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Editorial

Smart Land Use Planning: New Theories, New Tools and New Practice

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Currently, the world has entered the fourth technological revolution era characterized by intelligence (the era of Industry 4.0). In the era of intelligence, how to leverage new technologies to drive the smart transformation of land use planning and achieve sustainable land utilization has become a critical issue. Presently, various measurement, photography, and remote sensing data collection and processing technologies are increasingly being integrated together with the aim of establishing more reliable and accurate geospatial reference data and related geodetic networks [1], providing important references for land use planning. With the development and improvement of technologies such as geographic information systems (GIS), remote sensing (RS), global positioning system (GPS), and artificial intelligence (AI), smart land use planning has gradually transitioned from theory to reality [2].

Smart land use planning is characterized by smart land management, refined planning, big data analysis, and intelligent monitoring. Its core lies in the widespread application of artificial intelligence algorithms such as machine learning (ML) and deep learning (DL), which generate large amounts of data to enhance the efficiency and level of land use planning. In addition, in recent decades, remote sensing sensors and related technologies have become increasingly complex and sophisticated [3]. They can provide a large amount of high-quality and high spatial resolution data, thus driving the smart development of land use planning. As an emerging form of land use planning based on big data simulation algorithms, smart land use planning represents the future direction of land use planning. In the future, land use planning will evolve towards greater precision and intelligence, further integrating technologies such as the Internet of Things (IoT), cloud computing (CC), and internet technology (IT) to form a diverse and interconnected smart planning decision-making management system.

Smart land use planning is currently in the process of transitioning from theory to practice. Therefore, there are still many discussions and analyses regarding the theories, tools, and practices of smart land use planning. However, the existing theories, tools, and practices are still anchored in the previous stages of land use planning and do not fully align with the emerging forms of smart land use planning that are maturing with the rapid development of artificial intelligence. Traditional methods used for land use planning, such as field surveys and participatory mapping, are time-consuming, expensive, and labor-intensive. Currently, with advancements in data collection techniques and increased computing power, it is possible to utilize big data algorithms for smart land use planning to improve the quality and efficiency of planning [4]. However, there is a lack of innovations and breakthroughs in the theories, tools, and practices of smart land use planning.

Consequently, there is still insufficient research into new theories, tools, and practices of smart land use planning, specifically those related to big data, artificial intelligence, and

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other emerging technologies. There is a need to expand and innovate in the realm of smart land use planning to accommodate these new developments and advancements.

Based on the background mentioned above, the theme of our Special Issue is "Smart Land Use Planning: New Theories, New Tools and New Practice." We have invited experts and scholars to share their theoretical insights and practical experiences in this field. Additionally, we aim to provide an academic platform for scholars and stakeholders to exchange ideas on smart land use planning theories, tools, and practices. Our goal is to delve into in-depth discussions on new theories, tools, and practices of smart land use planning and make some contributions to the relevant research areas.

Through a call for papers worldwide, we received a total of 11 submissions for this Special Issue, including 8 empirical research papers and 3 review articles. The content covered in the Special Issue papers is diverse and covers a wide range of distinct topics. Now, we will provide an overview of the content included in the collected papers for this issue.

Jia et al. (2023) focused on the issue of urban form changes in land use planning (Appendix A). Using the Carbon Emission Accounts and Datasets (CEADs) and studying 255 cities in China, they applied a fixed-effects panel quantile regression model to examine the heterogeneous effects of urban form on CO_2 emissions and its efficiency from three perspectives: urban expansion, urban compactness, and urban complexity. The study found that there is variation and heterogeneity in the impact of different urban forms on CO_2 emissions. Additionally, cities with different levels of CO_2 emissions exhibit heterogeneity in their approaches to CO_2 reduction. This research contributes to the theoretical advancements of smart land use planning in areas such as urban form changes and sustainable land use planning.

