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Research Article / Araştırma Makalesi

Assessment of Urban Land Use Change within the Spatial and Legal Framework

Kentsel Alan Kullanımı Değişiminin Mekânsal ve Yasal Çerçevede Değerlendirilmesi

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Abstract

This study aims to evaluate changes in urban land use in terms of spatial and regulatory compliance. The research universe is the reserve project planning area in the Kırıkhan district of Hatay province. In this area, pre- and post-project land use types (commercial, residential, religious, educational, park, road, etc.) were compared using numerical data. During the analysis process, spatial data production and comparative mapping were carried out using Netcad and ArcGIS software. The obtained area sizes were evaluated considering legal regulations such as the Urban Planning Law No. 3194, the Municipalities Law No. 5393, and the Environmental Law No. 2872. The findings reveal significant increases in commercial and residential areas, while decreases were observed in public areas such as social amenities, green spaces, and roads. This situation has the potential to cause various issues in terms of urban living quality and planning principles. The study makes the spatial impacts of local-scale planning decisions visible and provides evaluation criteria for more balanced and legally compliant urban development.

Keywords: *Urban land use, Spatial analysis, Zoning plan, Sustainable planning, Pre- and post-project comparison.*

Öz

Bu çalışma, kentsel alan kullanımındaki değişimlerin mekânsal ve mevzuat uyumu açısından değerlendirilmesini amaçlamaktadır. Araştırma evreni Hatay ili Kırıkhan ilçesindeki rezerv proje planlama alanıdır. Bu alanda proje öncesi ve sonrası kullanım türleri (ticaret, konut, ibadet, eğitim, park, yol vb.) sayısal verilerle karşılaştırılmıştır. Analiz sürecinde Netcad ve ArcGIS yazılımları kullanılarak mekânsal veri üretimi ve karşılaştırmalı haritalama gerçekleştirilmiştir. Elde edilen alan büyüklükleri, 3194 sayılı İmar Kanunu, 5393 sayılı Belediye Kanunu ve 2872 sayılı Çevre Kanunu gibi yasal düzenlemeler ışığında değerlendirilmiştir. Bulgular, ticari ve konut alanlarında belirgin artışlar gözlemlenirken, sosyal donatı, yeşil alan ve yol gibi kamusal alanlarda azalmalar yaşandığını ortaya koymaktadır. Bu durum, kentsel yaşam kalitesi ve planlama ilkeleri açısından çeşitli sorunlara yol açma potansiyeli taşımaktadır. Çalışma, yerel ölçekteki planlama kararlarının mekânsal etkilerini görünür kılarak, daha dengeli ve mevzuata uygun kentsel gelişim için değerlendirme kriterleri sunmaktadır.

Anahtar Kelimeler: *Kentsel alan kullanımı, Mekânsal analiz, İmar planı, Sürdürülebilir planlama, Proje öncesi ve sonrası karşılaştırma.*

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1. Introduction

Urban land use is one of the fundamental elements determining the physical structure of cities [1]. Many key indicators, such as the quality of social life, environmental sustainability, and economic efficiency, are shaped by the distribution of urban spaces and their functional uses [2]. Modern urban planning processes require not only the organisation of the built environment, but also the balanced placement of social amenities, transport networks, green spaces and public services [3].

Urban area planning and land use decisions in Türkiye are governed primarily by the Building Code No. 3194, the Municipalities Law No. 5393, the Environmental Law No. 2872, the Building Control Law No. 4708, the Decree Law No. 648 on the Organisation and Duties of the Ministry of Environment and Urbanisation, the Spatial Planning Regulations, the Parking Regulation, the Planned Areas Urban Planning Regulation, Law No. 6306 on the Transformation of Areas at Risk of Disaster, and the related Law No. 5216 on Metropolitan Municipalities [4–6]. These regulations comprehensively address the technical, social and environmental dimensions of planning processes, making it mandatory to ensure inter-functional balance.

It is not only important that planning decisions comply with legal regulations, but also to what extent these decisions reflect the actual spatial transformation on the ground [7]. Indeed, in many cities, the differences between implementation and planning lead to inadequacies in social infrastructure services such as parking, green spaces, places of worship and educational facilities, and to congestion in road and transport networks [8–10]. In this context, comparing pre- and post-planning land use distributions spatially and quantitatively contributes to the validation and re-evaluation process in urban planning [11].

In Türkiye, planning implementation processes are categorized under the headings of master plans, zoning plans, and detailed zoning plans. Regional land use decisions are implemented through master plans, while the main transportation system, infrastructure balance, and settlement structure are implemented through zoning plans. Parcel-based development conditions and functions are implemented through detailed zoning plans. Additionally, there are procedures that must be followed in accordance with relevant legislation for the regulation of the planning area and for public projects. Table 1 details the planning processes and their specifics.

