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Research Article

Architectural Transformations and Planning Regulation Violations in Residential Housing Allotments: A GIS Approach in Zouaghi Slimane-Ain El Bey, Phase 2, Constantine (Algeria)

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Geographic Information Systems (GIS);
Zouaghi Slimane;
Constantine.

Abstract:

This paper investigates residential housing allotments in the city of Constantine, Algeria, with a particular focus on their compliance with urban planning regulations. The study adopts the urban residential area of Zouaghi Slimane, Ain El Bey, Phase 2, as a representative case study, as this subdivision is characterized by a high prevalence of urban planning violations committed by residents.The research aims to identify and analyze the various forms of urban violations, explore their underlying causes, and ultimately propose a set of recommendations to mitigate and limit the spread of such practices. Geographic Information Systems (GIS) are employed as the primary analytical tool, enabling the spatial identification, quantification, and visualization of violations. The findings highlight the effectiveness of GIS as a decision-support tool for urban control, monitoring, and sustainable urban management.

1. Introduction

Since gaining independence, Algeria has experienced a rapid and unprecedented urban expansion, characterized by the emergence of numerous new residential neighborhoods, both collective and individual. This accelerated urban growth necessitated the implementation of regulatory frameworks, among which housing allotments were adopted as a key urban planning instrument to organize land use and construction activities. Despite these measures, many allotments have gradually exhibited widespread non-compliance with urban planning regulations. Such violations are frequently caused by individual property owners and are especially common in cities of developing countries, where urban governance and monitoring mechanisms are often limited.

The city of Constantine, located in northeastern Algeria, exemplifies this phenomenon. Historically constrained by topographical features, the city has undergone multiple phases of urban expansion, from the limited urban zones before colonization to post-independence residential developments. The rapid population growth after independence, particularly during the 1970s and 1980s, led to the creation of new residential neighborhoods under the framework of housing allotments. Among these, the urban residential area of Zouaghi Slimane, and specifically the Ain El Bey Phase 2 allotment, stands out due to the high prevalence of urban planning violations. These include illegal building heights, encroachments on sidewalks and pathways, unauthorized changes in building function, and non-compliance with land coverage coefficients, which collectively disrupt the intended spatial harmony and urban order.

The selection of Ain El Bey Phase 2 as a case study is motivated by several factors. Firstly, the area exhibits a significant concentration of urban planning violations, providing a relevant empirical context for analysis. Secondly, comprehensive field data and cadastral information are available, enabling precise mapping and measurement of infractions. Thirdly, the authors' familiarity with the area allowed for direct field observation and interpretation, enhancing the accuracy and reliability of the study.

This study seeks to answer several interrelated questions: What is the legal and land tenure status of the Ain El Bey Phase 2 allotment, and to what extent does it comply with urban planning standards? How can Geographic Information Systems (GIS) be effectively used to identify, analyze, and visualize urban planning violations? Finally, what practical measures can be proposed to mitigate or prevent such violations in housing allotments, ensuring better adherence to planning regulations and promoting sustainable urban development?

The primary objective of this research is to provide a detailed assessment of the actual conditions within the Ain El Bey Phase 2 allotment, identifying and categorizing violations while analyzing their underlying causes. Utilizing GIS as a spatial diagnostic and decision-support tool, the study maps violations such as height exceedances, functional changes, encroachments on sidewalks and public pathways, and non-compliance with land utilization ratios. The integration of GIS allows for accurate visualization of spatial patterns, facilitating the identification of areas with high violation density and enabling the formulation of targeted corrective measures.

Ultimately, this research contributes to a broader understanding of the interplay between urban planning regulations, individual behaviors, and local governance. It highlights the challenges faced in ensuring compliance within rapidly expanding urban environments, particularly in the context of developing countries. The findings and proposed interventions such as the integration of GIS in monitoring, stricter law enforcement, enhanced inspection protocols, and community engagement aim to support decision-makers in promoting orderly, sustainable, and socially equitable urban development in Constantine and comparable urban contexts.

2. Methodology

To address the research questions and achieve the study objectives, a methodological approach combining theoretical and empirical analysis was adopted. The study begins by defining key concepts related to housing allotments, regulatory legislation, urban violations, and Geographic Information Systems.

Subsequently, the city of Constantine is presented, followed by a detailed description of the Zouaghi Slimane Phase 2 study area, progressing from a general to a specific scale of analysis.