Li et al. (2023) integrated economic methods into the land planning process and provided economic support for land transfer planning. Using the 2018 China Family Panel Studies (CFPS) data and studying 4644 households, they employed the Simpson Index to investigate the impact of land transfer on the diversity of household consumption in rural China. The study addressed endogeneity issues through propensity score matching (PSM) and instrumental variable (IV) methods, while robustness checks were conducted using the Shannon Index. The research revealed that household consumption diversity decreases for households acquiring land, while it relatively increases for households transferring land. Furthermore, the impact of land transfer on low-income households was found to be more significant. This study provides critical information for smart land use planning.

Shi et al. (2022) focused on the sustainable assessment of tourism projects in rural land use planning and studied the resilience of tourism development projects in rural land (TDPRL). They constructed a "sustainable resilience model" from three dimensions: tractive force, driving force, and internal dynamic. They also established a qualitative evaluation index system through stakeholder meetings. Based on this, they used an analytic network process (ANP) to quantitatively evaluate the resilience of tourism development projects in rural land. They provided an empirical analysis of three rural tourism projects in Zhengzhou, Henan Province, to validate the rationality of the evaluation index system. The research found that the sustainable resilience of tourism development projects in rural land depends on their fundamental aspects, and local elites and the core needs of stakeholders are also important influencing factors. This study offers a new tool for the development of rural tourism projects and land use planning decisions throughout their lifecycle.

Zhang et al. (2022) conducted research on the sustainable spatial planning of cultural tourism in the national economic zone, taking the Western Triangle Economic Zone in China (consisting of Xi'an, Chengdu, and Chongqing) as an example. Using social network analysis techniques such as network density, centrality analysis, and a core–periphery model, they studied the dynamic spatial pattern of cultural tourism internet attention in the Western Triangle Economic Zone based on Baidu Index data. The study revealed that the core cities with high internet attention on cultural tourism experience increasing radiating effects. The distribution pattern of cultural tourism internet attention is gradually becoming more balanced. Furthermore, the spatial–temporal pattern of cultural tourism internet

attention is influenced by factors such as transportation, reception facilities, consumer capacity, and the political environment. This research contributes to the realization of sustainable spatial planning for cultural tourism in the national economic zone through smart data governance. It represents an extension and innovation in the field of smart land use planning research by utilizing new algorithms in the era of intelligence.

Meng et al. (2022) conducted research on land use planning for tourist destinations in ethnic villages in mountainous areas. Taking the Jiaju Tibetan Village in Danba County, southwestern China, as an example, they developed a sustainable evaluation index system for tourist destinations. The research divided the sustainable evaluation index system into five levels: economic development, ethnic culture, management, sustainable development, and infrastructure and service facilities. Furthermore, they detailed the sub-levels and index levels under each criterion level and constructed matrices for each index level to calculate the weights of each indicator. This allowed them to derive a comprehensive score for the sustainability of the tourist destination. The study found that the cultural life of ethnic minorities and the level of transportation convenience are the most important factors influencing the sustainability of the tourist destination. The determinants of sustainable indicators should be adjusted according to the specific tourist destination, and traditional villages should learn from each other's experience in tourist development. The research provides references for adjusting and formulating tourist development strategies in traditional ethnic villages and for the smart land use planning of tourist destinations.

Yang et al. (2022) conducted a study on the suitability and spatial distribution characteristics of rural settlements in mountainous areas during land use planning. They focused on 525 rural settlements in karst mountainous areas in Songtao Miao Autonomous County, Guizhou Province, China. Using point model spatial analysis and neighborhood analysis methods, they examined the spatial distribution characteristics of rural settlements and used GeoDetector to investigate the influence of natural and regional environmental factors. They further developed a suitability evaluation model based on GeoDetector and the analytic hierarchy process (AHP) to address the subjective issues in weight allocation of the AHP. The study found that the spatial distribution of rural settlements was mainly random, and it was influenced by both natural and regional environmental factors, with slope and distance from rivers having the greatest impact. The research provides references for the planning and reconstruction of rural settlements in mountainous areas.

