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The Impact of Unregulated Urban Sprawl on Public Services and Quality of Life in Baghdad: A Case Study of Al-Dora District Using Spatial Analysis

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ABSTRACT

The rapid and uncontrolled expansion of urban sprawl in Baghdad, particularly after 2003, has significantly transformed the city's landscape. This expansion stems from socio-political instability, a lack of affordable housing, and inadequate urban planning frameworks. As informal settlements encroach on agricultural lands, the city's infrastructure—including water, sanitation, and transportation systems—faces mounting pressure. This situation presents critical challenges to the sustainability of Baghdad's public services and the quality of life for its residents. This study aims to evaluate the impact of unregulated urban sprawl on Baghdad's public services and infrastructure, focusing on how informal growth has undermined the city's capacity to deliver essential services. Through the analysis of household and stakeholder survey data, the study highlights critical shortcomings in service delivery and infrastructure within the Al-Dora district. Moreover, the research proposes actionable recommendations to enhance urban planning and governance, addressing the socio-environmental consequences of unregulated growth. The findings emphasize the severe strain urban sprawl has exerted on Baghdad's public services, with critical deficiencies observed in water supply, electricity access, healthcare services, and transportation networks, particularly in informal settlements. Stakeholders identified institutional barriers, such as poor coordination and insufficient policies, as major obstacles to managing this growth. The study underscores the urgent need for urban planning reforms, strengthened governance, and the integration of modern technologies like GIS to monitor and control urban sprawl. These recommendations aim to foster a sustainable urban future for Baghdad, ultimately improving the quality of life for its residents.

1. INTRODUCTION

Following 2003, Baghdad experienced significant urban sprawl that encroached upon large portions of agricultural land, drastically transforming the city's landscape. This uncontrolled, poorly planned, and unregulated expansion of urban areas was driven by accelerated population growth and the absence of effective regulatory measures. As rural populations migrated to Baghdad seeking work and security, the demand for informal housing replaced much of the agricultural land surrounding the city with unplanned neighborhoods. This trend is expected to persist, and the lack of essential services in these newly developed areas will further exacerbate urban planning challenges for Baghdad [1].

The primary causes of this phenomenon include the absence of supportive legal frameworks to preserve agricultural lands and weak urban governance within a context characterized by socio-political instability. Following 2003, the lack of strict government land-use regulations allowed extensive informal settlements to proliferate over what were once fertile agricultural lands, transforming them into overcrowded and poorly planned urban zones [2]. The expansion of these settlements has had far-reaching implications, largely driven by the unaffordability of housing, which forces economically marginalized populations to cluster on farmland at the city's peripheries. The conversion of these lands has not only reduced agricultural productivity but also exerted significant pressure on water supply, sanitation, and infrastructure development. This uncontrolled growth has led to underdeveloped infrastructure, creating significant challenges for city planners. Consequently, the quality of life for residents in these areas has declined, as public services remain consistently inadequate [3]. The reduction of green spaces and farmland by urban sprawl also endangers the environmental sustainability of Baghdad, compounding issues such as flooding, for example, due to warmer local climates resulting from both deforestation and climate change. Baghdad's future is also threatened by urban sprawl, and further emergent agricultural land will be needed to support an expanding city. The city is in danger of losing its agricultural heart and green lungs if urban planning reforms are not forthcoming. Recent research highlights that the application of remote sensing technologies, coupled with advanced urban planning tools, should be adopted to control land-take and land-use transitions,

striking a balance between city growth and environmental preservation requirements [4].

Immediate policy reforms need to be made that ensure sustainable urban growth without gobbling up the last of our agricultural lands.

The city is unique in the region due to its ancient history, urban character, and significance, as well as its economic livelihood. For centuries, urban development in Baghdad has been shaped by a vibrant influence of learning and commerce. The city, divided by the Tigris River into two sides, still maintains unique characteristics where some regions combine traditional and contemporary architecture. The image of Baghdad as a city sheds light on an approach to urban identity wider than merely physical traces—one that is determined by its historical development and social practices, which still influence life in the present. More than a decade after the invasion of Iraq, Baghdad has developed several distinct features, and despite modernization, its urban dimension remains unique in combining elements from Middle Eastern traditional towns with the rapid pressures influenced by events following 2003 [5].

Unregulated urban sprawl, particularly the encroachment by housing on agricultural land, has also had major spatial impacts in Baghdad. Whether caused by war or economic sanctions, growth in Baghdad has been haphazard and unplanned, unlike the pattern of growth typically associated with overseas urban centers. As a result, the urban landscape is fractured and scattered with informal settlements and other uncontrolled neighborhoods along its perimeter. Compared to other Middle Eastern cities that 'develop' in a more controlled way, the growth of Baghdad is marked by weak local governance and a rapid population increase, with migrants coming from rural areas [6].

One of the defining aspects of Baghdad's urban fabric is the imbalance between modern infrastructure and its historical core. The rapid expansion of informal housing settlements post-2003 has exacerbated the challenges of maintaining public services, such as water supply, electricity, and transportation, which struggle to keep pace with the city's unplanned growth [4]. Moreover, the city's environmental challenges—such as rising temperatures due to the "urban heat island" effect—are exacerbated by the loss of green spaces and the expansion of construction zones, further distinguishing Baghdad from its regional counterparts [7].

In summary, Baghdad's urban characteristics are marked by its unique historical importance, its struggle with modern urbanization pressures, and the significant environmental and infrastructural challenges it faces as a result of unregulated growth. These factors create a distinct urban environment that sets it apart from other regional cities.

1.1 Importance of the research

Urban sprawl is an extremely dubious issue in Baghdad, especially because of its unplanned and uncontrolled process, as the city has been rapidly growing through the years due to what is being called "socio-political driving forces". The ban on converting agricultural inward areas to residential use for human settlement has led to the breakdown of essential services like water supply and sanitation, as well as negatively affected the quality of life in these areas. Furthermore, the uncontrolled expansion also imperils Baghdad's 'Liveable City' status, consuming vital green space and straining infrastructure.

These are, of course, children who suffer the most from inadequate housing, and a lack of supply due to high costs under inefficient regulatory frameworks only accelerates further sprawl into informal settlements. Through studying the impacts of urban sprawl, this research intends to provide information for city planners and policymakers alike on how best to interpret such data as a recommendation towards strategies that would address both infrastructural deficiencies in the city and environmental needs. The aim is, ultimately, to factor in urban sustainability scientifically so as to ensure more livable conditions can return permanently for Baghdad.

1.2 Research objectives

Infrastructure: Evaluate the impacts on infrastructure, such as roads, transportation systems, and networks of water supply and sanitation in Baghdad due to urban sprawl. This study will determine where the city is most vulnerable to strain on its systems and identify critical gaps for managing a population that continues to grow.

Assess access to public services: Review the provision and adequacy of basic healthcare and education facilities, as well as utilities, in areas experiencing urban expansion. The aim is to illustrate how urban sprawl has diluted the quality of these services and to identify places in need of attention.

