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Geographical analysis of traffic congestion in the city of Kufa

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Abstract

Traffic congestion is one of the major urban problems affecting the quality of life, mobility, and economic productivity in cities. Kufa, a historic and rapidly growing city in Iraq, has witnessed increasing levels of traffic congestion due to population growth, urban expansion, and limited infrastructure capacity. This study aims to analyze the spatial and temporal patterns of traffic congestion in Kufa through a geographical approach. Geographic Information Systems (GIS), spatial analysis, and field surveys were employed to identify congestion hotspots, assess the role of infrastructure, and examine socio-economic factors influencing mobility. The results revealed significant congestion zones at Imam Ali Bridge, the entrance of Maysan neighborhood, near Al-Sahla Mosque, Al-Najaf–Kufa road from Ibn Bilal Hospital to the University of Kufa, near Kufa Mosque, Al-Jisr Street, Al-Sikka Street, and the beginning of Al-Matar Street. Congestion was strongly associated with population density, institutional concentration, and commercial activity. The study concludes with practical recommendations to improve traffic management, including enhancing public transportation, optimizing road networks, and integrating sustainable mobility strategies.

Keywords: Traffic congestion, Kufa city, GIS, spatial analysis, urban mobility

Introduction

Traffic congestion represents a critical challenge for modern cities, as it reduces mobility efficiency, increases travel time, elevates fuel consumption, and contributes to environmental pollution: ^[1]. In cities such as Kufa, the problem is exacerbated by rapid urbanization, inadequate road capacity, and the concentration of socio-economic activities in specific zones. Spatial analysis provides a powerful tool for understanding traffic dynamics by identifying spatial and temporal patterns of congestion, linking them to urban form, and proposing solutions. Previous studies across global, regional, and local contexts have shown the effectiveness of GIS-based approaches in analyzing traffic flows, predicting congestion hotspots, and planning for sustainable transportation.

Despite this, there is limited research focusing on the city of Kufa, where traffic congestion has intensified in recent years: ^[2]. The importance of this study lies in addressing this gap through a comprehensive geographical analysis. The main objectives of the research are:

1. To identify spatial and temporal factors contributing to traffic congestion in Kufa.
2. To analyze the spatial distribution of congestion across the city.
3. To propose practical solutions for decision-makers and urban planners:^[3, 6]

Methodology

Study Area: The study focuses on Kufa, located in Najaf Governorate, Iraq. The city has historical, religious, and educational importance, attracting large numbers of residents, students, and visitors. Its population growth, combined with limited transport infrastructure, creates significant mobility challenges.