Table 1. The planning process in Türkiye

Stage	Subheading	Explanation	Outputs	Competent Authority
Planning Stage	Upper Scale Plans	Regional land use decisions: agriculture, forestry, industry, settlement guidance	1/100,000 – 1/25,000 plans, protected areas	Ministry of Environment, Urbanization and Climate Change/Metropolitan Municipality
	Master Plan (1/5000)	Primary transportation system, infrastructure balance, settlement layout	Plan sheets, plan notes	Metropolitan Municipality
	Implementation Zoning Plan (1/1000)	Parcel-based development conditions, functions	1/1000 scale plan set, building regulations, plan notes	District Municipality
Organization of the Planning Area	Article 18 Implementation (Parceling)	Cadastral parcels are organized, DOP deductions are made, and new zoning parcels are created.	Parceling plan, DOP distribution table, registration list	Municipal Council + Land Registry Office
	Unity (Article 15)	Merging multiple parcels	New parcel geometry and registration	Municipality + Land Registry
	Subdivision (Article 16)	The division of a parcel into multiple parcels	Subdivision plan, registration list	Municipality + Land Registry
	Abandoned on the Road / Established from the Road	Abandonment of the portion planned as a road from the parcel or addition of the road surplus	Abandonment plan, establishment plan	Municipality + Land Registry
	Technical Infrastructure Harmonization	Coordination of infrastructure lines such as sewage, drinking water, energy, natural gas, and fiber	Application plan revisions, institutional opinions	Water Authority, Electricity Authority, Natural Gas, Telecommunications

Table 1. The planning process in Türkiye (continued)

Application for Public Projects	Expropriation (Law No. 2942)	Acquisition of real estate for public facility areas, parks, roads, health/school areas	Expropriation decision, market value report, registration	Municipality / Ministry
	Urgent Expropriation	Expropriation in case of disaster, emergency, or public harm risk	Court decision, expedited registration	Council of Ministers / Presidency
	Right of Surface /Right of Way	Determination of transition areas for energy, telecommunications, natural gas, and water transmission lines	Easement plan, consent, registration	Institution + Municipality + Land Registry
	Public Buildings Plan Implementation	Plan coordination for schools, healthcare facilities, police stations, and infrastructure facilities	Plan modification, implementation approval, institutional agreements	Municipality + Relevant Ministry

This study aims to analyse the changes in urban use before and after the project in the reserve planning area covering the Cumhuriyet and Kurtuluş neighbourhoods of Kırıkhan district, Hatay province, for the purpose of reconstruction following the earthquakes of 6 February 2023, using numerical data (Figure 1). The study spatially compared functional land use types such as commercial and residential use, places of worship, educational facilities, public service areas, parks, car parks, and roads. Numerical data were obtained using Netcad and ArcGIS software and evaluated within the framework of relevant laws, regulations, and plan notes [12,13].



Figure 1. Geographical location map

The aim of the study is to reveal the extent to which spatial transformation aligns with legal norms and to contribute to the balanced, holistic and sustainable re-evaluation of decision-making mechanisms in planning processes. Within this framework, the research proposes a comprehensive assessment model that analyses local authorities' plan implementation processes from technical, social and legal perspectives.

2. Literature Review

Urban land use is one of the fundamental analytical topics in the discipline of urban planning [14]. Land use changes are shaped by numerous factors, including demographic growth, changes in economic activities, infrastructure requirements, and environmental sustainability. The systematic monitoring and evaluation of these changes is of great importance for the planned development of cities [15,16]. For this purpose, spatial analysis techniques, particularly GIS-based evaluation methods, are widely used in the literature [17]. There are significant studies at the international and national levels related to the field of

study (Table 2). Studies conducted with Türkiye samples were evaluated within the framework of the Zoning Law No. 3194, the Municipal Law No. 5393, the Zoning Regulation for Planned Areas, and the Spatial Planning Regulation. Studies covering other countries (such as European countries) outside Turkey were considered important in terms of their evaluation of planning theories.

Table 2. Studies in the literature

Yazar	Çalışma alanı	Yöntem	Bulgular
Erdönmez and Çelik (2016)	Public space and user interaction in Istanbul (75th Year Republic Square)	Qualitative research, field observation, survey, literature review.	The square is physically accessible but weak in terms of social interaction; it functions as a transit area.
Carsjens and Ligtenberg (2007)	Integration of environmental impacts with the STEPP planning tool (Netherlands)	CBS-based decision support tool (STEPP), scenario analysis, environmental impact zones.	STEPP offers decision-makers the opportunity for early intervention; it may fall short in qualitative assessments.
Yin et al. (2018)	Urban growth modelling in Guangzhou	Landsat + Cellular Automata (CA); GIS + remote sensing.	Urban growth is concentrated near transport infrastructure; the model operates with 83% accuracy.
Tosics (2004)	Sustainability and housing policies in European cities	Comparative situation analysis, policy documents and statistics.	Social housing is risky in terms of sustainability; housing policies should be strengthened through sectoral integration.
Cengiz et al. (2022)	Analysis of urban growth and spatial metrics in Ankara	Spatial criterion analysis using Landsat + CBS + FRAGSTATS.	Growth in Ankara is fragmented and unplanned; spatial metrics are a powerful tool for planning decisions.
Akçakaya (2016)	The historical development of sustainability and the role of local authorities	Theoretical analysis, Brundtland Report, EMS and indicator systems.	Local authorities should support policy development through performance measurement; indicator systems are important.
González and De Lázaro (2011)	Sustainable urban development in European cities	Theoretical analysis, review of European reports and urban planning documents.	Widespread urbanisation creates environmental risks; compact cities and social participation should be prioritised.

