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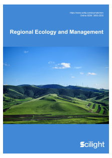

Article

Multidimensional Identification and Spatiotemporal Evolution Analysis of Land Use Landscape Conflicts in China, 2000–2020

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Abstract: With the continuous advancement of urbanization and industrialization, the conflict between the limited availability of land resources and the growing demand for diversified land use has intensified, making land use conflict a critical constraint on regional sustainable development. Based on the multi-source land use and natural-socio-economic data of China during the two periods of 2000 and 2020, this study systematically investigates the spatiotemporal evolution of land use conflicts and quantitatively explores their natural and anthropogenic driving mechanisms. The results indicate that: (1) from 2000 to 2020, China's land use changes exhibited a concurrent trend of construction land expansion and ecological restoration; (2) land use conflicts displayed a clear "high in the southeast—low in the northwest" spatial pattern, with high-level conflict areas concentrated around urban agglomerations east of the Hu Huanyong Line and in agro-pastoral transition zones, accounting for over 57% of the total area; (3) although high-level conflicts remain dominant, the proportion of extremely severe conflict areas declined slightly from 5.56% in 2000 to 5.37% in 2020; (4) vegetation cover and elevation are the primary determinants of conflict spatial distribution, and interactions between any two factors exhibited enhancement effects, indicating that the coupling of natural conditions and human activities is the key mechanism driving high-intensity conflicts. These findings suggest that land use conflicts in China are driven jointly by natural constraints and anthropogenic disturbances. Future land management should adopt differentiated strategies to prevent new conflicts arising from intensive development.

Keywords: land use conflict; spatiotemporal evolution; driving forces; land spatial governance; China

1. Introduction

Land serves as the spatial carrier for human socioeconomic activities and ecological processes, and its utilization directly affects food security, ecological stability, and regional sustainable development [1]. With the acceleration of global urbanization and the continuous growth of population, human demand for land resources has steadily increased, while land supply remains rigidly constrained by natural conditions and ecological limitations [2,3]. This imbalance between supply and demand intensifies competition among different land use functions, making land use conflict a globally recognized resource and environmental issue [4]. Land use conflict is typically defined as the mismatch or incompatibility among different stakeholders in land use types, intensity, or spatial allocation, fundamentally reflecting structural contradictions between production, living, and ecological functions [5]. On one hand, land use conflict may lead to farmland fragmentation, habitat degradation, and declines in ecosystem services; on the other hand, it can exacerbate regional developmental disparities and constrain the long-term sustainability of socioeconomic systems [6]. Therefore, systematically identifying the spatiotemporal patterns of land use conflicts and elucidating their underlying mechanisms is of both theoretical significance and practical value for optimizing land resource allocation and alleviating human–land tensions.

As one of the fastest urbanizing countries with the largest population globally, China has undergone dramatic land use transformations over the past decades [7]. Rapid industrialization and urbanization have significantly driven the expansion of construction land while causing the loss of high-quality farmland and the encroachment on ecological spaces [8,9]. Against the backdrop of national strategies such as ecological civilization construction, arable land protection redlines, and territorial spatial planning, the competitive interactions among production, living, and ecological spaces have become increasingly complex [10,11]. Influenced by pronounced variations in natural geographic conditions and regional development gradients, land use conflicts in China exhibit strong spatial heterogeneity, making the country an ideal case for studying the evolution and driving mechanisms of land use conflicts [12].

In recent years, a large body of research has focused on the identification, assessment, and regulation of land use conflicts, achieving significant progress in both methodological frameworks and practical applications. Previous studies have examined land use conflicts at the scales of urban agglomerations [13], counties [14], and river basins [15], using perspectives such as multifunctional land use, landscape pattern analysis, and spatial suitability evaluation. However, studies systematically characterizing the spatiotemporal evolution of land use conflicts at the national scale remain limited. Due to scale constraints, local-scale findings are often insufficient to directly inform national-level territorial governance decisions. Regarding driving-force analysis, most existing studies rely on traditional statistical methods such as multiple linear regression or logistic regression [16], which usually assume independence among driving factors and thus struggle to capture the nonlinear coupling between natural conditions and human activities [17]. Yet, land use conflict is inherently the result of multiple interacting natural and socioeconomic factors, and its spatial differentiation is often significantly influenced by factor interactions. Neglecting these interactions may lead to biased interpretations of the mechanisms underlying conflict formation.

Therefore, this study focuses on China as a whole from 2000 to 2020, integrating land use transition matrices, a land use conflict comprehensive index, and geographic detector methods to systematically reveal the spatiotemporal evolution and driving mechanisms of land use conflicts. Specifically, the study aims to address the following scientific questions: (1) under the context of rapid urbanization, what are the overall spatiotemporal patterns of land use conflicts in China? (2) What are the relative contributions of natural geographic and socioeconomic factors to the spatial differentiation of land use conflicts? (3) Do significant enhancement or nonlinear interaction effects exist among different driving factors? This study is intended to provide a scientific basis for the development of territorial spatial planning and differentiated land management policies in China.

2. Materials and Methods

2.1. Study Area

This study considers the entire territory of China as the research area (Figure 1). Located in East Asia along the western Pacific, China has a vast land area and highly complex natural geographic conditions, making it one of the countries with the most diverse land use types and pronounced regional differences globally. In terms of topography, China exhibits a distinctive “three-step” pattern with high elevations in the west and low elevations in the east, characterized by dramatic terrain variation. Regarding climate, China is influenced by the East Asian monsoon system and its complex topography, resulting in pronounced spatial gradients in temperature and precipitation. Mean annual temperature generally decreases from south to north, covering a range of climate zones from tropical to cold temperate regions. Precipitation exhibits a decreasing trend from the southeastern coast toward the northwestern inland, creating a mosaic of humid, semi-humid, semi-arid, and arid zones. Such pronounced differences in natural conditions impose fundamental constraints on land use structures and the intensity of human activities. Under these rigid natural constraints, China has undergone rapid urbanization and industrialization over the past decades. With a large population and significant regional development gradients, the competition among production, living, and ecological spaces has become particularly prominent. Different regions face heterogeneous development pressures regarding urban expansion, farmland protection, and ecological restoration, making China a typical case for studying the spatiotemporal patterns of land use conflicts and their driving mechanisms.