Field surveys constituted a central component of the methodology, supported by a descriptive analytical approach. ArcGIS software was employed to create spatial layers and associated databases based on field observations. These layers enabled the production of thematic maps and graphical representations illustrating the spatial distribution of urban planning violations. Finally, a set of recommendations aimed at reducing or mitigating these violations was formulated based on the analytical results.

3. General Concepts

Housing Allotments: A housing allotment is defined as the subdivision of a large land property into plots of varying sizes intended for the construction of buildings dedicated to specific uses, such as residential, commercial, or industrial activities[(1)].

Regulatory Legislation: Regulatory legislation refers to a set of written legal rules issued by the competent public authority within the State, typically the legislative authority and, in certain cases, the executive authority[(2)].

Urban Planning Violations: Urban planning violations refer to any form of non-compliance within the urban environment, manifested through discrepancies between constructed buildings and applicable planning regulations. These violations may occur due to the absence of a building permit or despite the existence of such permits[(3)].

Urban Sanctions: Urban sanctions consist of enforcement and corrective measures undertaken by planning authorities against individuals responsible for urban planning violations[(4)].

Geographic Information Systems (GIS): Geographic Information Systems are computer based systems

designed to collect, store, manage, analyze, and display spatial data. They play a crucial role in urban planning, land management, environmental analysis, and decision making processes[5].

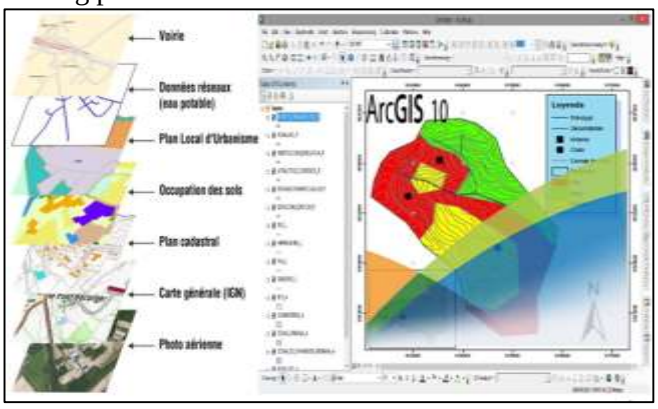

Figure 1: *The software used in Geographic Information Systems (GIS)*

4. Evolution of the Legislative Framework Governing Housing Allotments in Algeria

The legislative framework governing housing allotments in Algeria has evolved through three main phases[6]:

Pre-1974 Period: This phase was characterized by a limited number of laws and regulations governing the process of land subdivision.

Period between 1974 and 1990: This period marked a major turning point in the history of housing allotments, characterized by the adoption of key legislative instruments, including:

- Ordinance No. 74-26 related to land reserves.
- Law No. 82-02 concerning building permits and land subdivision permits.

Period from 1990 to the Present: This phase is marked by the enactment of several important laws, notably:

- Law No. 90-29 on urban planning and development, aimed at establishing conditions and rules for the use of developable land.
- Law No. 15-08 on land regularization, which defines procedures for the conformity and completion of buildings.

5. Presentation of the Study Area

5.1 Geographical Location of the City of Constantine

The city of Constantine is located in northeastern Algeria, approximately 134 km from the national capital and 512 km from the eastern border of the country. The city is characterized by steep slopes and rugged topography, with elevations ranging between 700 and 944 meters above sea level[7].

5.2 Urban Development of the City of Constantine

The urban development of Constantine has progressed through several historical phases. Prior to French colonization (before 1837), urbanization was limited to the Rock area. Following colonization, urban expansion extended beyond the city walls, leading to the development of new neighborhoods. After

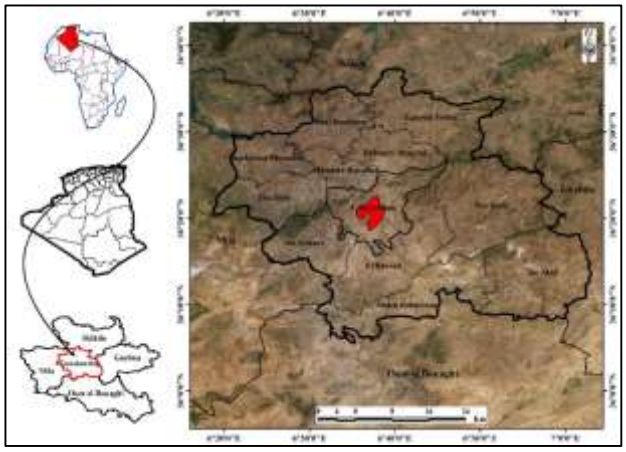

Figure 2: *Geographical location of the city of Constantine*

independence, the city experienced significant demographic growth, resulting in the implementation of three and four-year development plans during the 1970s, followed by the emergence of new urban residential areas during the 1980s and 1990s, including Zouaghi Slimane. Since 2000, urban expansion has intensified, particularly along major transportation corridors, especially toward the southern periphery[8].