Erdönmez and Çelik's [18] study entitled 'Public Space Relationships in Urban Spaces' examines the physical and social roles of public spaces in urban life. The research was conducted using the example of 75. Yıl Cumhuriyet Meydanı in Beşiktaş, Istanbul; in this context, the impact of public spaces on user behaviour was analysed through field observations and surveys. The methodology employed a qualitative research design, combining field observations, face-to-face surveys with users, and a literature review. Furthermore, public space quality criteria (protection, comfort, appeal) and spatial quality indicators were used as evaluation criteria. Within this framework, the square was analysed in terms of its physical design, level of accessibility, adequacy of facilities, safety, and user satisfaction. The study revealed that, despite its central and accessible location, the square has a structure that functions more as a transit space and does not sufficiently utilise its potential for social interaction. This situation emphasises that public space planning must consider not only physical accessibility but also social and spatial functionality.

Carsjens and Ligtenberg [19] introduce a GIS-based planning support tool (STEPP) developed to support sustainable spatial planning in urban areas. STEPP (Strategic Tool to Integrate Environmental Aspects in Planning Procedures) was developed to facilitate the assessment of environmental impacts by local authorities and urban planning offices during the early stages of planning. The tool aims to improve the alignment between spatial planning and environmental policy. The study conducted a case analysis in the city of Nijmegen, the Netherlands. This analysis was carried out to assess the environmental impacts of current activities, generate different scenarios, and explore ways to improve the environmental quality of the area. The STEPP tool considers four basic environmental impact categories: odour, dust, noise and hazards (fire, explosion, etc.), assessing impact zones and the effects of these impacts on receiving environments (such as residential areas, nature areas and parks). The study demonstrated that STEPP enhances interdisciplinary communication in planning, facilitates the easier and faster generation of alternative scenarios, and offers decision-makers the opportunity for early intervention. However, it also revealed that STEPP's focus solely on quantitative impacts (e.g., distance-based impact zones) limits its applicability in more qualitative assessments.

Yin et al. [20] conducted an applied analysis in Guangzhou, China, using a cellular automaton (CA)-based approach to model the direction and spatial patterns of urban growth. Arguing that land use changes in rapidly urbanising areas develop according to specific spatial patterns rather than randomly, the researchers attempted to predict these transformation processes by establishing a model supported by GIS (Geographic Information Systems) and remote sensing data. The methodology involved land use classifications based on Landsat satellite images from 1990 and 2000. Subsequently, spatial transition trends were analysed, and a cellular automaton model was established to determine the development of each cell based on its interaction with its surroundings. In the model, numerous influencing factors were evaluated, such as slope, distance to the transport network, proximity to the city centre, and environmental constraints, and specific weight values were assigned to each. The data obtained from the simulation were compared with the actual land use in 2000, and the model was shown to be highly accurate (83% accuracy rate). The findings revealed that urban sprawl is mostly concentrated along transport infrastructure and on flat land, while development is limited in sloping, protected or environmentally sensitive areas. The study demonstrates that cellular automaton models can make significant contributions to urban planning not only in analysing the current situation but also in developing future scenarios and providing spatial decision support. In this respect, Yin and Kong's approach provides a numerical infrastructure that increases the predictability of the spatial impacts of planning decisions.

Tosics's [21] study examines the development dynamics of European cities within the framework of sustainability principles and particularly emphasises the decisive role of housing policies in urbanisation. By evaluating the structural differences between cities in Western Europe and those in Central and Eastern Europe, it argues that sustainable urbanisation depends not only on physical planning but also on the integration of social policies. In this context, the potential and risks of large housing areas (e.g. social housing or collective housing blocks) in terms of both physical and social sustainability are examined comparatively. The study employs comparative case analysis as its methodology, evaluating policy documents, statistical data, and examples of urban interventions in cities such as Budapest, Berlin, Vienna, and Ljubljana. The urban transition process in post-socialist countries was addressed, particularly in terms of fragmented urbanisation caused by the shift from centralised planning to a free market model, infrastructure deficiencies, and social problems arising from the privatisation of housing. In the case of Germany, it is emphasised that large housing estates were transformed through state-supported regeneration projects, but these projects were carried out without sufficiently analysing sustainability objectives. Tosics argues that housing policies must be integrated with other sectoral policies, such as transport, land use and social services, in order to achieve sustainable urbanisation. The lack of sufficient housing policies at the European Union level leads to a lack of coherent and strategic planning at the local level. In this context, the study reminds us that, especially in countries with high urbanisation pressure such as Türkiye, housing policies must be integrated into the planning process alongside spatial analyses.