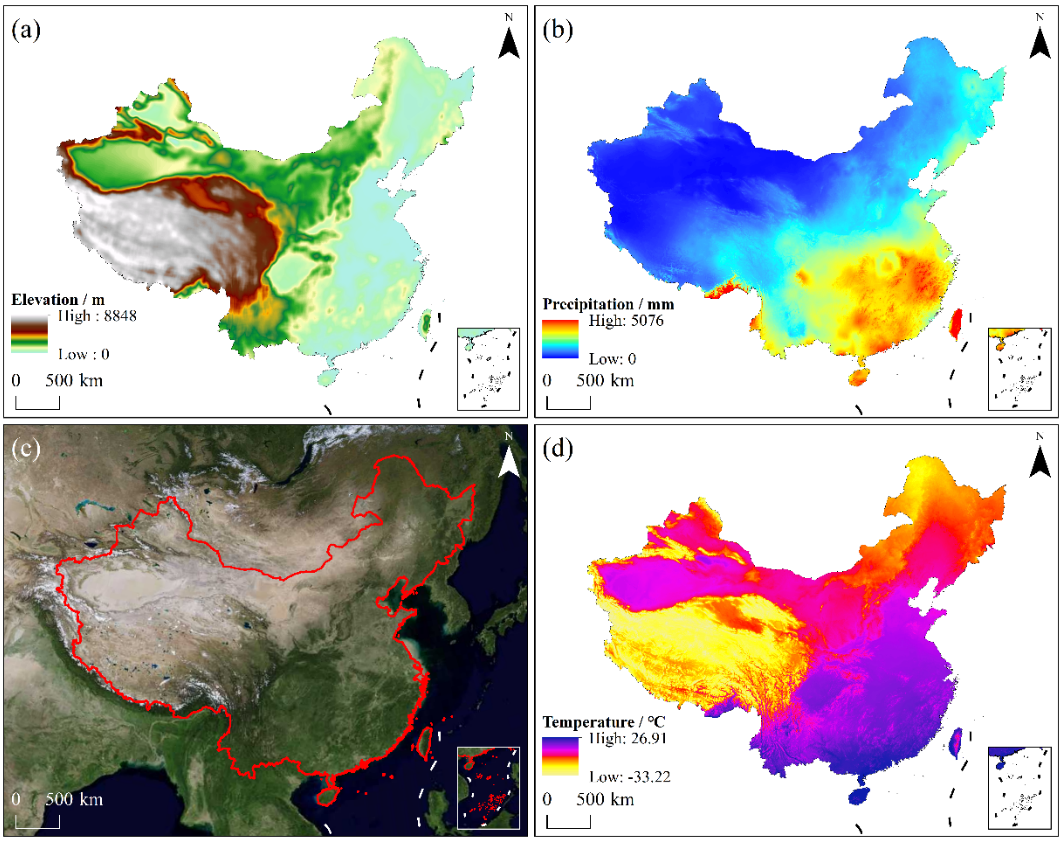

Figure 1. Study area (**a**): elevation; (**b**): mean annual precipitation in 2020; (**c**): Tianditu imagery; (**d**): temperature in 2020.

2.2. Data Sources

The data used in this study primarily consist of three categories: land use data, natural geographic data, and socioeconomic data (Table 1). To ensure consistency and comparability of multi-source data in spatial analyses, all datasets were subjected to unified spatial preprocessing within the ArcGIS 10.8 platform. Specifically, all spatial data were projected to the WGS_1984_Albers coordinate system to minimize area distortion and its potential impact on spatial calculations. In addition, raster datasets of varying resolutions were resampled using the nearest-neighbor and bilinear interpolation method to construct an analysis database with spatially matched grids.

Table 1. Data overview.

Data Name	Data Type	Spatial Resolution	Data Source
Administrative boundary	Vector	/	https://www.tianditu.gov.cn/ (accessed on 1 January 2026)
Land use data	Raster	30 m	https://zenodo.org/records/15063683 (accessed on 1 January 2026)
NDVI	Raster	30 m	https://www.nesdc.org.cn/sdo/detail?id=60f68d757e28174f0e7d8d49 (accessed on 1 January 2026)
Precipitation	Raster	1 km	https://www.geodata.cn/main/face_science_detail?guid=192891852410344&typeName=face_science (accessed on 1 January 2026)
Air temperature	Raster	1 km	https://www.geodata.cn/main/face_science_detail?guid=164304785536614&typeName=face_science (accessed on 1 January 2026)
Evapotranspiration	Raster	1 km	https://www.geodata.cn/main/face_science_detail?guid=34595274939620&typeName=face_science (accessed on 1 January 2026)
GDP	Raster	1 km	https://www.geodata.cn/main/face_science_detail?typeName=face_science&guid=56398100181506 (accessed on 1 January 2026)
Population density	Raster	1 km	https://hub.worldpop.org/geodata/listing?id=77 (accessed on 1 January 2026)
Nighttime light data	Raster	500 m	https://www.geodata.cn/main/face_science_detail?typeName=face_science&guid=38493429288227 (accessed on 1 January 2026)
DEM data	Raster	30 m	https://panda.copernicus.eu/panda (accessed on 1 January 2026)
Land surface temperature	Raster	1 km	https://earthengine.google.com/ (accessed on 1 January 2026)

2.3. Methods

2.3.1. Land Use Change Analysis

To systematically characterize the changes in both the quantitative structure and spatial patterns of land use in China during the study period, this study employs the land use transition matrix method to analyze the mutual conversion relationships among different land use types. The land use transition matrix, originating from systems analysis theory, is a quantitative tool capable of simultaneously reflecting the area composition of each land use type at the beginning and end of the study period, as well as the direction and magnitude of transitions between different land use categories [18–20]. The calculation formula is as follows:

$$S_{ij} = \begin{bmatrix} S_{11} & \cdots & S_{1n} \\ \vdots & \ddots & \vdots \\ S_{n1} & \cdots & S_{nn} \end{bmatrix} \tag{1}$$

where *S* represents the land area; *n* denotes the number of land use types; and *i* and *j* indicate the land use type codes at the beginning and the end of the study period, respectively.