Recommendations for urban planning: As a consequence, the research will identify solutions to reduce or control the side effects of sprawl in local government practices. The plans include ways to strengthen infrastructure, boost public services, and ensure future growth is sustainable.

2. LITERATURE REVIEW

Urban sprawl is a widespread phenomenon that has garnered significant attention globally due to its multifaceted impacts on cities' infrastructure, public services, and sustainability. Various studies have explored its consequences in different regions, providing insights that can inform urban development policies.

2.1 Economic and public service impacts

Municipal finances are arguably the key impact of urban sprawl. An example is research conducted in the Valencian Community, Spain, which shows that urban sprawl drives up the costs of providing municipal services, including water supply, sanitation services, public lighting, and waste disposal, among others. From an economic point of view, this urban settlement model is absolutely dysfunctional, as it leads to higher per capita costs (especially in public transport and security services) and inefficient growth [8]. Similar findings have been reported in Japan, where suppressing urban sprawl can reduce the marginal costs of providing local public services by up to 0.11% [9].

2.2 Environmental and health effects

Urban sprawl also poses significant environmental and health challenges. In China, a study found that sprawl exacerbates pollution by increasing the number of days when pollutant concentrations exceed safe levels, particularly in regions with fragmented urban growth patterns [10]. In a similar context, a study in Tanzania highlighted the negative impact of sprawl on ecosystem services, showing how built-

up areas replace essential green spaces like grasslands and forests, which are crucial for carbon sequestration and biodiversity [11, 12].

2.3 Social and livability concerns

In developing countries, urban sprawl has been linked to declines in livability due to the inadequate provision of basic services. For example, in Nigeria's Kaduna metropolis, sprawl has led to overstressed public utilities and infrastructure, contributing to rising unemployment and urban poverty [13, 14]. Similar trends have been observed in Uganda, where sprawl negatively affected public satisfaction with urban planning and service delivery, resulting in social fragmentation and reduced quality of life [15].

In summary, the global body of research highlights that while urban sprawl may offer short-term economic benefits, its long-term impacts on public services, environmental sustainability, and social well-being are largely negative. These findings underline the necessity of implementing sustainable urban planning practices to mitigate the detrimental effects of sprawl.

2.4 Regional and local studies: Focus on Middle Eastern cities similar to Baghdad

While urban sprawl has been studied in-depth in various contexts, the Middle East is hardly an exception to this challenge, characterized by similar unregulated growth patterns combined with unique regional issues. Urban sprawl is driven by demographic pressures and socio-economic factors that fuel rapid urban growth within cities or adjacent areas, resulting from a legacy of inadequate planning frameworks (e.g., in countries like Jordan, Iran, or Egypt). These studies provide insights that may inform strategies to address these challenges in Baghdad while also highlighting areas of research need for the future.

2.5 Urban sprawl in Baghdad: Challenges and policy frameworks

The main causes of urban sprawl in Baghdad include socio-political instability and high population growth rates, which have accelerated over the years, particularly after the 2003 Iraq War. This uncontrolled expansion presents challenges, especially within the context of a war-torn area where rules and regulations are weak, and law enforcement is inexperienced. The urban landscape of the city itself has undergone a drastic transformation, as whole swathes of the rural population displaced by the war have fled to urban centers in search of safety and economic opportunities. Unplanned and informal settlements have mushroomed through this urban sprawl, encroaching on agricultural lands and creeping into undeveloped parts of the city, leading to significant urban planning challenges [4, 16].

Urban sprawl in the Middle East is part of both a larger phenomenon of rapid urbanisation and ironic policy failure, noted by weakened policy frameworks alongside land-use-related legal inertia from development. This led to extensive informal settlements without services like water, sanitation and electricity causing adverse living environment conditions and socioeconomic disparities in Baghdad [3]. Assisted by unabated expansion of population, these developments are unplanned, making it a problem to maintain ecological balance and output which is only worsened with each part drought due to the climate change [1].

In war-torn cities such as Baghdad, there is a lack of political will amongst local authorities to incorporate these issues into broader urban planning policies which are often hindered by fragmented governance structures. In Iraq, the stated urban planning frameworks following a conflict are considered to be reactive instead of proactive which has resulted in prioritizing housing needs with short-term views while ignoring long-term sustainability and resilience [17]. However, this type of policy gap has discouraged the development of plans to control urban sprawl, resulting in uncontrolled urbanization and conversion of important arable land into low-density urban districts. Nevertheless, some recent efforts by the Iraqi government and Iraq based international organizations have begun to tackle these problems with urban development frameworks that take into account an establishment of urban resilience through sustainable growth in addition to infrastructure development [18].

2.6 Case studies in Jordan, Iran, and Egypt

The rapid and precarious urban development in Amman, Jordan, requires a proactive movement towards a sustainable tradition by adapting the existing sprawl policy dilemma into a future planning approach. Similar to Baghdad, the good intentions of a comprehensive master plan are thwarted by rapid urbanization and development, which constrain travel away from core areas. Finally, it identifies directions for future research, not only regarding sprawl per se but also its interplay with land use and environmental policy—especially in expanding cities [19]. Similarly, urban sprawl in Iranian cities like Hamedan and Nowshahr has been associated with increased car ownership, longer commute times, and diminished use of public transport, indicating infrastructure challenges that are also relevant to Baghdad [20].

In Egypt, urban sprawl in cities like Cairo has been attributed to weak planning systems and rapid population growth, resulting in fragmented development. These challenges echo the issues faced in Baghdad, where informal settlements expand due to inadequate regulatory oversight [21]. These case studies emphasize the critical role of urban planning policies in curbing sprawl and highlight the importance of addressing planning deficiencies.

2.7 Research gaps related to Baghdad

While studies on urban sprawl in the Middle East provide essential comparative insights, there is a notable lack of detailed research on Baghdad's specific context. Many studies focus on other major cities in the region, but the unique socio-political challenges of post-2003 Baghdad are underexplored. Existing literature on similar cities highlights issues such as rural-to-urban migration and the strain on public services, but further research is needed to evaluate how these factors manifest in Baghdad's distinct political and environmental landscape [18]. Additionally, studies that explore the spatial and environmental impacts of sprawl using advanced tools like remote sensing are limited in the context of Baghdad. There is a need for localized studies that use these methodologies to better understand the patterns of growth and their long-term implications.

In summary, while regional studies offer valuable lessons for addressing urban sprawl in Baghdad, gaps in the literature highlight the need for focused research on the city's unique challenges and the development of tailored urban planning solutions.

2.8 Research gaps

In contrast to the large body of research on urban sprawl and its impacts in numerous global- as well regional contexts, there is very little literature available that focuses upon understanding the distinct consequences rapid informal growth has caused in Baghdad. Despite the rapidly changing urbanization landscape in Iraq's capital post-2003, very few studies have sufficiently focused on understanding how urban sprawl has directly impacted public services such as water supply, sanitation, and transportation systems. These services are already under significant strain due to the rapid population mobility from provinces to Baghdad, driven by the city's better educational facilities and job opportunities [1].