Cengiz et al. [22] analysed the spatial changes in urban growth in Ankara, the capital of Türkiye, in this study. The authors argue that urbanisation processes should be evaluated not only in terms of spatial expansion but also in terms of qualitative elements such as spatial structure, integrity, and fragmentation. In this context, Ankara's growth pattern was evaluated using spatial metrics, and the question of whether the urbanisation process was planned was examined. Methodologically, the study combined spatial analysis techniques supported by remote sensing (Landsat images) and Geographic Information Systems (GIS). The research examined the urban development in these three periods comparatively, based on land cover data from 1990, 2000, and 2018. Following land use classifications, various spatial metrics were calculated using FRAGSTATS software. These metrics included indicators such as patch number, area size, edge length, intra-class cohesion, and fragmentation degree. Thus, the extent to which urban growth was fragmented, dense, linear, or compact was quantified. The findings reveal that Ankara experienced significant urban sprawl after 1990 and that this growth was mostly irregular, unplanned, and fragmented. The 2018 data, in particular, shows that development pressure has increased in areas far from the city centre and that this threatens green spaces. Furthermore, the study emphasises that spatial metrics are not

only important for academic analysis but also serve as a crucial tool for planners in their future decision-making processes. In this respect, the article argues that urbanisation should be considered not only in terms of quantitative growth but also in terms of spatial quality; it draws attention to the necessity of measurability and continuous monitoring for growth patterns to be transformed into planned development.

Akçakaya [23] provides a comprehensive framework in his work, starting with the historical development of the concept of sustainability and extending to the role of local governments in this area today. It is noted that the concept of sustainability was first used in 1713 by Hans Carl von Carlowitz in relation to the protection of forests, and then the 1987 Brundtland Report, which gave this concept international visibility, was taken as a basis. The Brundtland Report defined sustainable development as 'meeting the needs of the present without compromising the ability of future generations to meet their own needs; it also stated that this definition was subject to criticism in some respects. Akçakaya emphasises that the understanding of sustainability was later reshaped in social, environmental and economic dimensions with Elkington's 'Triple Bottom Line' approach. The study also examines the phenomenon of urbanisation in detail within the context of sustainability. Based on the United Nations' urbanisation reports, it is predicted that 66% of the world's population will live in cities by 2050, and attention is drawn to the fact that rapid and unplanned urbanisation increases environmental threats. In this process, it is stated that local governments have taken on leading roles in the production and implementation of sustainability policies. Particularly following global developments such as the Istanbul Habitat II Conference and the Rio Declaration, the concept of sustainable cities began to be discussed more extensively in the international arena. Fundamental responsibilities have been defined for local governments in relation to their role in sustainability, including policy development, increasing citizen participation, establishing sustainable infrastructure, and performance measurement. Drawing on the US Environmental Protection Agency's 'Environmental Management System' model, the study explains how the plan-implement-check-act cycle can be integrated into local government sustainability strategies. It is stated that this system contributes to local governments in areas such as improving environmental performance, efficient use of resources, and energy efficiency. In addition, various tools that can be used to measure sustainability performance are discussed. Different approaches and systems, such as Satterthwaite's five-point indicator system, the EU's sustainability indicators, the China City Sustainability Index, and urban metabolism, are detailed. It is emphasised that these systems enable the comparative analysis of cities' social, environmental, and economic performance and provide a scientific basis for the development of sustainable policies.

González and De Lázaro [24] examine the challenges facing sustainable urban development today and explore possible solutions through urban planning practices in Europe. The authors highlight that cities consume 90% of the world's natural resources and are therefore the main source of environmental imbalances. In this context, they emphasise that cities must establish more efficient environmental management mechanisms to build a sustainable future. The article focuses on two fundamental aspects of European urban planning policies: the regulation of new urban development areas and the improvement of existing city centres. Both approaches must be redefined in line with sustainability principles. The authors note that urbanisation today is progressing with dispersed (low-density) development models that result in high energy and land consumption, creating serious pressures on the natural environment in particular. Furthermore, it is pointed out that the transfer of such development patterns to European cities based on imported models (e.g., the American suburban model centred on detached houses) disrupts local cultural, social, and environmental balances. In this context, the compact city model and the re-evaluation of historic centres are presented as important solutions in terms of sustainability. The article emphasises the importance of urban regeneration efforts that are carried out not only through physical interventions but also in conjunction with social integration, economic vitality and public participation. It argues that limiting historic centres to tourist functions is unsustainable and that these areas must be transformed into living places. Sustainability is closely linked not only to reducing environmental impacts but also to improving the quality of public spaces and strengthening social solidarity. The principle of glocalisation (thinking and acting globally at the local level) is presented as a fundamental guideline in

this context. The study is based on theoretical and conceptual analysis methods. The authors draw on a comprehensive review of secondary literature on urbanisation processes, planning policies, and sustainability practices in various European countries (particularly examples from Spain, France, and Germany). Furthermore, urban development trends and environmental impacts are analysed through various official documents (European Commission reports, UN documents such as Habitat II, local planning guides) and statistical comparisons. Although no measurements based on numerical models were made, policy analyses and spatial comparisons were conducted within the framework of sustainability principles. At a conceptual level, an explanatory framework is presented through key concepts such as compact city, sprawl, urban voids, regeneration policies, and glocalisation.

2.1. The Importance of the Study in the Literature

The studies summarised above demonstrate the importance of spatial analysis and GIS use in urban planning processes. However, most of these studies either focus on a single function (such as housing, parks, or transport) or are limited to visualisation-based analyses. This study, however, comprehensively evaluates multiple usage functions (commercial, religious, educational, public, road, park, car park). Pre- and post-project plans were analysed comparatively. Subsequently, numerical data analysis was interpreted in light of legal regulations, and data control was ensured using Netcad and ArcGIS software. In this respect, the study offers a unique contribution to the literature. The study presents a dual-axis evaluation model in terms of both physical planning and legal compliance assessment.