2.3.2. Land Use Conflict Index

Land use conflicts manifest not only as spatial competition between different land use types, but more profoundly reflect the imbalance within the internal structure and functions of land use systems under human disturbance. Drawing upon the “pattern-process” theory of landscape ecology, this paper constructs the land use conflict comprehensive index (LCCI) [21] from three dimensions: system complexity, vulnerability, and stability. The LCCI quantifies the overall conflict intensity through three dimensions: “external disturbance-intrinsic sensitivity-structural resistance”. To achieve a spatialized representation of conflict intensity, a moving window approach was applied across the study area. A fixed-size analysis window (30 km × 30 km in this study) was continuously shifted across space, within which landscape pattern metrics were calculated to characterize the spatial heterogeneity of land use conflicts among different regions.

(1) Complexity index (CI)

CI represents the external pressure and intensity of human disturbance [21]. Higher complexity in patch boundaries often signifies a high degree of interweaving between different land use types (e.g., urban vs. agricultural), which increases the frequency of material and energy exchange, thereby raising the potential for conflict. The calculation formula is as follows:

$$\mathrm{CI} = \sum_{i=1}^{m} \sum_{j=1}^{n} \left[\frac{2\ln\left(0.25P_{ij}\right)}{\ln\left(a_{ij}\right)} \times \frac{a_{ij}}{A} \right] \tag{2}$$

where P_{ij} denotes the perimeter of the *j*th patch of the *i*th land use type, a_{ij} is the area of the corresponding patch, and A represents the total area of the moving window.

(2) Vulnerability index (VI)

VI represents the internal sensitivity of the land system [21]. Different land use types have varying levels of resistance to external disturbances. Systems with higher vulnerability are more susceptible to functional degradation when faced with competing demands. The formula is expressed as follows:

$$\mathrm{VI} = \sum_{i=1}^{m} F_i \times \frac{S_i}{S} \tag{3}$$

where F_i denotes the vulnerability coefficient of the *i*th land use type, S_i is the area of the *i*th land use type within the window, and S represents the total area of the moving window.

(3) Stability index (SI)

SI represents the systemic response and resistance [21]. A fragmented landscape (high patch density) indicates low stability, suggesting the system is less capable of maintaining its original functional state under pressure, thus leading to higher conflict intensity. The calculation formula is as follows:

$$\begin{cases} \mathrm{SI} = 1 - \dfrac{PD - PD_{min}}{PD_{max} - PD_{min}} \\ PD = \dfrac{N}{A} \end{cases} \tag{4}$$

where N denotes the total number of patches within the moving window and A is the window area.

(4) Land use conflict comprehensive index (LCCI)

By integrating these three dimensions—pressure (complexity), sensitivity (vulnerability), and resistance (stability)—the LCCI provides a comprehensive spatial representation of the "potential risk-process intensity-structural response" of land use conflicts, the LCCI is calculated as follows:

$$\mathrm{LCCI} = \mathrm{CI} + \mathrm{VI} - \mathrm{SI} \tag{5}$$

To facilitate comparisons across different periods and regions, the LCCI values were normalized. Subsequently, the natural breaks (Jenks) method was applied to classify land use conflict intensity into five levels: extremely low conflict (Level 1), low conflict (Level 2), moderate conflict (Level 3), high conflict (Level 4), and extremely high conflict (Level 5).

The robustness of LCCI index at the national scale in China can be justified for several reasons. First, although China has vast territory with marked regional heterogeneity in physical geography and socioeconomic conditions, all three sub-indices can be calculated from publicly available raster datasets, and the computed LCCI values show good consistency with field observations and policy implementation outcomes. Finally, in the context of China's rapid urbanization coexisting with ecological conservation, the LCCI effectively captures the changing intensity of competition among the three primary land use functions—construction expansion, agricultural protection, and ecological constraint—making it well suited for spatiotemporal analysis of land use conflict at the national scale.

2.3.3. Driving Force Analysis

To quantitatively reveal the driving mechanisms underlying the spatial differentiation of land use conflicts, this study employs the geographic detector model to analyze potential driving factors and their interactions. The geographic detector is a statistical method designed to identify spatial heterogeneity and explain its underlying causes. Its fundamental assumption is that if an independent variable has a significant influence on a dependent variable, their spatial distributions should exhibit a high degree of consistency [22]. Compared with traditional regression models, the geographic detector does not require assumptions of linearity or independence among variables. It is capable of effectively identifying the explanatory power of individual factors as well as the interaction effects between multiple factors, making it particularly suitable for analyzing complex geographical processes driven by the coupling of natural environmental conditions and human activities [23]. In this study, both factor detection and interaction detection were applied. The selected driving factors include natural environmental and socioeconomic variables (Table 2).

(1) Factor detector

The factor detector is used to quantify the explanatory power of a single driving factor on the spatial differentiation of land use conflicts [24]. This explanatory power is measured by the q statistic, which ranges from 0 to 1. A larger q value indicates a stronger ability of the factor to explain the spatial distribution of land use conflicts [25]. The mathematical expression is as follows:

$$q = 1 - \frac{\sum_{h=1}^{L} N_h \sigma_h^2}{N\sigma^2} \tag{6}$$

where q denotes the explanatory power of the driving factor; L represents the number of strata of the driving factor, obtained by discretizing continuous variables using the natural breaks method or predefined classification criteria; N_h and σ_h^2 are the number of samples and the variance of the dependent variable within stratum h, respectively; and N and σ^2 represent the total number of samples and the variance of the dependent variable over the entire study area.