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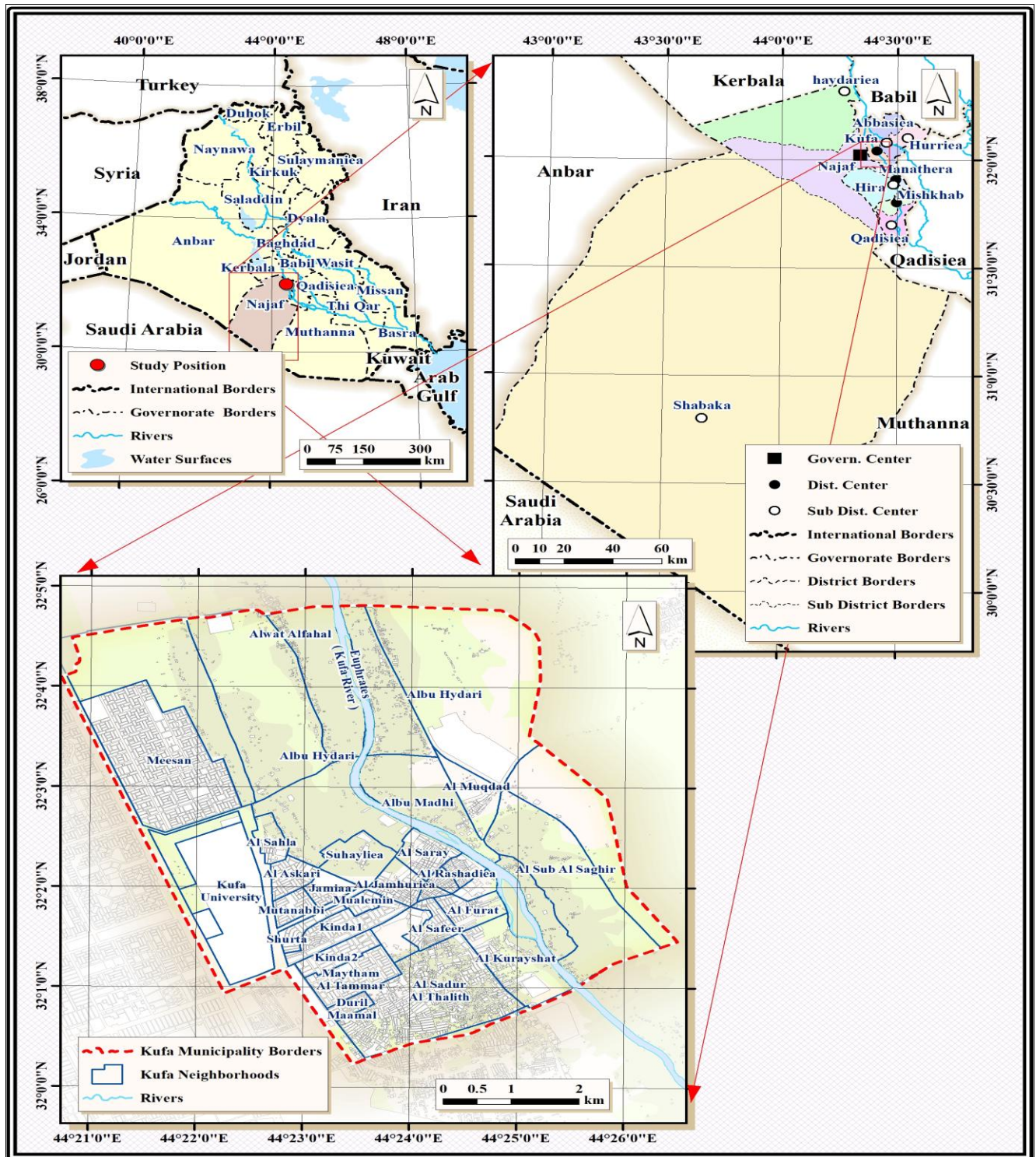