3. Materials and Methods

3.1. The Universe of the Study

This research was conducted within the reserve planning area located on the border of the Cumhuriyet and Kurtuluş neighbourhoods in the Kırıkhan district of Hatay province, which suffered extensive damage in the earthquakes of 6 February 2023 (Figure 2). This area was planned by the Ministry of Environment, Urbanisation and Climate Change (ÇŞB) as a reserve project area, independent of the 1/1000 scale Implementation Zoning Plan. The study is based on a comparative analysis of the planned urban area's implementation zoning plan and reserve project area plans. The area in question is comparable in terms of size and functional diversity, but there are significant differences in both plans regarding basic urban land use types such as housing, commerce, worship, education, public services, green spaces, car parks, and roads. These differences were quantified and presented through the visualisations created.

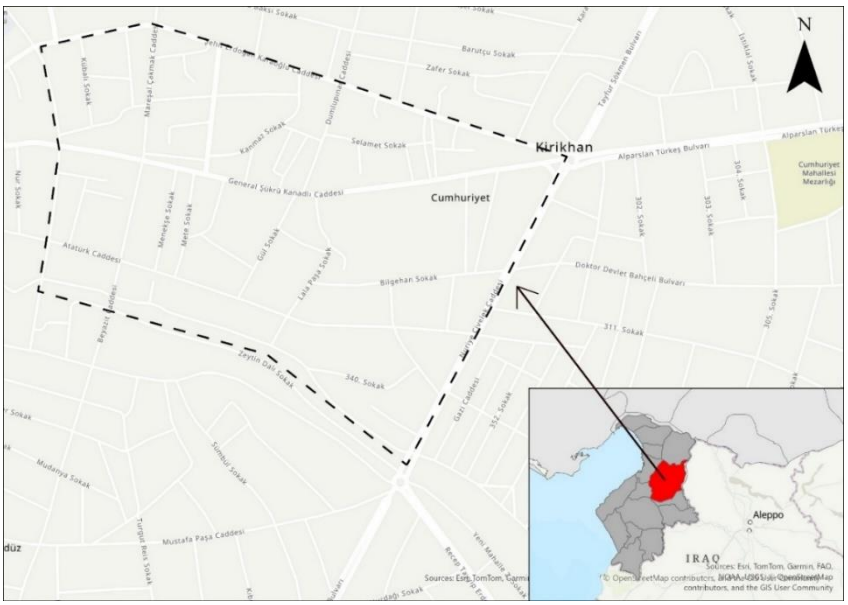


Figure 2. Work area boundary map

3.2. Data Sources

All spatial data used in the study were obtained from the 1/5000 scale Master Development Plan (MDP), the 1/1000 scale Implementation Development Plan (IDP), planning area implementation sheets and plan notes, digital area data obtained from the GIS infrastructure (in Netcad format), field observations, and plan implementation reports. The data was collected to cover both the pre-project and post-project periods, thus enabling a comparative analysis of the two time periods.

3.3. Software Used and Technological Infrastructure

Two primary software programmes (Netcad and ArcGIS Pro) were utilised in conducting the spatial analyses. Netcad, a widely used software programme in Türkiye for digital plan production and area calculation, was employed to digitise all plan sheets with coordinates and calculate area sizes. The Netcad outputs were then transferred to the ArcGIS environment in shapefile format, and visualisation, overlay, and area change analysis were performed on the layers. For data compatibility and intersection control, the area values from Netcad were recalculated in ArcGIS for verification.

3.4. Analysis Process

The research method is a comprehensive approach that combines quantitative spatial analysis and qualitative regulatory compliance assessment. Therefore, the analysis process was carried out in six stages: digitisation, layering and classification, area calculations, mapping, tabulation, and criteria-based assessment (Table 3).

Table 3. Analysis process

Process	Process details
Digitisation [25]	The zoning plan sheets were digitised in Netcad, with each function produced as a separate layer and converted to .shp format. Similarly, the .kmz versions of the plan projects for the reserve project area were exported in .shp format. This enabled the zoning plan and the reserve project area to be compared in the same format.
Layering and classification [26,27]	Commercial, residential, religious, park, educational, etc. usage types were imported into ArcGIS as separate polygon layers.
Area calculations [28–30]	The functions of the development plan and reserve project area were examined, and the necessary information was extracted from the attribute using the calculate field feature. Comparative differences were identified for before and after the plan revision.
Mapping	Functional change maps were produced.
Tabling	The area differences for all functions have been tabulated.
Criterion-based assessment [31,32]	Land use changes were interpreted by comparing them with both planning principles and legal standards.

3.5. Legal Assessment

The types of land use in the planning area have been assessed in accordance with the relevant legal framework. Accordingly, building density and amenity area ratios are governed by the Town Planning Act No. 3194, the planning of public services by the Municipalities Act No. 5393, green areas and environmental sustainability by the Environmental Protection Act No. 2872, parking, social facilities and road standards by the Town Planning Regulations for Planned Areas, increases in density and social infrastructure balance are regulated by Law No. 6306 on the Transformation of Areas at Risk of Disaster, and the technical equivalents of land use types are evaluated under the Spatial Plans Preparation Regulation. In addition, the regulatory compliance assessment was conducted by considering criteria such as minimum area sizes in plan notes, social infrastructure standards per capita, and road area ratios.