Other Middle Eastern cities have faced similar issues of urban planning and sprawl, but the study of Baghdad's dynamic growth has been largely absent from academic research. This book draws on the findings of such studies in comparing sources of urban sprawl and its impacts on infrastructural provisions and public services with other cities are further located. That being said, Baghdad has its own specific political and economic context which can be vulnerable to urban land grabbing due to the lack of formal procedures with regard to new short rush cities because they are not regulated in a way that serves people out at least it does not help unregulated slump areas where there is no service or quality within life [21].

Additionally, there is a paucity in the applications of high technology such as remote sensing and GIS for assessing urban sprawl characteristics in Baghdad. Tools such as these are widely used in other cities to track land-use change and inform metropolitan planning, but the use of them is less common with respect to Bombay. Urban planners in Baghdad are faced with a serious problem of accumulating urban growth patterns and the result consequent to environmental, infrastructural consequences if they have no clear view on anticipated locations or directions for future expansion [4].

This study, therefore, hinges on these critical gaps by concentrating on the actual impacts of urban sprawl upon public services provision and quality of life in Baghdad. Using a mix of qualitative and quantitative methodologies, including spatial analysis the study will offer insights into some unique challenges faced by the city which in turn shall help to suggest few reproducible practices that can contribute towards urban sustainability.

3. METHODOLOGY

3.1 Research design

The study is carried out in a mixed-methods design which combines quantitative and qualitative methods. This spatial approach aims to provide a holistic view of the consequences of urban sprawl as it affects public services and quality of life in Al-Dora District, one that has experienced substantial informal growth. The file is a gazetted residential and business leaflet. It integrates spatial data with detailed socioeconomic statistics to provide clear policy recommendations on managing urban expansion in this area, enabling a comprehensive analysis of related issues at multiple scales.

3.2 Study area

One of the main districts in Baghdad, Al-Dora is located to the south and borders the Tigris River to the west. The district is one of four rapidly urbanizing districts in Iraq since 2003. Formerly verdant with orchards and agricultural lands, these have been replaced by the concrete of a crowded residential zone known as Al-Dora. The unchecked sprawl of housing during that period has transformed a district historically rooted in agriculture and replete with open spaces. Satellite imagery shows that this urban sprawl has impacted green spaces and exerted pressure on infrastructure, much of it informal. Maps of Al-Dora prior to 2003—illustrated with photos by the author—show the area before and after (Figure 1), when agricultural land predominated, compared to its state in 2022 (Figure 2), where residential expansion has overtaken much of the area. These maps illustrate the significant changes in land use and infrastructure development over the two decades.

Figure 1. Study area before 2003

Figure 2. Study area in 2022

- Unregulated urban expansion

Al-Dora also provides an intriguing case study of the uncontrolled urban sprawl that has fueled much of Baghdad's growth. Agricultural lands were turned into informal settlements with no formal zoning or urban planning, as internally displaced populations sought cramped residential housing opportunities. In the absence of legal oversight, many neighborhoods lack basic services such as water supply, sanitation, and electricity. Much of the land had been illegally converted into inexpensive housing, which is said to have caused significant negative impacts on agricultural production [1].

- Impacts on public services and infrastructure

Al-Dora's public services have been severely affected by the population explosion. This, along with the growth of informal settlements, has strained service provision—particularly water supply, sanitation, and electricity. The antiquated, overburdened infrastructure that provides these services is increasingly failing to meet demand, leading to regularly scheduled shortages or service interruptions. This situation is mirrored in the public sector, where overcrowding has become normalized in both schools and health centers. Public institutions, unable to keep pace with urban expansion or to match it with similar growth in service delivery capabilities, have been well-documented in failing service studies [4].

- Environmental and quality of life concerns

This urban sprawl is exacting an environmental toll so vast that it feels practically unquantifiable. With the encroachment of concrete infrastructure and the replacement of orchards and green areas with residential buildings, air quality continues to decline, and urban heat islands are increasing, creating an unhealthy environment. Residents have experienced a steep drop in quality of life, largely due to environmental deterioration and a lack of recreational areas. The area is rapidly being reduced to an urban desert; what was once fertile land is now overrun with uncontrolled and illegal housing projects [5].

3.3 Data collection

This study will rely on a combination of primary and secondary data sources to explore the effects of urban sprawl on infrastructure and public services in Al-Dora.

1) Primary data
   - Interviews: Semi-structured interviews will be conducted with local officials, urban planners, and residents of Al-Dora. The aim is to gather qualitative insights into the governance challenges and lived experiences concerning access to public services in the context of rapid urban expansion.
   - Surveys: A structured survey will be administered to households within informal settlements in Al-Dora. The survey will focus on access to essential services such as water, electricity, sanitation, and healthcare, while also gauging residents' perceptions of their overall quality of life. The survey questions were developed based on a thorough review of prior literature addressing urban sprawl, public service satisfaction, and quality of life in similar contexts. Additionally, expert consultations were conducted to refine the questions, ensuring relevance and clarity for the study's target demographic.
   - Sampling criteria: Inclusion criteria for participants were defined as residents aged 18-65 who have lived in the Al-Dora district for at least two years, capturing the long-term impacts of urban sprawl. Individuals who recently moved to the area or who live in distinct demographic zones were excluded to maintain a focus on the main affected population.
2) Secondary data
   - Remote sensing data: Satellite imagery from Landsat 8 and Sentinel-2 will be utilized to analyze land-use changes in Al-Dora from 2003 to the present. These data will enable the identification and measurement of the urban sprawl's impact on agricultural lands and open spaces.
   - Municipal records and reports: Data from the Baghdad Municipality and the Ministry of Planning will be reviewed, particularly focusing on urban planning documents, land-use regulations, and public service infrastructure reports.

3.4 Data analysis

Spatial analysis: Processing spatial data from satellite images: The Geographic Information System (GIS) software will be used to process the spatial data on Al-Dora City, in order to map its expanse of urban sprawl. This includes techniques like supervised classification and change detection to pinpoint areas that were converted from agriculture into urban land. The new maps will be spatialized with infrastructure and public service distribution of more sprawling areas.

Quantitative analysis: Survey data will be statistically analysed using SPSS or R to uncover the statistical correlation of urban sprawl with deprivations in public services (water, sanitation and health). Descriptive statistics will summarize the conditions, while regression models may be used to test whether sprawl has an influence on service availability and quality.

Factor analysis: In the factor analysis, a Varimax rotation method was used to achieve a clearer and more interpretable factor structure. This method was chosen to maximize the variance of factor loadings, simplifying the interpretation of underlying factors related to public service access and urban satisfaction.