(2) Interaction detector

The interaction detector is used to identify the joint effects of two driving factors on the spatial differentiation of land use conflicts. By comparing the q values of individual factors with the q value obtained from their interaction, it is possible to determine whether the interaction between factors exhibits enhancement, weakening, or independence [26]. This approach effectively reveals the nonlinear coupling mechanisms between natural factors and socioeconomic factors during the formation of land use conflicts [27].

Table 2. Selection of driving factors for land use conflict.

Factor Type	Factor Name	Abbreviation
Natural factors	Elevation	ele
	Slope	slope
	Precipitation	pre
	Temperature	tem
	Evapotranspiration	pet
	Vegetation cover	ndvi
Socioeconomic factors	GDP	gdp
	Land surface temperature	lst
	Population density	pop
	Nighttime light intensity	nl

3. Results

3.1. Spatiotemporal Evolution of Land Use Types in China

From 2000 to 2020, the overall spatial pattern of land use types in China remained relatively stable. However, pronounced structural adjustments occurred among different land use categories (Figure 2). At the macro scale, China's land use pattern exhibits a clear east–west differentiation delineated by the Hu Huanyong Line. Areas west of the Hu Huanyong Line are constrained by elevation and precipitation conditions, with grassland and bare land dominating land use, mainly distributed across the Qinghai–Tibet Plateau and the arid regions of northwestern China. Forest land is primarily concentrated in the Greater and Lesser Khingan Mountains and the Changbai Mountains in northeastern China, as well as in the Hengduan Mountains of southwestern China and the hilly regions of southern China, forming critical ecological barriers. Cultivated land is mainly distributed in relatively flat areas with favorable hydrothermal conditions, including the Northeast China Plain, the North China Plain, the middle and lower reaches of the Yangtze River Plain, and the Sichuan Basin. Although construction land accounts for a relatively small proportion of the national land use structure, it exhibits strong spatial agglomeration, being primarily concentrated in major urban agglomerations such as the Beijing–Tianjin–Hebei region, the Yangtze River Delta, and the Pearl River Delta.

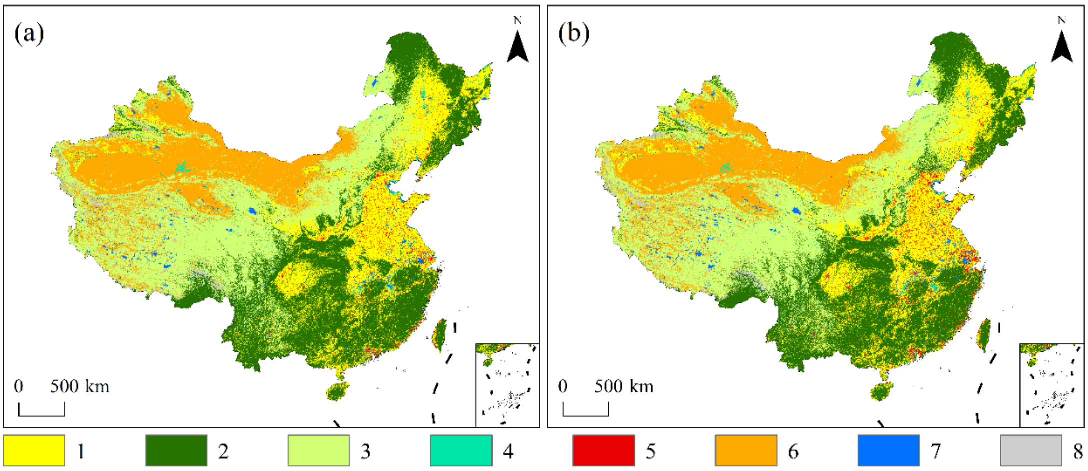

Figure 2. Spatial distribution of land use types in China for the years 2000 and 2020 (1: cropland, 2: forest land, 3: grassland, 4: wetland, 5: built-up land, 6: bare land, 7: water body, 8: ice and snow cover).

The land use transition analysis (Table 3 and Figure 3) further reveals the dominant conversion pathways and their magnitudes during 2000–2020. Construction land expansion was the most prominent land use change, with cultivated land serving as its primary source. Approximately 93.71 million patch units of cultivated land were converted into construction land, with this process being particularly concentrated in eastern coastal regions and around core cities in central China, reflecting the persistent encroachment of urban land on agricultural land under rapid urbanization. Meanwhile, ecological land exhibited a clear restoration trend, with approximately 40.67 million and 72.57 million patch units of cultivated land converted into forest land and grassland, respectively, mainly occurring in ecologically fragile areas and regions targeted by key ecological policies. In addition, substantial bidirectional transitions were observed between grassland and bare land, indicating dynamic adjustments of land use types in northwestern China under the combined influence of climate variability and environmental change.

Overall, land use changes in China from 2000 to 2020 are characterized by the coexistence of continuous construction land expansion and ecological restoration, reflecting a pronounced restructuring of land use patterns driven by the simultaneous advancement of urbanization and ecological conservation.