3.6. Originality of the Research Methodology

The methodology of this study differs from other studies in the planning literature in several important ways. It possesses a unique methodology through the following stages: ensuring the integrity of spatial and legal analysis, integrating two software programmes to verify data validity, focusing not only on single functions such as housing or parks but on multi-functional planning, and examining not only the existence of change but also its appropriateness in terms of its legal basis.

4. Research Findings

In this section, the spatial impacts of pre- and post-project usage decisions have been evaluated comparatively. Area sizes for each type of urban function have been analysed numerically, and trends in change have been presented graphically. Subsequently, the extent to which functional changes comply with relevant legislation has been examined.

4.1. Functional Area Changes

The seven main types of urban use analysed within the scope of the study were compared between the pre- and post-project periods. This comparison reveals changes in area size within the urban fabric, usage priorities, and the spatial implications of planning decisions.

It is observed that commercial and residential areas have increased significantly according to the planned project and are designed to occupy more than 21% of the total area. Conversely, a reduction has been identified in social and technical infrastructure areas such as car parks, green spaces and roads. In particular, the approximately 51.8% decrease in road areas indicates serious problems in terms of accessibility and traffic flow in the planning implementation.

The pre- and post-project comparison chart clearly illustrates the direction of change. The chart shows both the breakdown in functional diversity and the prioritisation of private use areas (commercial and residential) over public service use areas (Figure 3). Despite a 363.77% increase in the residential area and a 520.91% increase in the commercial area, a decrease of 7.86% in official institutions, 12.10% in worship areas, 100% in education, 54.02% in parking, and 51.80% in the road network was observed (Figures 4 and 5). These findings indicate that planning decisions have deviated from the principle of spatial sustainability and that the balance between functions has not been maintained.