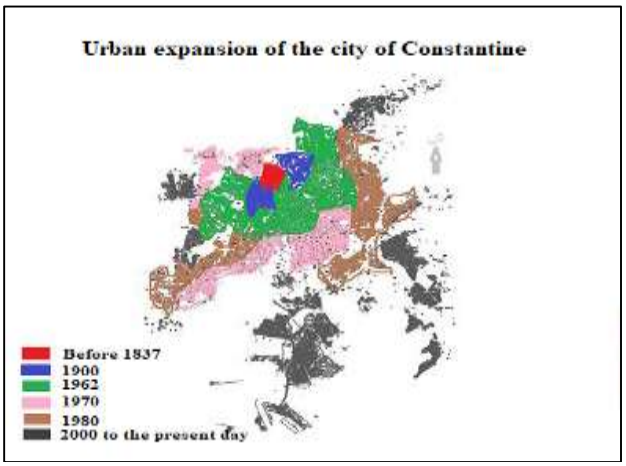

Figure 3: *Urban expansion of the city of Constantine*

5.3 Geographical Location and Emergence of the Study Area

The Zouaghi Slimane urban residential area is located in the southern part of Constantine and constitutes a major southern gateway to the city[9]. The Ain El Bey Phase 2 allotment is situated adjacent to the Faculty of Earth Sciences, Geography, and Urban Planning and along National Road No. 79 leading to Mohamed Boudiaf International Airport.This allotment was established under **Decree No. 91/176 dated May 28,**

1991, and is subject to a detailed **specifications document** that defines a set of regulatory conditions, including[10]:

- The allotment is authorized exclusively for **individual residential use**, and commercial activities are strictly prohibited.

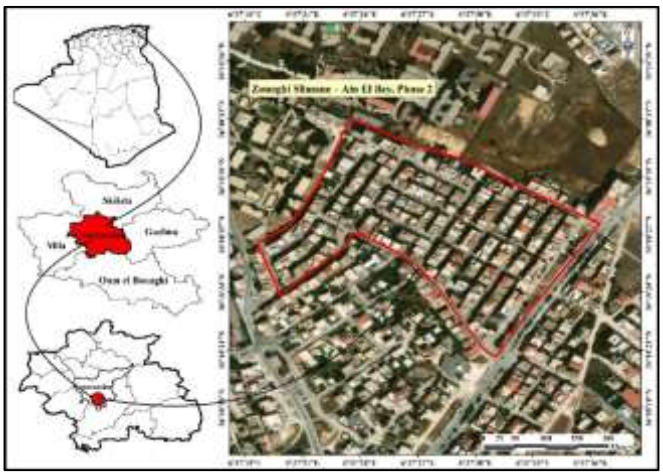

Figure 4: *Geographical location of the study area in the city of Constantine*

- **Setback distances** between neighboring plots must range from **2 to 4 meters**.
- **Street widths** must vary between **6 and 8 meters**, with **sidewalk widths** between **1.5 and 2.0 meters**.
- **Pedestrian pathways** are provided to facilitate movement and reduce the distance pedestrians must travel to access different parts of the residential area.
- Allocation of space for **parking areas** and **green spaces** is mandatory.
- For individual plots, the **maximum building height** must not exceed **11.5 meters**.
- The **Land Exploitation Coefficient (CES)** must range between **0.4 and 0.6**.
- The **Land Occupation Coefficient (COS)** must range between **0.8 and 1.2**.