Qualitative analysis: The transcriptional data of interviews will be analyzed by thematic coding to extract reoccurring trends regarding governance challenges, urban planning deficits and community responses to the burdens laid on them from sprawl growth. This process will be supported by software, such as NVivo.

3.5 Sampling strategy

Sampling frame: The research will focus on the most informal populated parts of neighborhoods in Al-Dora. These hotspots will be identified using preliminary spatial analysis of satellite data.

Area: All neighborhoods within Al-Dora, 300 households on average (to cover a representation of newly developed informal settlements and aged urban areas). In addition to a survey, 15–20 semi-structured interviews will be carried out among relevant stakeholders (urban planners, municipal officials and residents).

3.6 Validity and reliability

Validity: The validity of the spatial analysis will be ensured through ground-truthing—a field verification process where selected urban areas identified through remote sensing are visited to confirm the accuracy of the classification. Additionally, the survey will undergo pilot testing to refine question clarity and relevance.

Reliability: To ensure the reliability of findings, triangulation will be employed, combining the results from GIS analysis, survey data, and interviews. This multi-faceted

approach helps to cross-validate findings, thereby enhancing the credibility and robustness of the study.

3.7 Ethical considerations

Ethical clearance will be sought from a relevant institutional review board. All participants will provide informed consent, and confidentiality will be maintained throughout the study. Data from the surveys and interviews will be anonymized to protect the privacy of respondents.

3.8 Limitations

Access and security: The majority of neighborhoods in the Al-Dora site are accessible for data collection, but considering socio-political conditions reported elsewhere in Baghdad overall some barriers could hamper access to specific embedded or enclaved neighbourhoods. Security constraints may also limit the breadth of data collection on the ground.

Data availability: Temporal gaps may result in delays between the last satellite imagery capture and analysis of recent urban development.

Potential for bias: A potential drawback of surveys is response bias, in which participants may underreport or over-report their exposure to public services. To this aim, the survey design will include neutral and objective language.

4. RESULTS

4.1 Household survey results: Assessing the impact of urban sprawl on daily life and public services

The survey conducted among 300 households in the Al-Dora district of Baghdad, an area significantly affected by unregulated urban sprawl, provided several critical insights into the impact of this expansion on public services and quality of life.

4.1.1 Demographic overview

The demographic distribution of the surveyed households shows that the majority of respondents were male (52%) and aged between 46-60 years old (35%). Most households had 3-5 members (45%), and the highest educational level attained by a large portion of respondents was university degree (28%), with informal employment being the primary occupation (40%) (Table 1).

Table 1. Demographic overview

Gender	Age Group	Household Size	Education Level	Occupation	Count
Male	46-60	3-5	University degree	Informal employment	84
Female	60+	1-2	Postgraduate degree	Retired	48
Female	60+	1-2	University degree	Informal employment	54
Male	46-60	6-8	No formal education	Formal employment	60
Female	60+	9 or more	Primary school	Retired	54

4.1.2 Housing and infrastructure

The condition of housing and access to essential services were among the major challenges faced by the residents. Unsafe housing accounted for 23%, and only 45% of households owned their homes. Frequent water supply interruptions (35%) and unreliable electricity (28%) further compounded the issues (Table 2).

Table 2. Housing and infrastructure

Housing Type	Housing Condition	Water Access	Electricity Access	Sewage Access	Count
Owned	Needs minor repairs	Yes	No	Yes	45
Rented	Unsafe for habitation	Yes	No	No	60
Informal/Temporary shelter	Good condition	No	Yes	No	45
Owned	Needs minor repairs	Yes	No	Yes	54
Owned	Unsafe for habitation	No	Yes	Yes	54

4.1.3 Public services

Public services in the district were notably insufficient. Only 40% of respondents had access to healthcare facilities, and 55% reported irregular or absent waste collection services. A significant percentage (42%) expressed dissatisfaction with healthcare services, while 35% did not feel safe in their neighborhoods (Table 3).

Table 3. Public services

Healthcare Availability	Education Availability	Waste Collection	Feeling Safe	Waste Collection Frequency	Count
Yes	Yes	Yes	No	Occasionally	45
No	Yes	No	Yes	Never	60
Yes	Yes	No	No	Frequently	54
No	No	Yes	No	Always	72

4.1.4 Environmental impact

The survey highlighted severe environmental degradation due to urban sprawl. A majority (60%) of respondents reported that no green spaces were left in their area, while 45% believed air quality had significantly deteriorated. Environmental hazards such as pollution and flooding were common, with 30% of households reporting such issues (Table 4).

Table 4. Environmental impact

Green Spaces	Air Quality Impact	Environmental Hazards	Count
No green spaces left	Yes significantly	No	180
Some green spaces remaining	Yes slightly	No	60
No green spaces left	No change	Yes	30
Some green spaces remaining	Not sure	No	30

4.1.5 Social and economic impact

Population growth and urban sprawl have strained public services, with 40% of respondents reporting a significant impact on service availability. Moreover, 48% of households

stated that job opportunities were insufficient, and 30% noted a significant decline in their quality of life (Table 5).

Table 5. Social and economic impact

Public Services Impact	Job Opportunities	Quality of Life	Count
Slight impact	No	Improved significantly	90
No impact	Not sure	Slightly improved	60
Slight impact	Yes	Worsened significantly	45
No impact	Not sure	Worsened significantly	60
Not sure	Yes	Worsened significantly	45

4.1.6 Main challenges and priorities for improvement

The most significant challenges reported by households included poor public services (35%) and environmental degradation (20%). The majority (40%) of respondents prioritized enhancing public services, while 25% emphasized the need to improve infrastructure (Table 6).

Table 6. Main challenges and priority for improvement

Main Challenges	Priority for Improvement	Count
Poor public services	Enhancing public services	105
Environmental degradation	Addressing security issues	60
Overcrowding	Increasing green spaces	45
Lack of infrastructure	Enhancing public services	45
Poor public services	Job creation and economic opportunities	45

4.2 Stakeholder responses: Identifying challenges and solutions to unregulated urban growth in Al-Dora

The stakeholder survey, which involved 20 participants representing various key roles such as local officials, urban planners, and representatives from NGOs in the Al-Dora district, provided critical insights into the challenges and proposed solutions related to unregulated urban sprawl.

4.2.1 Stakeholder roles and experience

Among the surveyed stakeholders, the majority held positions as urban planners (30%) and local officials (25%). Regarding experience, 40% had more than 10 years of experience, while 30% were relatively new to their fields with less than 5 years of experience (Table 7).

Table 7. Stakeholder roles and experience

Job Title	Years of Experience	Count
Urban planner	More than 20 years	4
Local official	11-20 years	5
NGO representative	Less than 5 years	3
Public services sector	5-10 years	2

4.2.2 Impact of unregulated urban sprawl

The stakeholders identified deterioration in water supply and sanitation as the major impacts of unregulated urban sprawl in Al-Dora. 40% of respondents reported a deterioration in public transportation services, while 35% noted a deterioration in healthcare services (Table 8).