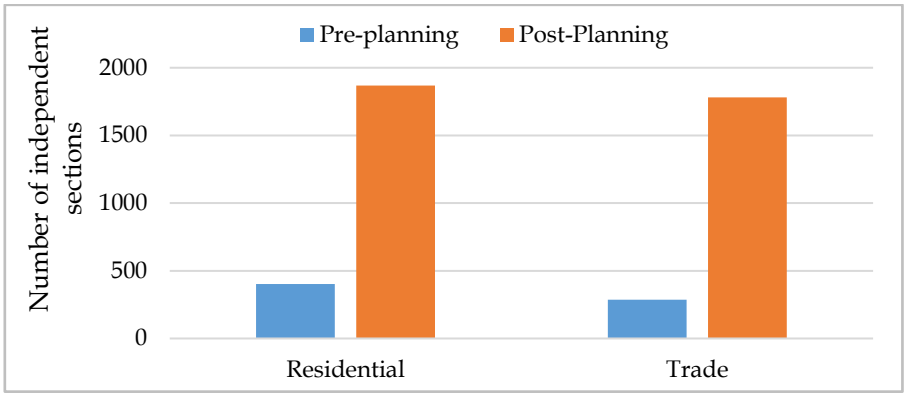


Figure 3. Residential and commercial area changes

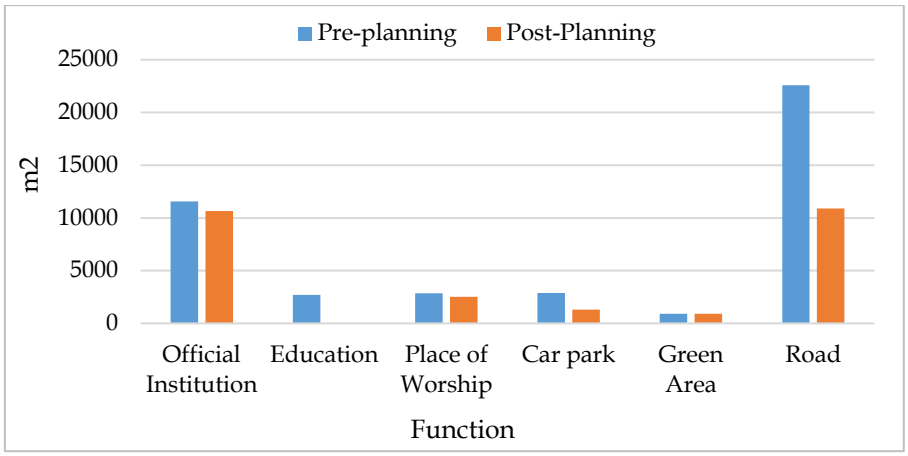


Figure 4. Function-based area changes

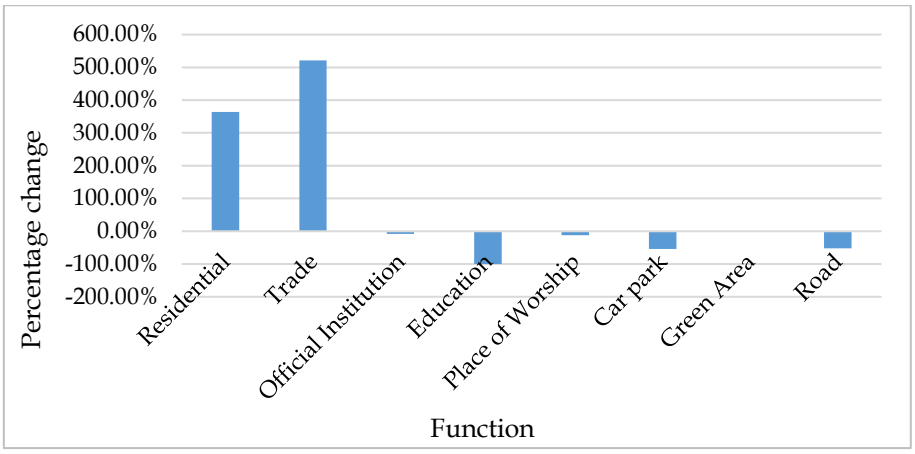


Figure 5. Function-based area change ratio

4.2. Pre- and Post-Field Analytical Data

The pre- and post-project area sizes for each function type are shown in Table 3. This table shows not only the differences in terms of surface area, but also the changes in functional priorities and the extent of area abandonment. A 363.77% increase in the residential area and a 520.91% increase in the commercial area were observed, while a 7.86% decrease in the public services area, a 100% decrease in the education area, a 12.10% decrease in the worship area, a 54.02% decrease in the parking area, and a 51.80% decrease in the road network were noted (Table 4). These comparative data reveal not only spatial transformation but also serious deficiencies in terms of urban planning principles, infrastructure standards, social needs balance, and regulatory compliance.

Table 4. Functional changes (Before and after the project)

Function	Unit	Before	After	Change Amount	Change Rate (%)
Residential property	adet	403	1869	1466	363.77
Commercial	adet	287	1782	1495	520.91
Public Service	m²	11.564	10.655	-909	-7.86
Education	m²	2.709	0	-2.709	-100.00
Worship	m²	2.851	2.506	-345	-12.10
Parking lot	m²	2.871	1.320	-1.551	-52.02
Green space	m²	921	921	0	0,00
Road	m²	22.589	10.888	-11.701	-51.80

According to the Planned Areas Zoning Regulations, a minimum of 10 m² of green space per person, a minimum of 0.50 hectares of worship space per 1,000 people, and 1.60 hectares of space per 1,000 people for educational facilities must be planned. However, the analysis of the area distribution before and after the project revealed a significant reduction in social amenities, thus indicating that the plan conflicts with the legislation.

4.2.1. Residential and Commercial Areas

According to the zoning plan prior to the project, there were 403 residential units and 287 commercial independent units. After the project, the number of residential units increased to 1,869 and commercial independent units to 1,782. This increase corresponds to a growth of 363.77% for residential units and 520.91% for commercial independent units. The total additional construction area of 49,586 m² indicates that priority was given to commercial and residential functions in the planning. This increase ensures a rapid response to the city's housing needs. However, the disproportionate increase in the commercial and residential share of the planning area leads to insufficient social amenities and infrastructure areas. Such planning, which is contrary to planning principles, violates the principle of balanced spatial distribution. Ultimately, urban quality of life can only be achieved not only through housing supply but also through accompanying infrastructure such as schools, green spaces, transportation, and parking [33–35]. Furthermore, according to the Building Law No. 3194, an increase in building density requires a proportional increase in the ratio of social areas per capita [36]. However, in this study, while residential areas increased, supporting functions such as education, green spaces, places of worship, and transportation either remained constant or decreased.

4.2.2. Places of Worship

The worship area, which was 2,851 m² before the project, decreased to 2,506 m² after the project. This corresponds to a 12.1% reduction (Figure 6). There is a total loss of 345 m² in worship areas. According to planning principles, worship areas are part of the urban social infrastructure. The reduction in these areas leads to spatial accessibility problems and prevents social needs from being met. According to the Municipal Law No. 5393 and the Planned Areas Zoning Regulation, it is mandatory for places of worship in residential areas to be easily accessible and planned with sufficient size per person [37]. While at least 0.50 hectares (5,000 m²) of worship space is envisaged for every 1,000 people, the current area is well below this standard.



Figure 6. Religious sites within the designated planning area

4.2.3. Public Service Areas

The public service area, which was 11,564 m² before the project, decreased to 10,655 m² after the project (Figure 7). Considering the increase in the number of commercial and residential units, the 909 m² decrease in public service areas is not statistically significant. According to planning principles, while there has been a significant increase in commercial and residential areas, the fact that the public service area has remained almost unchanged will cause public services to be disrupted in the future. Furthermore, Article 14 of Municipal Law No. 5393 directly links the effectiveness of public services to planning [38,39]. Therefore, there is an inconsistency between planning and population projections.



Figure 7. *Public service domains within the planning area*

4.2.4. Educational Areas

The educational area, which was 2,709 m² before the project, has been reduced to 0 m² after the project. In other words, despite the population increase in the planning area, the educational area (primary school) has been disregarded (Figure 8). The increase in residential areas will increase the number of students, which will strain the existing educational infrastructure. Educational facilities should be supported not only in terms of area but also with a capacity increase proportional to the population. According to the Planned Areas Zoning Regulations, at least 1.60 hectares of educational area should be planned for every 1,000 people for primary school areas. The lack of educational facilities in the planning area indicates that sustainability in education has not been foreseen.