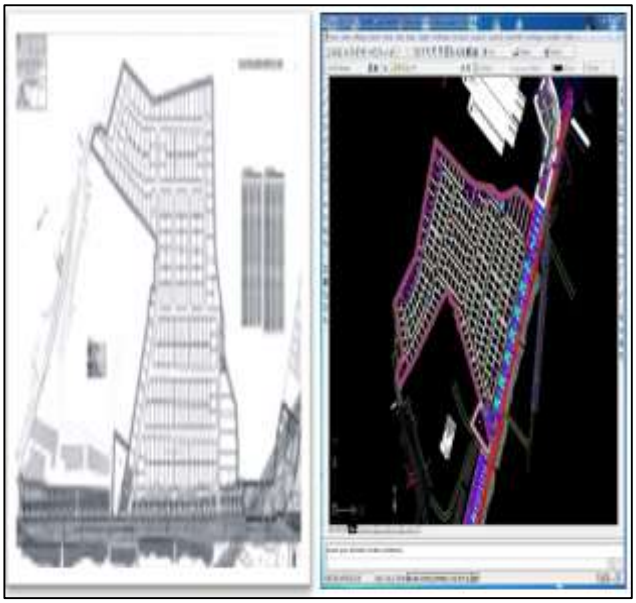

Figure 5: *The studied subdivision plan, scanned and digitized using ArcGIS*

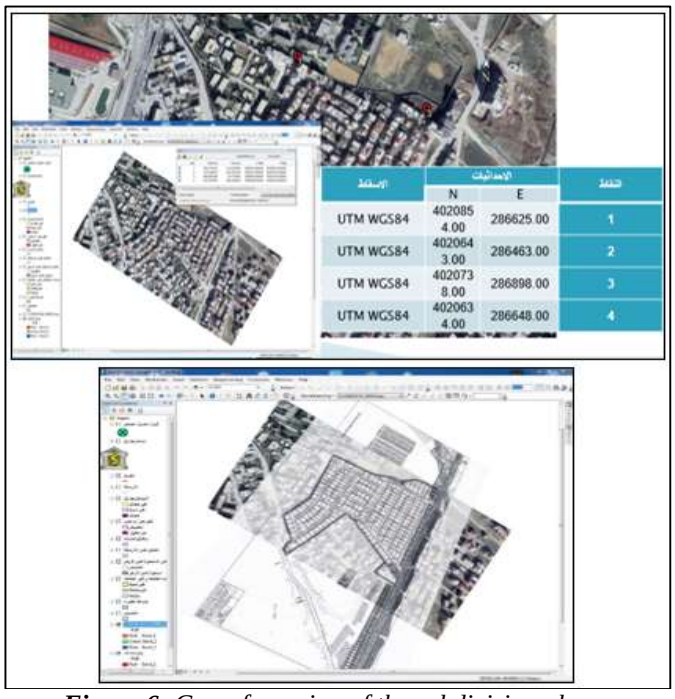

Figure 6: *Georeferencing of the subdivision plan*

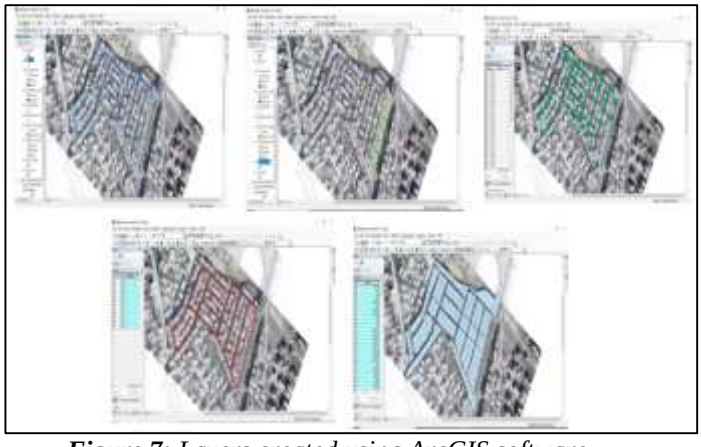

Figure 7: *Layers created using ArcGIS software*

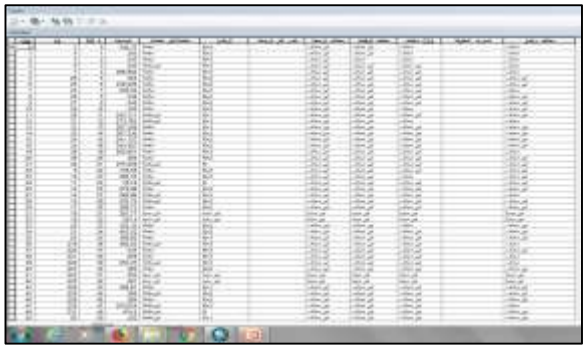

Figure 8: *Database of urban planning violations for the allotment created in ArcGIS*

6. Use of Geographic Information Systems (GIS) to Study the Zouaghi Slimane - Ain El Bey Phase 2 Allotment

- **Georeferencing**
  The subdivision plan was scanned and imported into GIS software for georeferencing, as illustrated in Figure 5.