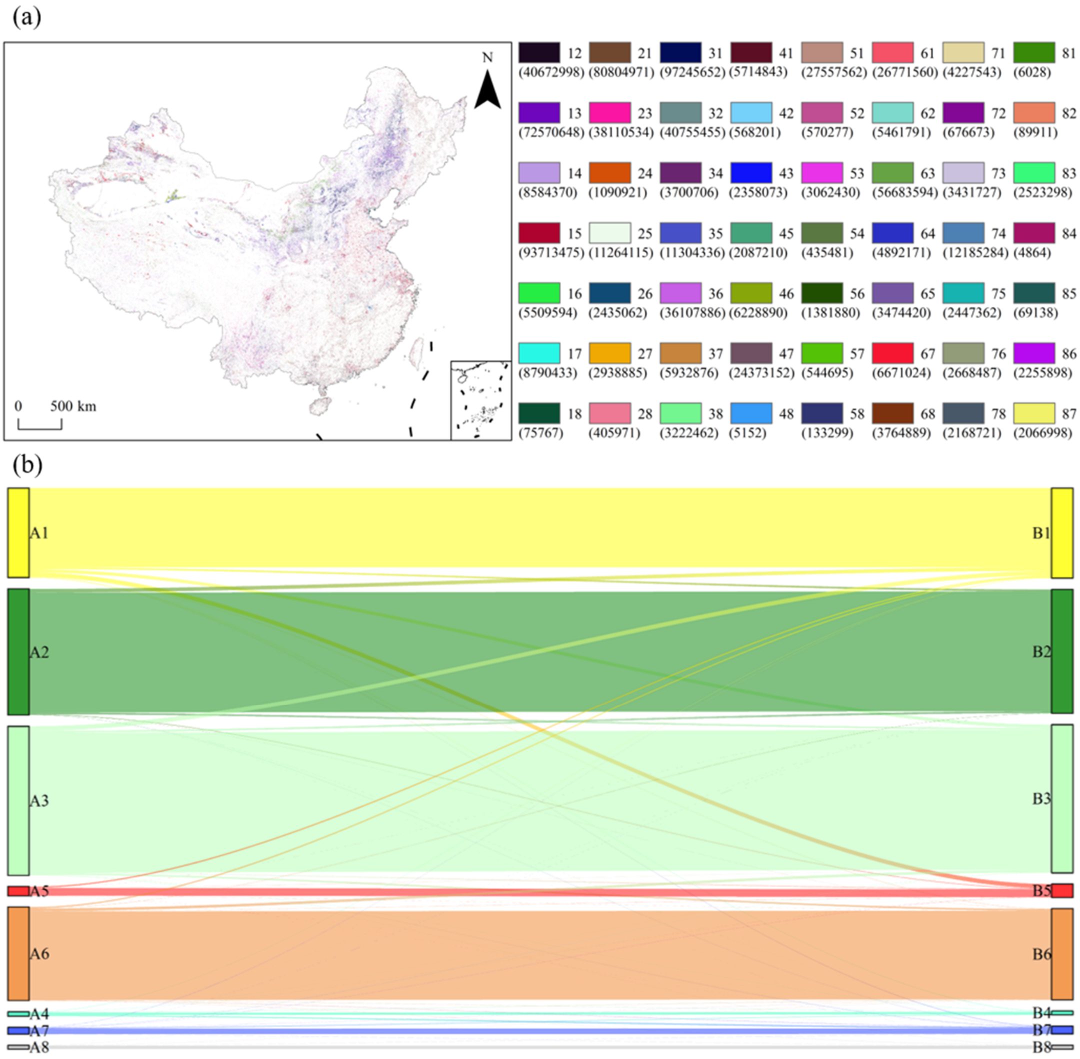

Figure 3. Land use transitions in China from 2000 to 2020. (**a**): "12" indicates land type 1 in 2000 transitioning to type 2 in 2020, with the number in parentheses representing the specific count of transferred patches; other codes follow the same logic. (**b**): "A1" represents land type 1 in 2000, and "B1" represents land type 1 in 2020.

Table 3. Land use transition matrix in China from 2000 to 2020 (unit: km^2).

Type	1	2	3	4	5	6	7	8
1	1,560,877.12	36,605.70	65,313.58	7725.93	84,342.13	4958.63	7911.39	68.19
2	72,724.47	2,375,207.62	34,299.48	981.83	10,137.70	2191.56	2645.00	365.37
3	87,521.09	36,679.91	2,748,130.77	3330.64	10,173.90	32,497.10	5339.59	2900.22
4	5143.36	511.38	2122.27	47,488.12	1878.49	5606.00	21,935.84	4.64
5	24,801.81	513.25	2756.19	391.93	150,009.56	1243.69	490.23	119.97
6	24,094.40	4915.61	51,015.23	4402.95	3126.98	1,740,525.29	6003.92	3388.40
7	3804.79	609.01	3088.55	10,966.76	2202.63	2401.64	107,293.60	1951.85
8	5.43	80.92	2270.97	4.38	62.22	2030.31	1860.30	66,000.26

3.2. Spatiotemporal Evolution of Land Use Conflicts in China

From 2000 to 2020, land use conflicts in China exhibited a gradual adjustment trend characterized by the expansion of low-intensity conflicts and the contraction of high-intensity conflicts (Table 4), while the overall conflict situation remained severe. Severe conflict (Level 4) consistently dominated the national landscape, with its area proportion only slightly declining from 58.60% in 2000 to 57.44% in 2020, still accounting for more than half of the national territory. Meanwhile, the proportions of very slight (Level 1) and slight conflicts (Level 2) increased by 0.43% and 0.46%, respectively, and moderate conflict (Level 3) expanded from 27.79% to 28.25%. The observed temporal evolution may suggest that the implementation of national spatial planning instruments, such as territorial spatial planning and ecological protection redlines, might have alleviated land use pressure in certain regions and could be associated with a modest reduction in extreme conflict (Level 5), which declined from 5.56% to 5.37%. However, ongoing urbanization and the intensified concentration of population and industries may have continuously broadened the scope of competition among land use functions, potentially offsetting part of the governance gains through the expansion of medium-intensity conflicts.