Table 8. Impact of unregulated urban sprawl on services

Service	Impact	Count
Water supply	Deteriorated	8
Electricity	Deteriorated	4
Sanitation	No change	7
Public transportation	Deteriorated	6
Healthcare services	Deteriorated	7

4.2.3 Main barriers to service provision

The key barriers to addressing these infrastructural challenges, as reported by the stakeholders, included a lack of financial resources (30%) and a lack of coordination among stakeholders (25%). 20% of the participants pointed to insufficient urban planning as a major obstacle (Table 9).

Table 9. Main barriers to infrastructure development

Main Barrier	Count
Lack of financial resources	6
Lack of coordination among stakeholders	5
Lack of proper urban planning	4
Rapid population growth	3
Agricultural land degradation	2

4.2.4 Environmental impact

Regarding the environmental impact, 40% of stakeholders identified increased pollution as a significant consequence of urban sprawl. Additionally, 25% mentioned the loss of green spaces as a critical issue, while 30% highlighted air quality deterioration (Table 10).

Table 10. Environmental impact of urban sprawl

Environmental Impact	Count
Increased pollution	8
Loss of green spaces	5
Changes in air quality	6

4.2.5 Effectiveness of policies and solutions

When asked about the adequacy of policies for managing urban expansion, 35% of stakeholders stated that the policies were insufficient, while 25% believed there were no sufficient policies in place. For reducing unregulated sprawl, the majority recommended improving urban planning (30%) and raising public awareness (25%) (Tables 11 and 12).

Table 11. Effectiveness of urban management policies

Policy Sufficiency	Count
Insufficient	7
No	5
Don’t know	4
Yes	3

Table 12. Proposed strategies to reduce unregulated sprawl

Strategy	Count
Improving urban planning	6
Raising public awareness of the impacts	5
Promoting modern technology	4
Strengthening land use regulations	3

4.2.6 Use of GIS and remote sensing

Finally, the stakeholders acknowledged the potential of GIS and remote sensing technologies, with 40% stating these tools

would be highly effective in improving urban planning processes, while 30% believed they would be effective (Table 13).

Table 13. Effectiveness of GIS and remote sensing

GIS and Remote Sensing Effectiveness	Count
Highly effective	8
Effective	6
Don't know	5
Ineffective	1

4.2.7 Factor analysis results

The factor analysis extracted five key factors from the household survey data. These factors represent underlying patterns across various variables, helping to simplify the complex data. Below is the detailed table showing the loadings of the variables onto each factor (Table 14, Figure 3).

Table 14. Factor loadings

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Gender	-0.057	0.015	0.107	0.017	0.108
Age	0.015	-0.056	-0.121	0.230	-0.099
Household Size	-0.035	-0.004	-0.245	0.068	0.033
Education Level	-0.239	0.165	0.066	0.074	0.092
Occupation	0.090	-0.375	0.130	-0.233	0.146
Residence Duration	-0.008	-0.125	0.220	0.070	-0.164
Housing Type	0.180	-0.381	-0.091	0.086	0.003
Housing Condition	-0.169	-0.038	-0.060	0.067	-0.183
Water Access	-0.001	-0.038	0.026	0.007	0.025
Electricity Access	0.041	0.042	-0.118	0.012	0.134
Sewage Access	0.049	-0.032	0.045	0.021	0.010
Paved Roads	0.031	-0.069	0.089	0.055	0.007
Public Transportation	0.047	-0.047	0.092	-0.004	-0.032
Healthcare Availability	-0.008	-0.019	0.014	-0.022	-0.018
Education Availability	0.009	-0.026	0.020	0.046	0.052
Waste Collection	-0.029	-0.014	-0.009	0.034	-0.006
Feeling Safe	-0.034	-0.077	-0.009	0.087	-0.037
Waste Collection Frequency	-0.252	0.022	-0.155	-0.013	0.029
Green Spaces	-0.111	0.147	0.078	-0.035	-0.145
Air Quality Impact	-0.010	0.019	0.229	-0.153	-0.164
Environmental Hazards	0.003	-0.050	0.042	0.017	-0.037
Public Services Impact	-0.038	-0.013	0.173	-0.042	-0.106
Job Opportunities	0.001	-0.106	-0.015	-0.051	-0.060
Quality of Life	-0.092	-0.055	0.332	-0.044	0.173
Main Challenges	-0.566	-0.089	-0.040	0.477	-0.118
Priority for Improvement	-0.605	-0.384	-0.298	-0.277	0.156

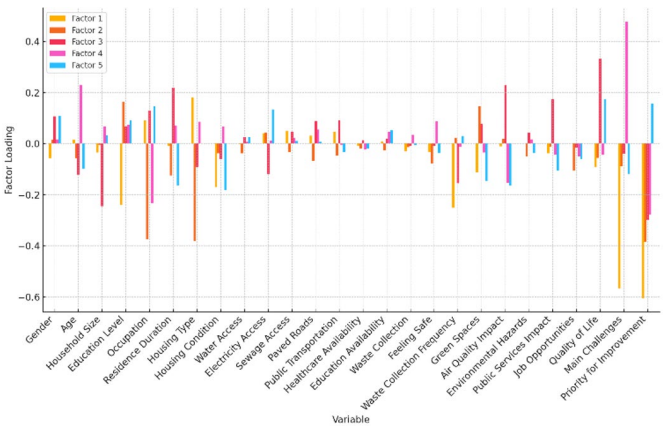

Figure 3. Factor loadings for household survey

4.2.8 Predicting household satisfaction (quality of life)

We conducted a linear regression using the extracted factors to predict household satisfaction, which was measured using the "Quality of Life" variable. The regression model revealed that Factor 3 and Factor 5 have the most substantial positive influence on household satisfaction, while Factor 1 and Factor 2 have negative effects (Table 15).

Table 15. Regression coefficients for predicting quality of life

Factor	Coefficient
Factor 1	-0.174
Factor 2	-0.131
Factor 3	0.753
Factor 4	-0.091
Factor 5	0.454

4.2.9 Sample of predicted household satisfaction

Using the regression model, we predicted household satisfaction for all respondents. Below is a sample of the predicted values compared with the actual values for quality of life (Table 16).

Table 16. Predicted vs. actual quality of life

Actual Quality of Life	Predicted Quality of Life
0	1.05
2	2.16
3	1.77
3	1.87
3	0.78

4.2.10 Factor analysis results for stakeholders

The factor analysis performed on the stakeholder survey data extracted five key factors that represent the underlying patterns across the variables. These factors simplify the interpretation of stakeholder responses regarding the challenges and solutions related to urban sprawl in Al-Dora, Baghdad. Below is a detailed table showing the loadings of each variable onto the five extracted factors (Table 17, Figure 4).