The scanned plan was aligned using the georeferencing function in ArcGIS (Figure 6).

- **Digitization and GIS Mapping**

Six spatial layers were created within ArcGIS, each accompanied by its corresponding database, based on field surveys (Figures 7 and 8). These layers facilitated the generation of thematic maps highlighting various types of urban planning violations, which constitute the main focus of this study (Figures 9, 11, 13, 14, and 16).

7. Legal and Land Status and Compliance with Urban Standards

- **Building Height Violations**

The allotment comprises 242 plots, of which 226 are built and 16 remain vacant. Among the built plots, 58 buildings (24%) exceed the authorized height limits, distributed across the allotment, while the remaining 168 buildings (69%) comply with regulations (Figure 9 and 10).

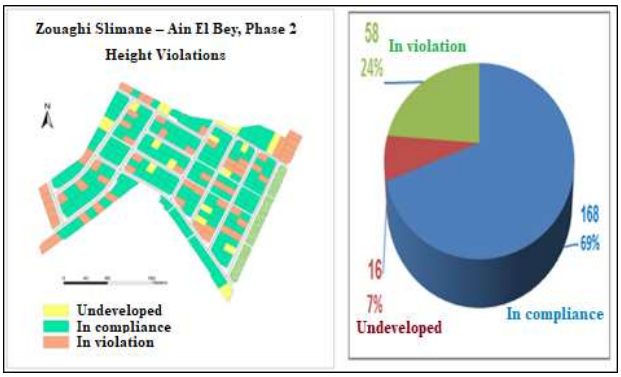

Figure 9: *Building height violations across the study area*

Figure 10: *Two buildings with height violations*

The primary causes of these height violations are the property owners themselves, either due to ignorance of urban planning laws or deliberate noncompliance, compounded by weak regulatory oversight and the absence of a comprehensive monitoring database.

- **Sidewalk Encroachment Violations**

Out of 126 buildings analyzed, 30 (12%) encroach on sidewalks, exceeding the prescribed setback distances of 1.5 to 2 meters as defined in the specifications. These violations are mainly located in the central part of the allotment and are often associated with commercial expansions (Figures 11 and 12).

- **Pedestrian Pathway Encroachment**

Only two buildings encroach upon designated pedestrian pathways, violating public property rights (Figure 13).

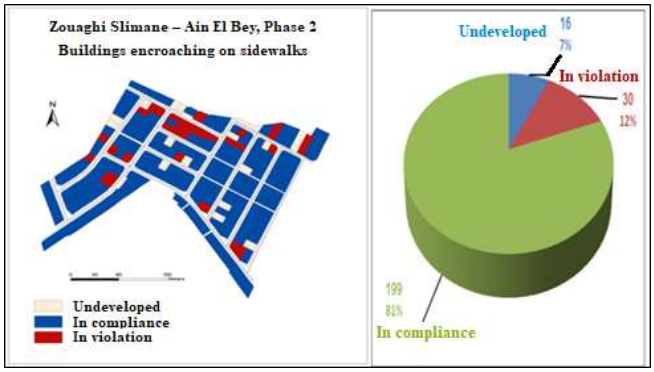

Figure 11: *Sidewalk encroachment violations across the study area*

Figure 12: *Two buildings violating sidewalk regulations*

Figure 13: *Violations encroaching on pedestrian pathways across the study area*

These infractions are the result of property owners expanding their private areas at the expense of public spaces, again with minimal regulatory oversight.

- **Land Use Violations**

Although the allotment is designated for individual residential use, 17 buildings (8%) have been converted to commercial use, representing a direct violation of the approved land-use regulations (Figures 14 and 15).