Spatially, land use conflicts in China display pronounced zonal differentiation, characterized by a clear pattern of "higher in the east than in the west, and stronger in the south than in the north," with the overall spatial configuration remaining highly stable throughout the study period (Figure 4). Areas of severe and extreme conflict (Levels 4 and 5) are predominantly concentrated east of the Hu Huanyong Line, particularly in densely populated regions such as the North China Plain, the middle–lower reaches of the Yangtze River Plain, the Sichuan Basin, and major coastal urban agglomerations. As both key grain-producing areas and national economic centers, these regions experience intense spatial overlap among urban expansion, cropland protection, and ecosystem conservation, resulting in pronounced trade-offs among competing land use functions. In contrast, very slight and slight conflict areas (Levels 1 and 2) are mainly distributed in regions with harsh natural conditions and relatively low human activity intensity, including the Qinghai–Tibet Plateau, the Tarim Basin, and the arid zones of the Inner Mongolia Plateau. A comparison between the spatial patterns in 2000 and 2020 indicates that, although the macro-scale configuration of conflict levels has not fundamentally changed, extreme conflict grids have shown localized expansion and clustering in rapidly urbanizing core regions such as the Beijing–Tianjin–Hebei and Yangtze River Delta. This highlights that, under the transition toward high-quality development, mitigating human–land conflicts in high-intensity development zones remains a central challenge for future territorial spatial optimization and refined governance.

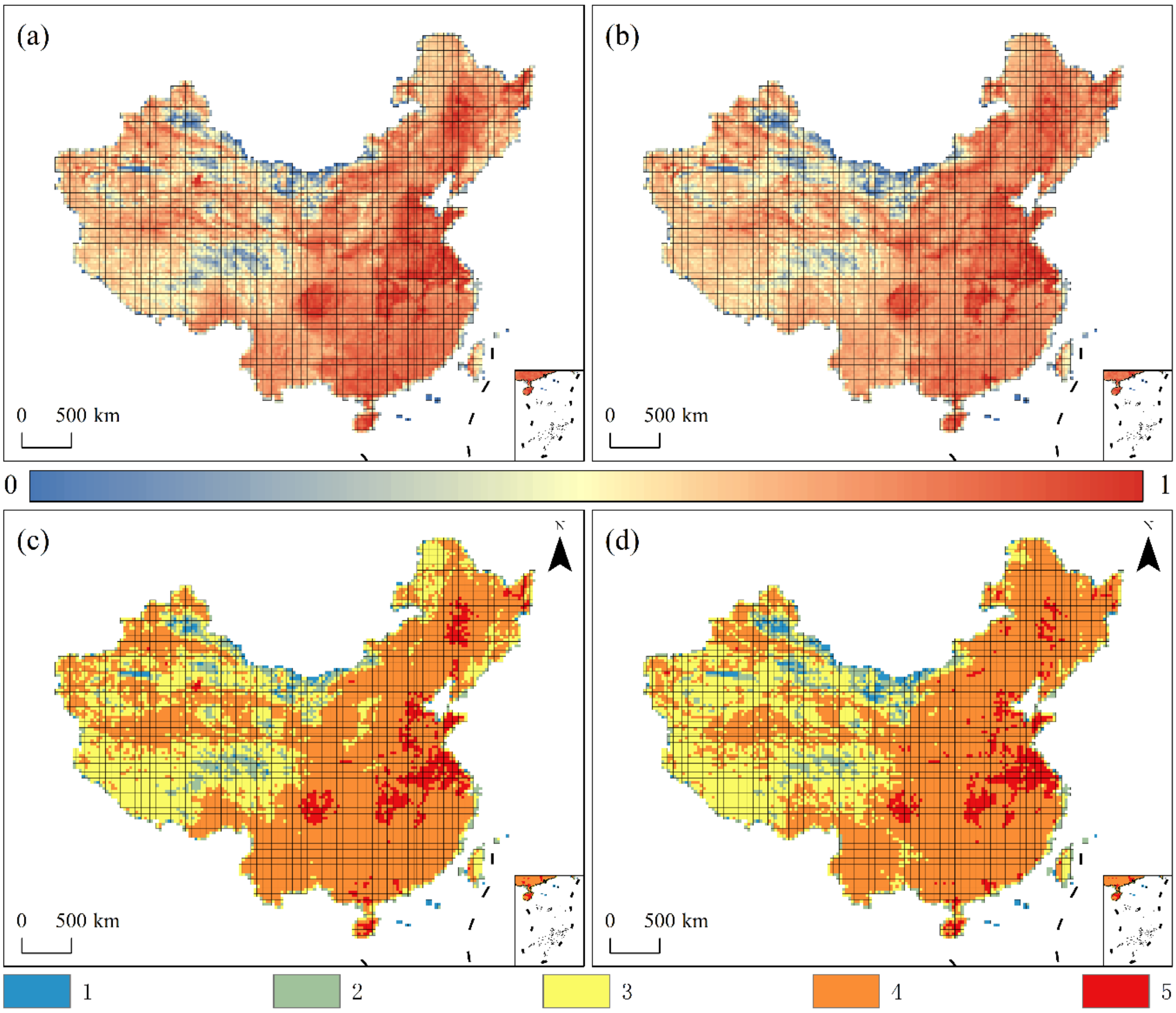

Figure 4. Spatial distribution of land use conflict (**a**,**b**) and conflict levels (**c**,**d**) in China for 2000 and 2020.

Table 4. Area statistics of land use conflict levels in China.