Table 17. Factor loadings for stakeholder survey

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Job Title	-0.331	-0.977	0.860	0.126	0.116
Years of Experience	1.030	0.165	0.139	0.089	0.102
Participation in Urban Planning	-0.131	-0.040	0.198	0.015	0.059
Water Supply Impact	-0.329	0.230	-0.227	0.628	0.273
Electricity Impact	0.431	-0.417	-0.197	-0.562	0.104
Sanitation Impact	-0.272	0.354	-0.288	-0.052	-0.339
Public Transportation Impact	-0.069	0.039	-0.333	0.577	0.387
Healthcare Services Impact	-0.233	0.219	0.376	0.688	-0.414
Main Barriers	-0.262	0.845	0.336	0.164	0.455
Environmental Impact	0.651	-0.634	0.202	0.026	-0.123
Sufficient Policies for Land Use	0.289	-0.768	-0.627	0.245	-0.047
Effective Strategies for Reducing	-0.111	0.195	-0.499	0.165	0.369
GIS and Remote Sensing Effectiveness	0.488	0.220	0.090	0.049	-0.580

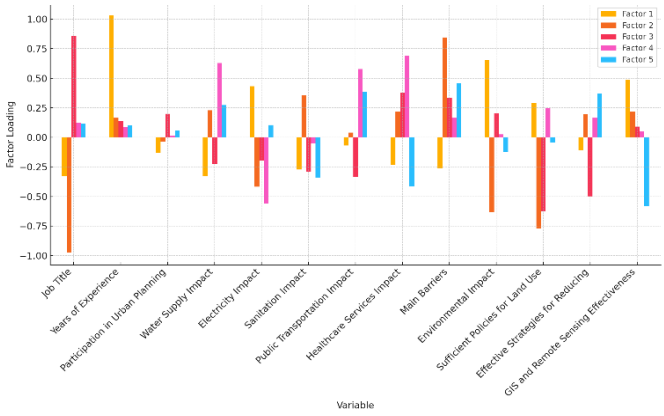

Figure 4. Factor loadings for stakeholder survey

4.2.11 Predicting stakeholder satisfaction

To predict stakeholder satisfaction or agreement with urban planning outcomes, we can use factor scores generated from this factor analysis and perform a regression analysis. By understanding which factors most strongly influence satisfaction, urban planners can prioritize solutions more effectively (Table 18).

A regression analysis was conducted to predict stakeholder satisfaction using the five factors extracted from the stakeholder survey data. The variable "Main Barriers" was used as a proxy for stakeholder satisfaction, reflecting how stakeholders perceive the challenges and barriers to addressing urban sprawl.

Using the regression model, we predicted stakeholder satisfaction for all respondents. Below Table 19 is a sample of the predicted values compared with the actual satisfaction levels.

Table 18. Regression coefficients for predicting stakeholder satisfaction

Factor	Coefficient
Factor 1	-0.274
Factor 2	0.911
Factor 3	0.377
Factor 4	0.198
Factor 5	0.603

Table 19. Predicted vs. actual stakeholder satisfaction

Actual Satisfaction (Main Barriers)	Predicted Satisfaction
1	-0.14
2	2.61
3	2.07
1	2.01
2	2.18

5. DISCUSSION

The findings from this study provide important implications for the uncontrolled expansion in Baghdad, especially in Al-Dora district Where limited public services and deteriorating environmental conditions are evaluated for their impact on residents' quality of life. The results largely support the research objectives of studying unplanned urban growth on infrastructure and public services, making these systems more resilient in order to master future rapid change by identifying inhibitors or promoters faced from the perspective of local stakeholders. This group will discuss these results with reference to the wider research literature and pose potential avenues for action.

5.1 Enhancing infrastructure for community resilience

The findings underscore the critical need for a structured approach to urban infrastructure, particularly in areas with significant informal growth, such as Al-Dora. Table 3 highlights that 35% of households report frequent water supply interruptions, while 28% report issues with electricity access, emphasizing the gaps in essential services. These results reflect a broader issue where the unmanaged urban sprawl stretches existing services beyond capacity, leading to frequent disruptions and low service quality. Such patterns echo the principles of Sustainable Development Goal (SDG) 11, which advocates for resilient and inclusive cities by ensuring access to reliable infrastructure and services. Addressing these infrastructure deficiencies through sustainable urban planning would not only enhance service delivery but also increase resilience, enabling communities to adapt better to future growth pressures.

5.2 Impact on public services and infrastructure

The survey results show that the uncontrolled expansion of Baghdad has severely impacted essential public services. For households, frequent disruptions in the supply of water and electricity were reported, alongside insufficient access to healthcare services (40%). This reflects the city's inability to meet the demands of a rapidly growing population. Similar issues were highlighted by stakeholders, where 40% noted a deterioration in water supply and public transportation (Table 8). These findings are consistent with global research, which shows that urban sprawl often leads to the overstretching of municipal resources and a decline in service quality, especially in cities where infrastructure development fails to keep pace with population growth.

Moreover, the findings indicate that public services in informal settlements are especially insufficient, with only 45% of households reporting ownership of their homes and 23% living in unsafe housing conditions (Table 2). This demonstrates the vulnerability of residents in unregulated areas, where infrastructure is not only underdeveloped but also poorly maintained. Addressing these infrastructural deficiencies is critical, as they directly affect residents' daily lives and overall well-being.

5.3 Environmental and social consequences

Urban sprawl has also caused severe environmental degradation in Baghdad. The survey revealed that 60% of households reported the complete loss of green spaces in their neighborhoods, and 45% noted a significant deterioration in air quality (Table 4). These environmental issues are exacerbated by unregulated construction, which replaces agricultural land with informal settlements, leading to increased pollution and flooding hazards. Stakeholders echoed these concerns, with 40% identifying increased pollution and 30% highlighting the worsening air quality (Table 10). This mirrors findings from other regions, where urban sprawl has been linked to environmental degradation, contributing to rising temperatures and the urban heat island effect.

Socially, the strain on public services and environmental

degradation has led to a measurable decline in the quality of life for many residents. As 30% of households reported, their quality of life has worsened due to the negative effects of urban sprawl (Table 5). This underscores the need for an integrated approach to urban planning that not only improves infrastructure but also protects the environment and enhances livability in rapidly growing urban areas.

5.4 Environmental preservation and sustainable land use policies

The findings indicate extreme environmental difficulties associated with unplanned urban growth in Al-Dora, particularly the reduced availability of green areas and the loss of farmland which adversely affect local food security and ecosystem sustaining process. Table 4 clearly shows that while almost two-thirds of the households indicated a complete loss of green spaces in their surroundings, around forty-five percent of these likewise reported significant reduction in air quality. This pressure on the environment is in accordance with global perspective of sustainable land use and resource conservation as mentioned under SDG 15. Focused on policies to prevent the loss of current farmland and green area through land-use policies, illustrates further strategies that attempt to balance urbanization with environmental interests for long-term sustainability.

