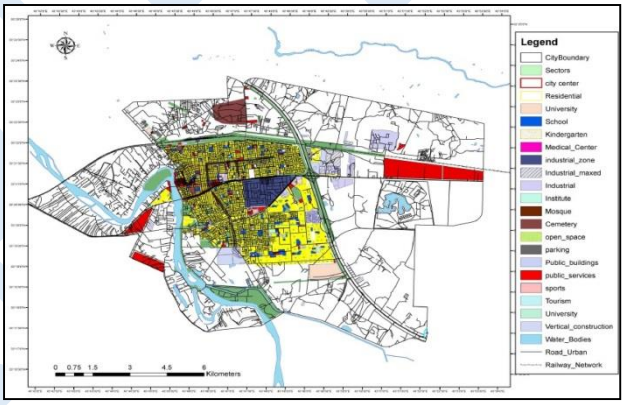
Map (5): Green zones levels 2024.

Local Government Policy for Fallujah City

The policy of local governments plays an important role in the development process and improving the quality of life in the city, by developing plans and programs and taking into account the current and future needs of the local community in the light of planning developments. In the study area, the local government took upon itself to shake off the dust of wars and destruction after the liberation of the city from terrorist gangs through the following:

1. Removing the remnants of war and examining all buildings from the impact of chemical radiation and military explosives.
2. Rehabilitation of the necessary services from the maintenance of the electrical power system and the maintenance of water and sewage installations.
3. 3-Opening and cleaning the main and secondary roads and rehabilitating the necessary government buildings, hospitals and health centers.
4. Providing the requirements of daily life and reopening local and commercial markets.
5. Bringing the city's residents back to their homes gradually according to the areas less affected by the military operations.
6. Work to restore life to the city through the maintenance of parks and gardens, and the re-planning and construction of ring roads.
7. Working on updating the city base plan with modern urban planning methods and collecting all the necessary data and surveys.

Accordingly, it was agreed to develop a new base plan for the city (2022-2042), as the land uses within the design map of the new base for the city of Fallujah included map No. (6), a large and diverse number of land uses, between horizontal and vertical residential use, recreational and green areas, as well as the use of various services (educational, health and service), as well as the identification of areas for future expansion. This is in addition to the establishment of a central business area with buildings of different heights in the center of the city instead of the industrial district. It is also noted in the land use plan for the new base design, which covers an area of (20497) hectares, attention to green areas, recreational areas, playgrounds, tourist use and the use of the two sides of the Euphrates River to establish tourist events that contribute to social interaction between members of the Fallujah community as well as its environmental and economic importance. This indicates the keenness of the government policy of the city of Fallujah in the diversity of recreational activities, including increasing the area of green spaces of the local community, which leads to improve the quality of life in the city.



Map (6): New master plan of the City of Fallujah.

Uses of Green Area in the City of Fallujah

The uses of green areas are one of the most important uses in urban areas and a very important element for any city that seeks to achieve sustainable development and provide the element of comfort and hiking for its residents. It is also the lungs of the city and the only area to provide entertainment and recreation in the urban environment, as well as its aesthetic function by forming picturesque views, which gives value to the city and its residential neighborhoods.

The area of the uses of green areas in the new design of the city of Fallujah reached (899) hectares, a large area that confirms the local government policy For the city of Fallujah in order to I ncrease the area of green areas and attention to them through the development of recreational areas and the afforestation of road approaches and the cultivation of central islands with evergreen trees, in addition to the provision of many stadiums and sports events, as the area of green areas developed for residential neighborhoods in the city at the present time (47.24) hectares, while there is an area of (76.5) hectares for green areas in residential neighborhoods of the city under construction as shown in Map No. (7), which shows

the difference in green areas according to the basic plan for the year 2000 and the implementation of green areas until 2024, as well as the green belt surrounding the city, as attention to my side The river to make it a tourist and recreational face, as the total length of the developed corniche of the city (1.8) km, which was reflected in the quality of urban life in the city and the increase in social interaction and the environmental and health role of those green spaces, As shown in the pictures below.

Map (7): The difference between the green spaces of Fallujah city.

Pic (1): Green spaces in Fallujah city.

Conclusions

This study highlights the role of local governments in enhancing the quality of life through the development of green spaces and recreational activities. The research findings reveal that the area of green spaces in the city of Fallujah increased by 34.44 hectares (a growth rate of 2.7%) between 2016 and 2024. Additionally, the allocation of green areas in the city's new master plan reached 899 hectares, indicating the effectiveness of the local government in shaping a future-oriented policy toward a sustainable city. The study further demonstrates the tangible and proactive approach adopted by the local government within the study area by expanding the extent of green spaces and making dedicated efforts to attract local residents to visit these areas. This was illustrated through the distribution levels of green spaces across residential neighborhoods during the selected time period.

However, the results also indicate that the proportion of green spaces in the study area remains below 25% of the city's total area. Therefore, it is essential to increase this percentage to maintain environmental balance, mitigate desertification, combat global warming, and reduce rising temperatures.

Accordingly, this study recommends that the local government in the study area adhere to planning standards when implementing green spaces, complete the remaining designated green areas in underserved residential neighborhoods, and prioritize the establishment of a green belt around the city to act as a dust barrier, lower temperatures, and improve the overall environment. Furthermore, the study emphasizes relocating the industrial zone from the city center and implementing the new master plan to transform it into a central business district. Such measures are expected to positively impact both the environmental and social conditions of the city, while also creating new recreational opportunities for local residents.

Finally, the study recommends that local governments adopt a decentralized governance policy in the city of Fallujah as a strategic approach for developing plans and programs to revitalize urban life, particularly in cities that have been affected by military operations and wars.

Disclosure Statement

- **Ethics approval and consent to participate: Not applicable**
- **Consent for publication: Not applicable**
- **Availability of data and materials:** The raw data required to reproduce these findings are available in the body and illustrations of this manuscript.
- **Author's contribution:** The authors confirm contribution to the paper as follows: study conception: NH, IH, IS, HA, KQ; methodology: NH, IH, SQ, HA, KQ; Literature review: NH, DE, SQ; modeling and mapping: NH, IH; data analysis and validation; NH, IH, HA, KQ; draft manuscript preparation: NH, draft manuscript revision: NH, IH, DE, SQ, IS; Template filling: DE
- All authors reviewed the results and approved the final version of the manuscript.
- **Funding:** No granted funding
- **Conflicts of interest:** The authors declare that there is no conflict of interest regarding the publication of this article.

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