Fig 1: Study Area

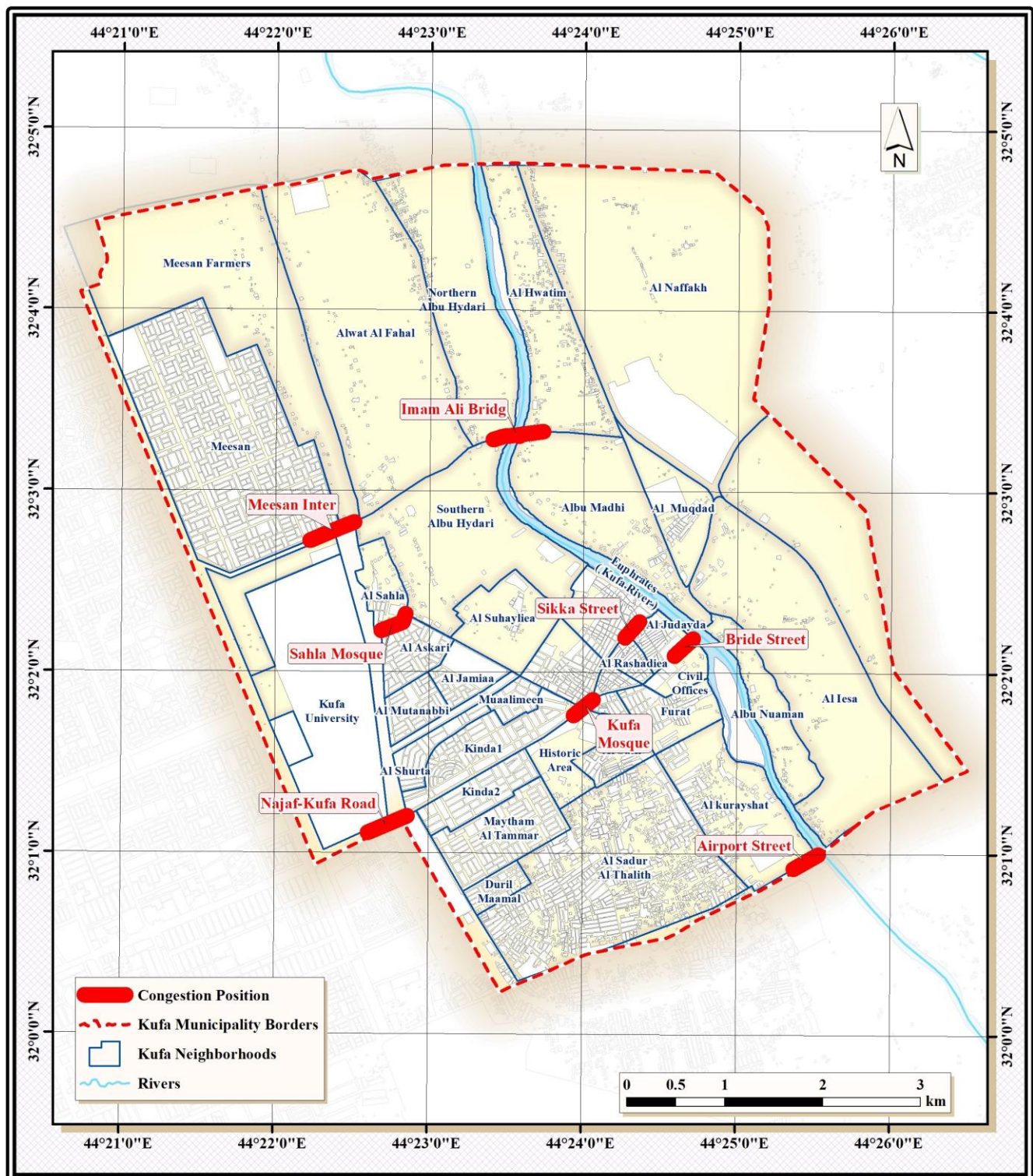


Fig 2: Traffic jam location

Data Sources

- Traffic data: number of vehicles, peak hours, and traffic volume surveys.
- Infrastructure data: road networks, bridges, intersections, and parking facilities.
- Field surveys and questionnaires: conducted to capture travel behavior and perceptions of traffic problems.

Tools and Techniques

- **Geographic Information Systems (GIS):** Used for mapping and spatial data integration.
- **Spatial analysis techniques:** Including Kernel Density

Estimation (KDE) and Network Analyst for traffic flow modeling.

- **Statistical analysis:** To identify correlations between congestion and socio-economic variables.

Procedures

- Data collection from official records and field surveys.
- Spatial mapping of congestion hotspots.
- Density analysis to visualize intensity and distribution.
- Comparative analysis across different zones.
- Interpretation of results in light of socio-economic and infrastructural conditions

Results

The table below presents the main locations in Kufa city affected by traffic congestion and identifies the primary causes contributing to the problem in each area. The data were collected through field observation and spatial analysis

to determine the main sources of congestion within the urban network. Results indicate that congestion is primarily caused by high traffic volume, limited road width, commercial and religious activities, and inadequate traffic control measures.

Table 1: Main Locations and Causes of Traffic Congestion in Kufa City

S. No.	Location	Congestion Cause
1	Imam Ali Bridge	Connector bridge, high traffic volume
2	Entrance of the Maysan neighborhood	Residential inflow, narrow road capacity
3	Near Al-Sahla Mosque	Religious gatherings
4	Al-Najaf–Kufa Road (Ibn Bilal Hospital to University of Kufa)	Commuter corridor for students and staff
5	Near Kufa Mosque	Pedestrian and vehicular activity during prayer times
6	Al-Jisr Street	Commercial activity, limited width
7	Al-Sikka Street	Local markets, residential traffic
8	Beginning of Al-Matar Street	Traffic inflow, insufficient regulation