In addition, stakeholders mentioned increasing pollution and air quality impact rates as one of the top three negative impacts of urban sprawl (40% significant impacts for pollution and 30% worsening air quality) (Table 10). This has significant implications to support resilient urbanization in Al-Dora, where sustainable land use regulation and environmental management practices can protect the remaining natural capital. For those reasons, we must protect agricultural lands from further encroachment not only to preserve ecological balance but also to enhance current and future quality of life.

5.5 The social impact and quality of life in Al-Dora

The results highlight the ramifications of unregulated urban expansion for Al-Dora inhabitants' well-being through restricted access to basic services and overcrowding infrastructure. In the household survey, only 45% of respondents stated that they have reliable access to health care and 35% indicated low levels of satisfaction with availability of public services. Such deficiencies can lead to social fragmentation and weaken the community's capacity to cope with the changing realities of ongoing urban growth.

This makes it all the more urgent that we better our infrastructure and spread access to critical services—not just for the sake of quality of life, but to lay down a cohesive foundation that can weather future crises together. Compatible with SDG 11, which focuses on sustainable and inclusive urbanization, this paper promotes a social-based development concept. A stronger Al-Dora, with a more supportive umbrella of public services designed to address future urban pressures and sustain social stability, is not only better equipped to withstand future shocks but also contributes to a more sustainable urban environment for greater Baghdad.

Improved coordination of various government departments in implementing these recommendations is another significant hurdle. In conjunction with this, when surveyed 1 in 4 stakeholders pointed to weak inter-agency collaboration as one of their top three challenges, the institutional fragmentation inhibits holistic urban governance. Urban planning can only be effective if the strategies are interwoven across sectors, such as housing, transport and environment. However, with no coherent framework, addressing uncontrolled urban sprawl and service delivery is slow and cost-ineffective. These coordination gaps should be addressed; it must have an agile urban governance model to adapt to the continuous growth and emerging needs of cities like Baghdad.

6. RECOMMENDATIONS

Based on the results, where it was clear that urban sprawl has caused a strain on public services, infrastructure, and environmental resources, and the discussion of the key challenges faced by the city's institutions in addressing these issues, the following detailed recommendations are proposed:

1) Al-Dora is faced with unregulated urban sprawl, where agricultural land has been transformed into informal settlements. For this, a remote sensing and GIS based centralized monitoring system need to be established. One approach is a regular analysis of satellite data to monitor changes in land use and GIS can help identify areas with the greatest potential threat. The Baghdad Municipality can partner with the Ministry of Planning to use this system, and report regularly for policy guidance Ground-truthing Ground truth measurements can be utilized to validate satellite data for the precision monitoring. The effort will help city officials identify where intervention is most necessary.
2) The study concludes that GIS and remote sensing technologies should be implemented as key resources for urban sprawl-related analysis in terms of its environmental consequences. Through systematic monitoring of satellite imagery for differences in land use, urban planners and services can accurately monitor transitions on the ground, enabling detection of areas at risk of encroachment before it is too late. This makes it possible for effective interventions, leading to sustainable land use practices and significantly alleviating pressures on vital resources. This technological monitoring supports the broader sustainable urban development goals of SDG 11, which calls for proactive and resilient cities that can adapt to rapid changes in the shape of urban landscapes. Moreover, protecting green space and agricultural land from uncontrolled urban growth advances SDG 15 on conserving terrestrial ecosystems. Deploying such technologies not only contributes to upholding the ecological integrity of Al-Dora, but also strengthens urban resilience with evidence-based planning decisions that focus on sustainable growth. Such systematic use of GIS and remote sensing is an essential basis for sustainable long-term urban management that makes certain the external growth of Al-Dora does not undermine its environmental and social viability.
3) Weak governmental coordination is one of the most significant obstacles to improved urban management. A coordination council needs to be set in place that would include delegates from municipalities, the Ministry of Housing and Construction and the Ministry of Environment. The council would

convene at regular intervals to consult on the progress regarding urban expansion activities, with a view towards coordinating and maintaining coherence in implementing notions of urban planning. The council also would be charged with making sure new land-use regulations designed to curb sprawl are enforced. Operationalize: Monthly cross-agency meetings and a common digital platform for communication in real time.

4) One of the most important problems associated with sprawl is that it has led to a reduction in agricultural lands, which poses an environmental threat as well as a food security challenge in Baghdad. This can only be known through implementing regulations preventing the informal construction of agricultural land. Such laws should have sanctions in case of breaching, and other measures as incentives to keep on producing agricultural commodities. Public infra cannot be any weaker than what it is in informal settlements that need this regulation like none other. A field team should be established to patrol these areas and ensure compliance as another part of enhanced governance mechanisms.
5) Infrastructure development that meets even long-term sustainability goals: The current infrastructure needs of Al-Dora, be it water, electricity, and transportation are foundational components to efficient urbanization that can accommodate both the existing and new residents of a city. Such an approach not only allows for consistent and equitable access to basic services but also enhances the community resilience against the challenges of rapid urbanization. The recommendations seek to reinforce these essential systems so that cities can be transformational, inclusive, and resilient by hitting the targets of SDG 11. Additionally, improving these infrastructures from an efficiency and sustainability perspective could considerably alleviate the pressure on such natural resources. The city can relieve the pressure on water and energy by implementing modern, resource-efficient infrastructure designs, resulting in a more sustainable urban ecosystem. It narrows the gap with SDG 15, which calls for the protection and sustainable management of land resources. Hence, a sustainable infrastructure agenda not only satisfies the current necessities of its people living in Al-Dora but also enshrines conservation values into the strategic framework appropriate to all urban plot developments without undermining the core ecological basis of any major city.
6) Living conditions in informal settlements: Lack of water, electricity and sanitation facilities Designating areas for sustainable urban growth land uses will require zoning regulations in the future to allow integrated infrastructure planning associated with greenfield developments. These zones need to be placed where infrastructure is not maxed out servicing existing population. Stakeholders said urban planning should be improved; this aligns well with the recommendation here. The transport links run through green spaces, which will create conurbations to add more zones in both land use and with environmental change. It attacks both short-term infrastructural needs and fosters long-term sustainable growth.
7) One of the important points that emerged in these results is that unfortunately, no awareness about urban sprawl which is a problem lately living public. Even in informal settlements, most households weren't happy with the basics that the government provides—and very few were making a connection between uncontrolled growth and weakened service quality. To combat this, prairie cities must lead with aggressive city-wide public awareness campaigns to educate the masses on both the sad ecological and societal implications of unchecked sprawl as well as the benefits of following new land-use policies. The rollout for a campaign such as this, on the other hand, would be through social media and local TV ad spots in cahoots with non-governmental organizations and environmental activists.

7. CONCLUSION

The research results presented have some indirect implications for the environmental and land use issues, especially regarding uncontrolled urban sprawl on public services and life conditions in Baghdad more specifically within Al-Dora subdistrict. The natural extension of informal settlements and their push onto agricultural lands has overburdened existing public infrastructure, mainly water supply, electricity as well healthcare. The challenges have further been compounded by institutional and governance issues, necessitating the demand for proper urban planning coordination from all sides of households and stakeholders.