Conflict Level	Number of Grids (2000)	Area Proportion (2000)	Number of Grids (2020)	Area Proportion (2020)
1	144	1.29%	192	1.72%
2	753	6.76%	805	7.22%
3	3098	27.79%	3149	28.25%
4	6531	58.60%	6402	57.44%
5	620	5.56%	598	5.37%

3.3. Driving Forces of Land Use Conflicts in China

The results indicate that both natural environmental conditions and socioeconomic activities jointly shape the spatial pattern of land use conflicts (Figure 5a). The explanatory power of different driving factors varies significantly, and their relative importance exhibits clear stage-dependent characteristics over the study period. Results from the single-factor detector show that socioeconomic factors generally exhibit stronger explanatory power. Among them, population density, GDP density, and the proportion of construction land consistently present high q values, indicating that the intensity of human activities is the primary determinant of the spatial differentiation of land use conflicts. Among natural factors, elevation, annual precipitation, and slope also demonstrate certain explanatory power, although their q values are generally lower than those of socioeconomic factors. From a temporal perspective, during the period 2000–2010, natural factors exhibited relatively stronger explanatory power, suggesting that land use conflicts in the early stage were still significantly constrained by resource and environmental conditions. In contrast, during 2010–2020, the explanatory power of socioeconomic factors increased markedly, with q values of several indicators rising substantially. This shift reflects the increasingly dominant role of human activities in shaping land use conflicts under accelerated urbanization and economic development. The interaction detector results reveal that the interactions between any two driving factors are characterized by either bi-factor enhancement or nonlinear enhancement, with no independent or weakening relationships observed (Figure 5b). Interactions among socioeconomic factors are particularly pronounced. For example, combinations of population density and GDP density, as well as precipitation and population density, yield interaction q values that are significantly higher than those of the individual factors. Moreover, interactions between natural and socioeconomic factors generally exhibit stronger explanatory power than single factors alone, indicating that land use conflicts are not driven by isolated factors but arise from the coupled effects of multiple drivers. Overall, the geographic detector analysis clearly reveals the multi-factor driving mechanisms underlying the spatial differentiation of land use conflicts in China, providing a robust quantitative basis for further discussion of conflict formation mechanisms.

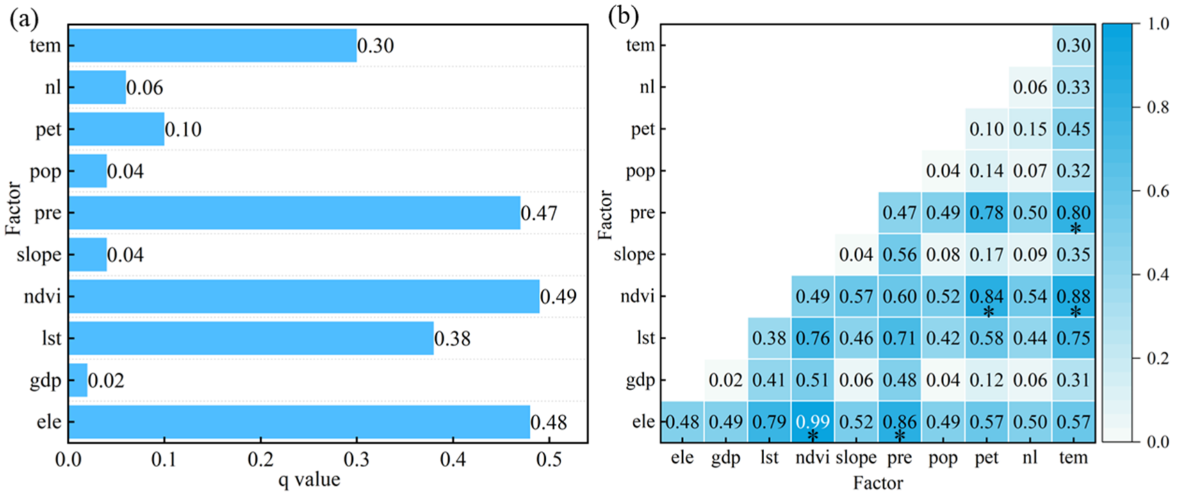

Figure 5. Geodetector results for land use conflict in China in 2020. (**a**): factor detection; (**b**): interaction detection, with * are bi-factor enhancement, without * are nonlinear enhancement.).

4. Discussion

4.1. Comparison with Previous Studies

The land use change and conflict evolution patterns revealed in this study are largely consistent with the general trends reported in previous research. Numerous studies have shown that under rapid urbanization, the coexistence of continuous expansion of construction land, encroachment on cultivated land, and restoration of ecological land has become a typical feature of land use change in China [13,14]. The findings of this study—particularly that construction land expansion is primarily sourced from cultivated land and that land use conflict intensity in eastern and central China is significantly higher than in western regions—are highly consistent with existing studies on urban expansion and intensified land use competition [9,28]. These results further validate the fundamental evolutionary characteristics of China's land use system at the macro scale [29].

However, compared with previous studies that mainly focused on describing individual land use changes or specific conflict phenomena, this study extends both the analytical scale and the methodological framework for conflict characterization. On the one hand, many existing studies rely on administrative units or fixed regions as analytical units, which are often constrained by scale effects and administrative boundaries [12]. By introducing a moving window approach and constructing the land use conflict comprehensive index at the pixel scale, this study effectively reduces the influence of administrative boundaries and more realistically captures the spatial continuity and heterogeneity of land use conflicts [30]. On the other hand, previous studies often simplified land use conflicts into binary relationships, such as cultivated land versus construction land or ecological land versus production land. In contrast, this study characterizes land use conflicts from the integrated dimensions of complexity, vulnerability, and stability, allowing for a more comprehensive identification of potential risks arising from internal structural imbalances within the land use system.

Regarding driving force analysis, previous studies have largely relied on regression-based or correlation-based methods, which typically assume independence among driving factors and thus have limited capacity to reveal multi-factor coupling effects. By applying the geographic detector method, this study not only quantitatively identifies the explanatory power of individual natural and socioeconomic factors but also systematically uncovers the interaction-enhancing effects among different drivers. The results demonstrate that interactions between natural and socioeconomic factors generally exhibit stronger explanatory power than single-factor effects [17]. This finding provides new empirical evidence for understanding the mechanisms underlying land use conflict formation and addresses a key limitation of existing studies in multi-factor coupling analysis [31].

Overall, building upon previous research, this study deepens the understanding of the spatial patterns and driving mechanisms of land use conflicts in China through scale refinement, index integration, and methodological synthesis.