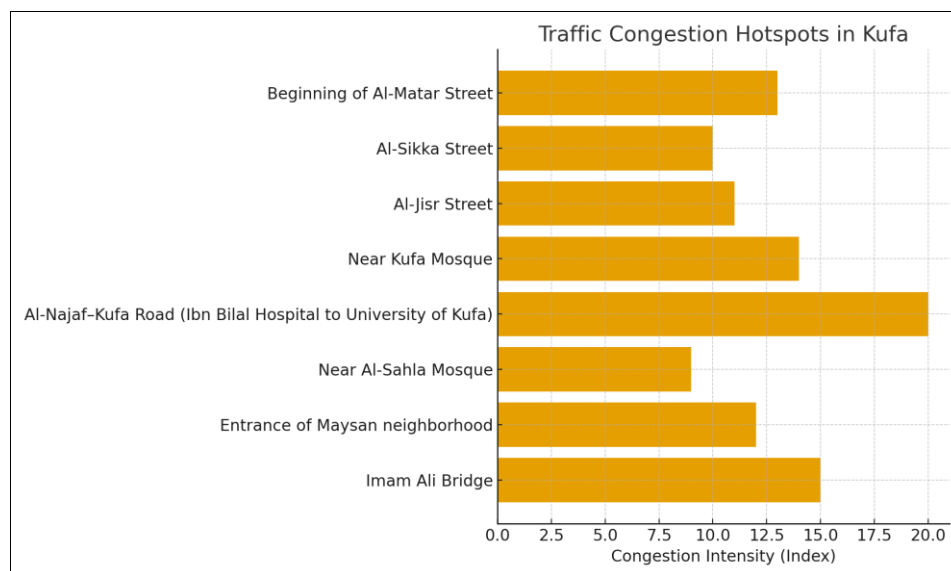


Fig 4: Traffic Congestion Hotspots in Kufa

5. Discussion

1. Functional Causes

The highest congestion levels occur near religious sites, where daily and seasonal pilgrimages significantly increase traffic volumes. Commercial areas such as Sikka Street experience regular congestion due to on-street parking and narrow road sections.

2. Spatial Structure

The absence of ring roads or secondary connectors forces all traffic to pass through the central network. The radial structure limits movement flexibility and increases pressure on the main arteries.

3. Infrastructure Limitations

Road and intersection geometry do not meet the existing traffic demand. Further compounding the above problem is the absence of (ITS) and public transportation facilities.

4. Environmental Impact

Long-term congestion leads to air and noise pollution, especially around religious areas. This creates less pure air and is a difficult to cross obstacle for the pedestrian ^[6-10].

6. Recommendations

- **Build alternative routes:** Construct a ring or bypass

road around the city to divert traffic.

- **Improve intersections:** Modernize Imam Ali Bridge and Meesan Intersection to increase flow capacity.
- **Smart traffic management:** Use the adaptive signal systems and surveillance cameras.
- **Public transportation enhancement:** Offer shuttle buses to and from parking areas, religious centers, and business districts.
- **Parking System:** Implement a formalized parking lot system close to Sahla and Kufa Mosques.
- **Regulation:** Ban lorries from the city centre during peak hours.

7. Conclusion

The spatial analysis confirms that traffic jam in Kufa City is mainly concentrated at the main intersections and connecting roads between religious and residential regions. These issues of accessibility are compounded further by the present pattern of urban form and small road widths. If integrated urban transport strategies are not pursued, congestion will hamper the city economically and environmentally. "Kufa could be made so much better and sustainable in terms of mobility with a mix of new infrastructure development such as smart traffic systems and enhancing public transportation there.

Reference

1. Alkaissi ZA. Traffic congestion evaluation of urban streets based on GIS. *Journal of Urban Planning and Development*. 2024;150(1):04023034.
2. Al-Tamimi AH. Urban uses change: an analytical study of land use transformations in Kufa city. *International Journal of Urban Planning and Sustainable Development*. 2022;10(3):45-60.
3. Ali FA, Salman AD. Utilization of GIS to study the relationship between traffic congestion and land uses: an academic study of Al-Karrada city, Iraq. In: Karkush M, Choudhury D, Fattah M, editors. *Current Trends in Civil Engineering and Engineering Sciences 2024*. Vol 1. Springer; 2025. p. 392-404.
4. Ismail M. Spatial variation of traffic accidents recorded in the city of Al-Amirah, southern Iraq. *Genius Journal of Economics*. 2024;10(2):18-32.
5. Lateef IM. Analysis of traffic patterns between Karkh and Rusafa. *E3S Web of Conferences*. 2025;70:07005.
6. Mhana KH. Urbanization impact assessment on environment and traffic congestion: a comparative study. *Science of the Total Environment*. 2024;857:159166.
7. Mustafa Omer W, AL-Taei AKA. Traffic congestion in urban road networks using GIS technology. *International Journal of Engineering and Technology*. 2018;7(4):1-10.
8. Qasim Z. TransCAD analysis and GIS techniques to evaluate traffic congestion in urban areas. *MATEC Web of Conferences*. 2018;320:03029.
9. Salah Mahdi O, Ismail M, Asaad Resen M. Spatial variation of traffic accidents recorded in the city of Al-Amirah, southern Iraq. *Genius Journal of Economics*. 2024;10(2):18-32.
10. Zaid SA, Obaid HH. Antibacterial activity of synergistic effect of colicin and gold nanoparticles against *Pseudomonas aeruginosa*. *Iraqi Journal of Science*. 2017;58(2C):1-10.