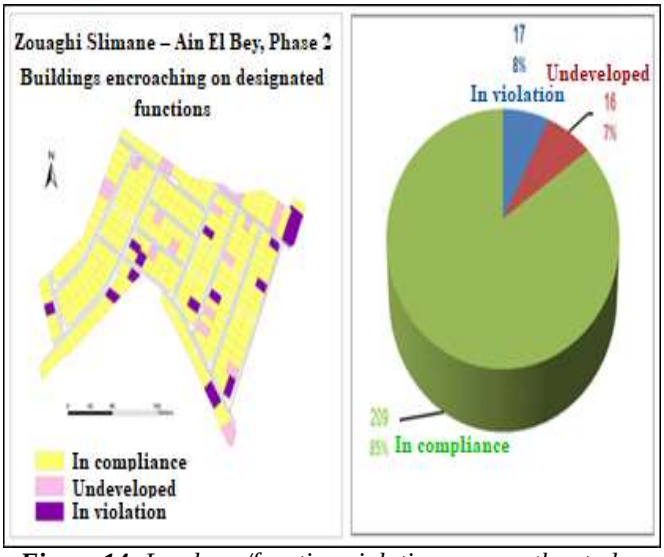

Figure 14: *Land-use/function violations across the study area*

Figure 15: *A building in violation of the designated land-use/function*

- **Land Occupation Coefficient Violations**

The Land Occupation Coefficient (CES) was set between 0.4 and 0.6, yet 72 buildings (30%) exceed this limit, particularly on the eastern side of the allotment (Figure 16). These violations result from owners fully utilizing their plots, neglecting the mandatory green spaces, and reflect inadequate monitoring. The direct cause of these buildings' violations of the land occupancy coefficient is always the owners themselves, who carried out extensions by fully utilizing their plots (constructing on the entire land without leaving the designated space for gardens).

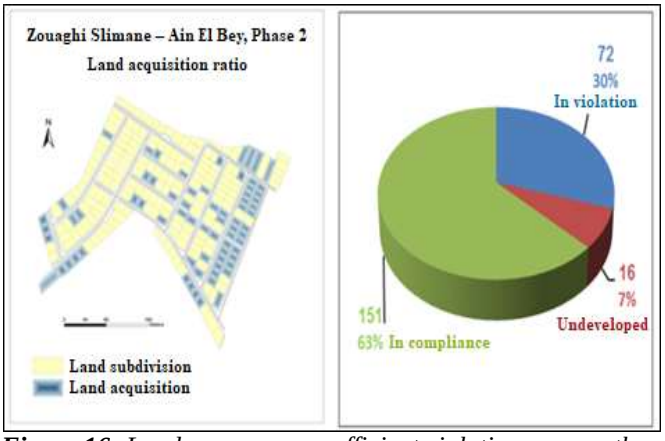

Figure 16: *Land occupancy coefficient violations across the study area*

In addition, the absence of oversight and monitoring by authorities and relevant agencies has contributed to the proliferation of these violations within the allotment.

8. Proposed Measures to Reduce or Limit Urban Planning Violations in Housing Allotments:

Given the widespread nature of violations and their impact on urban cohesion, and considering that Geographic Information Systems (GIS) provide an effective tool to manage and process information to identify violators and make informed decisions, the following solutions are proposed:

- Integrate Geographic Information Systems into urban monitoring and control processes.
- Ensure strict enforcement of urban planning laws.
- Establish a dedicated monitoring authority to update spatial databases on a daily basis.
- Create an executive unit for rapid intervention in case of violations.
- Strengthen inspection operations by forming periodic monitoring teams to check illegal modifications and constructions that do not comply with regulations.
- Review urban planning regulations to adapt current legislation more effectively to existing realities and impose more deterrent penalties.
- Involve residents in the creation and management of housing plans to ensure better compliance with regulations.
- Conduct awareness campaigns to educate citizens about the importance of respecting urban planning laws and the consequences of violating them.

9. Conclusion:

Although this allotment is regulated by a detailed set of specifications and governed by urban planning laws, our study and analysis using Geographic Information Systems (ArcGIS) allowed us to identify and map numerous violations. This enabled the quantification of violators and the types of infractions, which are primarily caused by:

- Lack of oversight by the competent authorities.
- Absence of a deterrent policy in law enforcement.
- Citizens' noncompliance with urban planning laws.

To curb these violations, authorities must maintain comprehensive GIS-based databases for all allotments and monitor their processes and developments. Inspection mechanisms should be reinforced through periodic monitoring teams to examine illegal modifications and non-compliant constructions. Additionally, strict enforcement of the law must be ensured, accompanied by thorough public awareness campaigns about urban planning regulations and the importance of adhering to them.

Author Statements:

- **Ethical approval:** The conducted research is not related to either human or animal use.
- **Conflict of interest:** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper
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- **Data availability statement:** The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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