4.2. Zoning-Based Management and Optimization Strategies for Land Use Conflicts

Based on the spatiotemporal differentiation of land use conflicts and the identified driving mechanisms, implementing differentiated and zoning-based land use management and optimization strategies is a key pathway to mitigating land use conflicts in China and promoting regional sustainable development. Regions with different conflict levels exhibit significant disparities in land use structure, dominant driving forces, and development stages, thereby necessitating targeted management objectives and regulatory pathways.

For areas characterized by high and extremely high conflict levels, which are mainly distributed in eastern coastal regions, core urban agglomerations, and urban–rural transition zones, land use conflicts are primarily manifested as intense competition between construction land expansion, cultivated land protection, and ecological security. In such regions, management strategies should be guided by the combined principles of rigid constraints and stock-based optimization. On the one hand, strict enforcement of cultivated land protection red lines and ecological conservation red lines is essential to curb disorderly urban sprawl. On the other hand, priority should be given to optimizing internal urban land use structures by improving the efficiency of existing construction land, promoting industrial agglomeration, and encouraging compact spatial development, thereby reducing the demand for additional land conversion. Meanwhile, in peri-urban areas, systematic protection of agricultural production spaces and ecological buffer zones should be strengthened to alleviate conflict risks arising from functional mismatches.

For areas with moderate conflict levels, which are mainly located in major grain-producing regions in central China and rapidly urbanizing expansion zones, land use conflicts are characterized by multi-dimensional trade-offs among production, living, and ecological spaces. Management strategies for these regions should focus on strengthening territorial spatial use regulation and functional zoning guidance. By optimizing agricultural structures, improving cultivated land quality, and promoting large-scale and intensive agricultural management, the stability of the land use system can be enhanced. At the same time, urban development boundaries should be reasonably delineated to prevent excessive encroachment of construction land on high-quality cultivated land and ecological areas, thereby achieving a coordinated balance between agricultural production security and regional development.

For areas with low and very low conflict levels, which are predominantly distributed in western China, key ecological function zones, and regions with high conservation intensity, land use conflicts are relatively mild, while ecosystem vulnerability remains high. In such regions, management strategies should prioritize ecological conservation and risk prevention by strictly controlling high-intensity human activities and preventing latent conflicts from transforming into explicit ones. In addition, measures such as ecological compensation, development of eco-friendly industries, and support for green livelihoods can be adopted to enhance regional resilience and avoid the emergence of new land use conflicts induced by resource exploitation or inappropriate land use.

Overall, zoning-based management of land use conflicts should be implemented within a nationally coordinated strategic framework, while being adapted to regional development stages and resource–environment carrying capacities. By establishing a multi-level and differentiated optimization and regulation system, it is possible to simultaneously enhance land use efficiency, safeguard ecological security, and promote coordinated regional development.

4.3. Limitations and Future Research

Although this study reveals the spatiotemporal evolution patterns and driving mechanisms of land use conflicts at the national scale, several limitations should be acknowledged. First, land use data from only two time points (2000 and 2020) were used, which may smooth temporal fluctuations and obscure short-term evolution and policy-induced discontinuities. Second, although ten representative natural and socioeconomic factors were selected for the driving force analysis, implicit factors that are difficult to quantify—such as land tenure arrangements and decision-making processes—were not included, potentially leading to an underestimation of the role of socioeconomic drivers. Future research could be advanced in three main directions. First, improving spatiotemporal resolution and integrating multi-scale analytical frameworks would allow for more precise identification of land use conflict hotspots. Second, scenario-based simulations using models such as the Patch-generating Land use Simulation (PLUS) model could be employed to explore alternative land use trajectories and support forward-looking territorial spatial planning. Third, incorporating multi-source big data, including points of interest and mobile phone signaling data, could help overcome the time-lag limitations of conventional statistical data and enable a more comprehensive analysis of the complex natural–social–policy driving mechanisms underlying land use conflicts.

5. Conclusions

Based on multi-source datasets from 2000 and 2020, this study systematically examined the spatiotemporal evolution of land use conflicts in China and their underlying driving mechanisms by integrating land use transition matrices, a spatial conflict index model, and the geographical detector method. The main conclusions are summarized as follows:

(1) Land use change in China exhibits a dual pattern characterized by the expansion of construction land and ecological restoration. Between 2000 and 2020, rapid urbanization led to large-scale conversion of cropland to construction land, particularly in eastern coastal regions. Meanwhile, ecological restoration policies promoted the transformation of cropland into forest and grassland in ecologically fragile areas, reflecting the coexistence of development-oriented expansion and conservation-driven restoration.

(2) The spatial pattern of land use conflicts maintains pronounced heterogeneity, with higher conflict intensity in southeastern China and lower intensity in northwestern regions, while governance effectiveness has begun to emerge. High-level conflict areas are primarily concentrated east of the Hu Huanyong Line and within agro–pastoral transition zones. Although severe conflicts (Level 4) still dominate the overall landscape (accounting for more than 57%), the declining proportion of extremely severe conflicts (Level 5) indicates that territorial spatial optimization policies have played a positive role in alleviating human–land tensions.

(3) The driving mechanisms of land use conflicts are characterized by a nonlinear coupling between natural background constraints and human activity pressures. Vegetation cover and elevation are the dominant factors shaping the macro-scale distribution of land use conflicts (with q-values of 0.49 and 0.48, respectively). Moreover, the interaction between natural conditions and human activities exhibits a significant nonlinear enhancement effect, with interaction q-values reaching as high as 0.99, highlighting that the superposition of multiple driving factors is a critical trigger of high-intensity land use conflicts.

Author Contributions

S.L.: methodology, software, data curation, writing—original draft; D.G.: conceptualization, writing—review & editing; H.W.: writing—review. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement

Data will be made available on request.

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Conflicts of Interest

The authors declare no conflict of interest.

Use of AI and AI-Assisted Technologies

No AI tools were utilized for this paper.

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