Figure 8. *Educational areas within the planning area*

4.2.5. Parking Areas

The car park area, which was 2,871 m² prior to the project, has been reduced to 1,320 m² after the project (Figure 9). The increase in residential and commercial areas will inevitably lead to road obstructions and traffic congestion, as it will increase traffic density and human circulation in the area. According to the Planned Areas Zoning Regulations, it is mandatory to plan parking spaces in residential and commercial areas according to the size of the area and the number of independent units. However, after the plan, there is no area left that complies with this requirement. This deficiency will not only affect daily life but also increase traffic density, hinder emergency access, and reduce environmental quality.



Figure 9. *Educational areas within the planning area*

4.2.6. Parks and Green Areas

The 921 m² of park and green space existing prior to the project has been preserved unchanged (Figure 10). However, in accordance with Environmental Law No. 2872 and the Spatial Planning Regulations, a minimum of 10 m² of green space per person is stipulated [40]. Consequently, based on the population projection for the planning area, this standard has not been met.



Figure 10. *Parks and green areas within the planning area*

4.2.7. Transport Network

In the planning area, the transport network (road) has been reduced from 22,589 m² to 10,888 m², representing a decrease of 51.80% (Figure 11). This indicates that access and transport networks have been narrowed in the planning, posing significant risks in terms of pedestrian/vehicle mobility. When considered together, the Highway Traffic Law No. 2918 and the Urban Planning Law No. 3194 require that road widths, cadastral connections, and emergency access routes such as fire lanes be uninterrupted. However, in the planning area, the road network is severely restricted.

The change in the transport axis to the road structure in the development plan and the reserve project area is clearly noticeable. While the transport axes in the development plan are denser and more organically developed, the reserve project area features more planned settlement around this transport network, with 15- and 12-metre-wide roads being preserved (Figure 12). However, considering the planned residential and commercial units within the area and the area's high traffic flow, it is anticipated that the removal of parking areas could lead to disorderly parking and traffic flow in the long term.



Figure 11. *Roads in the Development Plan*



Figure 12. *Roads in the reserve planning area*

5. Conclusion and Recommendations

The study comparatively analyzed the spatial distribution of land use types in the urban planning area of Kırıkhan district, Hatay province, during the pre- and post-project periods. Analyses conducted using Netcad and ArcGIS-based digital data revealed significant changes in fundamental urban functional areas such as commercial and residential areas, places of worship, education, public services, car parks, green spaces, and transportation. The findings reveal that the urban planning process is particularly oriented towards private property-focused growth, with public spaces and social amenities being neglected in this process.

In the planning of the reserve project area, there has been a 363.77% increase in the residential area and a 520.91% increase in the commercial area. However, functions such as car parks and green spaces, which are essential for sustainable urban development, have been neglected. A 51.80% decrease in the transport network is also noteworthy. This situation not only implies spatial imbalance but also presents a scenario that could create serious problems in terms of traffic flow, emergency response access, and overall urban security. Findings such as the reduction in worship areas, the disregard for educational areas, and the decrease in public service areas clearly show that social infrastructure has not been reflected in the plans, despite population growth and construction density. Legislation governing planning, such as the Town Planning Act No. 3194, the Planned Areas Town Planning Regulation, the Environment Act No. 2872, and the Municipalities Act No. 5393, mandates that such social and technical infrastructure be defined as mandatory within the planning framework.

The comprehensive spatial and legal analyses conducted in the study revealed that not only the size of the areas but also their functional compatibility, accessibility and regulatory validity must be taken into account. When population projections, social needs analyses, and amenity equivalence balances are not taken into account in the planning process, it is inevitable that the plans will result in a decline in the quality of urban life. Therefore, ensuring functional balance in zoning plans must be considered a critical necessity. Social infrastructure areas should be increased in proportion to the rate of increase in construction density, and the minimum standards for these areas in the legislation must be strictly adhered to. Plans should create a sustainable urban form by jointly evaluating the principles of green space, infrastructure, transport and social equality. Furthermore, planning decisions should be based not only on technical data but also on qualitative inputs such as local community participation, professional associations' opinions, and social needs maps. Monitoring the implementation of plans and supporting them with annual performance evaluations will also enhance their effectiveness in the field and their suitability for the public interest.

In planning area studies, a current situation analysis must be conducted. This analysis will determine the adequacy of area functions in accordance with relevant legislation. Population projections and the developmental process of planning area region should be evaluated, and these evaluations should include solutions to needs. Evaluating new planning areas with numerical data prior to implementation will ensure compliance with legislation and facilitate the fulfillment of sustainable urban requirements in land use.

In conclusion, this study conducted specifically in Kırıkhan will also shed light on similar-scale urban planning applications in Türkiye. Planning should not only focus on construction but also consider the need for a people-oriented, environmentally sensitive and legally compliant approach. Such comprehensive assessments will strengthen the unity of practice and theory in the discipline of planning and contribute to the construction of more liveable cities.

Contribution Statement

The research design, literature review and evaluation, data analysis, verification of data and analyses, interpretation of findings, and writing of the article were carried out by 1. author, while data collection and visualisations were performed by 2. author.

Declaration of Competing Interest

The authors of the article declare that they have no personal or financial conflicts of interest with any institution, organisation or individual.

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