The household survey results demonstrate the daily tribulations residents suffer because of inadequate service provision, and the stakeholder survey also revealed structural problems in urban governance. Factor analysis identified underlying themes, including the need to improve public service delivery and tackle deficient infrastructural levels that were crucial for both resident satisfaction as well as decision-maker outlook.

A number of policy recommendations have arisen to counteract the harm of unregulated growth. It is a matter of overcoming institutional hurdles by enhancing cooperation and harmonizing land-use laws, relying on contemporary technology such as GIS & remote sensing for better urban planning; emphasising environmental elements to safeguard natural green areas whilst reducing pollution.

This will only further decrease liveability in Baghdad, undermining the ecological and infrastructural sustainability of this city unless an immediate intervention is done. The findings highlighted in this study underscore the importance of implementing transformative technological solutions, good governance and sustainable development to provide more holistic urban planning reforms for Baghdad's future balance growth.

REFERENCES

[1] Kadhim, A.A., Abbas, L.Z. (2021). Unplanned urbanization and agricultural land degradation in Baghdad city from 2003 to 2017. Journal of the College of Education for Women, 32(1): 1-17. https://doi.org/10.36231/coedw.v32i1.1474

[2] Repeva, A. (2021). Informal settlements in Baghdad city. E3S Web of Conferences, 263: 05001. https://doi.org/10.1051/e3sconf/202126305001

[3] Hatem Nawar, A., Adnan Saed, A., Noori Hammoodi, S. (2023). Sprawl of residential slums on agricultural land in city of Baghdad. In VII. International Scientific Congressof Pure, Appliedandtechnological Sciences, pp. 395-404. https://doi.org/10.47832/MinarCongress7-29

[4] Al-Hameedi, W.M.M., Chen, J., Faichia, C., Al-Shaibah, B., Nath, B., Kafy, A.A., Al-Aizari, A. (2021). Remote sensing-based urban sprawl modeling using multilayer perceptron neural network Markov chain in Baghdad, Iraq. Remote Sensing, 13(20): 4034. https://doi.org/10.3390/rs13204034

[5] Abbas, A.A., Hussein, S.H. (2024). Unveiling Baghdad's urban identity: A comprehensive study on the dynamics of urban imprint. Academia Open, 9(2). https://doi.org/10.21070/acopen.9.2024.8238

[6] Mohsin, M.M., Beach, T., Kwan, A. (2020). Consensus-based urban sustainability framework for Iraqi cities: A case study in Baghdad. Heliyon, 6(12): e05348. https://doi.org/10.1016/j.heliyon.2020.e05348

[7] Ahmed, S.M., Al-Ramahi, F.K.M. (2022). Evaluate the effect of relative humidity in the atmosphere of Baghdad City urban expansion using remote sensing data. Iraqi Journal of Science, 2022: 1848-1859. https://doi.org/10.24996/ijs.2022.63.4.41

[8] Gielen, E., Riutort-Mayol, G., Miralles I Garcia, J.L., Palencia Jimenez, J.S. (2021). Cost assessment of urban sprawl on municipal services using hierarchical regression. Environment and Planning B: Urban Analytics and City Science, 48(2): 280-297. https://doi.org/10.1177/2399808319869345

[9] Ida, T., Ono, H. (2019). Urban sprawl and local public service costs in Japan. Advances in Local Public Economics: Theoretical and Empirical Studies, 37: 195-215. https://doi.org/10.1007/978-981-13-3107-7_11

[10] Cappelli, F., Guastella, G., Pareglio, S. (2021). Urban sprawl and air quality in European cities: An empirical assessment. Aestimum, 78: 35-59. https://doi.org/10.2139/ssrn.3807084

[11] Shao, Z., Sumari, N.S., Portnov, A., Ujoh, F., Musakwa, W., Mandela, P.J. (2021). Urban sprawl and its impact on sustainable urban development: A combination of remote sensing and social media data. Geo-Spatial Information Science, 24(2): 241-255. https://doi.org/10.1080/10095020.2020.1787800

[12] Ali, N.M., Ebraheem, A.K., Ebraheem, M.A., Laffta, S.J. (2020). Environmental assessment of land use in the city of Samawah using spatial techniques. In IOP Conference Series: Materials Science and Engineering, 737(1): 012240. https://doi.org/10.1088/1757-899X/737/1/012240

[13] Tini, N.H., Light, B.J. (2020). Impacts of urban sprawl on livability in Kaduna Metropolis, Nigeria. International Journal of Scientific Research in Science and Technology, 7(6): 334-343. https://doi.org/10.32628/IJSRST207644

[14] Obaid, Z.A., Ibrahim, A.K. (2024). Enhancing security and reducing crime by relying on spatial planning. AIP Conference Proceedings, 3105(1): 050097. https://doi.org/10.1063/5.0212914

[15] Bidandi, F. (2018). The city as an experimental space: The interface between public satisfaction and effects on urban planning resulting from Kampala city's sprawl. Urban Agglomeration, 5: 107-131. https://doi.org/10.5772/intechopen.72186

[16] Al-Hussaini, Z.I.H., Jassim, A.H., Alkinani, A.S. (2023). The 20 minutes neighborhood between planning and reality: Analytical study of Al-Jumhuriya district (District 838 and Part of District 840). Civil Engineering and Architecture, 11(2): 696-713. https://doi.org/10.13189/cea.2023.110212

[17] Ismael, N.T., Yas, S.M., Hussain, A.H.A. (2022). Impact of migration resulting from ethnic and racial armed conflicts on accelerating urban sprawl. International Journal of Design & Nature and Ecodynamics, 17(3): 353-358. https://doi.org/10.18280/ijdne.170304

[18] Alkinani, A.S., Al-Hussaini, Z.I.H., Alzaidi, M.M.K. (2022). Cities' urban resilience in the face of urban sprawl challenges. Acta Scientiarum Polonorum Administratio Locorum, 21(3): 295-319. https://doi.org/10.31648/aspal.7508

[19] Abdeljawad, N., Nagy, I. (2023). Evaluation urban land use related policies to reduce urban sprawl environmental consequences in Amman City-Jordan compared with other two cities. WSEAS Transactions on Environment and Development, 19: 119-137. https://doi.org/10.37394/232015.2023.19.11

[20] Mehriar, M., Masoumi, H., Mohino, I. (2020). Urban sprawl, socioeconomic features, and travel patterns in middle east countries: A case study in Iran. Sustainability, 12(22): 9620. https://doi.org/10.3390/su12229620

[21] Masoumi, H.E., Hosseini, M., Gouda, A.A. (2018). Drivers of urban sprawl in two large Middle-Eastern countries: Literature on Iran and Egypt. Human Geographies: Journal of Studies & Research in Human Geography, 12(1): 55-79. https://doi.org/10.5719/hgeo.2018.121.4