Gao et al. (2022) focused on the analysis of landscape ecological risk in the process of land use planning. Using land use data from 2000, 2010, and 2020, they selected Sichuan Province and Yunnan Province as the study areas. They employed an enhanced Markov-PLUS (patch-generating land use simulation) model to predict and analyze the spatial distribution patterns of landscape ecological risk under three scenarios: business-as-usual (BAU), urban development and construction (UDC), and ecological development priority (EDP). The study also explored the influence of terrain conditions on landscape ecological risk. The research found that the landscape ecological risk index showed an initial increase followed by a decrease over the past 20 years. Furthermore, the highest risk areas under the three scenarios expanded to a spatial extent. Additionally, the study emphasized the value of multiscale geographically weighted regression (MGWR) in identifying spatial heterogeneity in terrain gradient and landscape ecological risk. This research provides theoretical and practical support for ecological conservation and land use planning in significant ecological functional areas.

Xiong et al. (2022) conducted a study on land use transition in the process of land use planning, focusing on the context of rapid urbanization. They selected Wuhan, a water-rich city in China, as the study area. Using remote sensing image data and macro-economic data from 2000 to 2020, the researchers employed spatial analysis, equivalent factor calculation, and hot spot analysis methods to investigate the spatial–temporal patterns of land use transition in Wuhan and its impact on ecosystem service value. The study revealed that farmland, water, and built-up land were the main land use types in Wuhan. Furthermore, the variation in ecosystem service value in Wuhan was greatly influenced by the fluctuation

in the water area. By considering the transition patterns of land use, the research contributes to the practice of sustainable land use planning and provides valuable information for smart land use planning.

Zhuo et al. (2022) comprehensively considered the issue of urban land use mix in the process of land use planning. They conducted a literature review to summarize the development of urban land use mix strategies and reviewed the strategies employed in China since 1949. Specifically, the study first reviewed the global and Chinese development of land use mix strategies and further summarized the theoretical evolution of land use mix from four perspectives: ideological evolution, conceptual model, quantitative measurements, and influential factors and effects. The research found that after several decades of evolution, although the theory of land use mix initially formed a certain theoretical paradigm and methodological system, there are still some gaps or deficiencies that require further development and improvement. The study conducted a comprehensive review of land use mix, particularly focusing on the land use mix strategies in urban areas. It contributes to the development and improvement of smart land use planning theory.

Ye et al. (2022) focused their research on free-trade zone (FTZ), which comprises smart land use planning tools aimed at increasing trade, attracting foreign investment, attempting financial openness, and other pilot economic reforms. The study conducted a literature review and visual analysis using CiteSpace, based on 953 articles from the Web of Science Core Collection, to identify the current status, new theories or practices, and potential future directions of FTZ research. The research found a significant increase in the number of studies on FTZs since 2013. China and the United States have played a leading role in FTZ research, and the growth trend in FTZ utilization remains considerable. This study contributes to a better understanding of FTZs and provides references for the experiences and practices of smart land use planning worldwide. It also offers a new research perspective and analytical tool for smart spatial planning, smart industrial planning, and smart management planning.

Guo et al. (2022) focused on big data analytics in smart land use planning and conducted a literature review to study urban parks in visitor dimension. The study employed a bibliometric approach and found an exponential growth in the number of publications on the topic in recent years. In the context of big-data-based urban park research, user visitation data were found to be the most frequently used, and the current research themes were centered around visitors' behavior, perception, and effect. The study further revealed that big data, by providing low-cost and timely information, adopting a user-centric perspective, and offering fine-grained site-specific information, is advantageous for urban park research. The research contributes methodological insights to the study of smart land use planning in the era of big data.

Based on the above content, it can be concluded that this Special Issue primarily utilizes techniques such as GIS, RS, landscape ecology methods, and resilience modeling to conduct in-depth analyses of various issues in land planning. These issues include urban form, sustainable tourist development, planning of rural settlements in mountainous areas, landscape ecological risk, urban land use transition, land use mix, and urban park. The research presented in this Special Issue is rich in content, diverse in themes, and distinct in characteristics. It covers current hot topics in smart land use planning, providing valuable references and insights for related research in the field of smart land use planning.

With the rapid development of "Internet +", big data analysis, artificial intelligence, and Internet of Things technology, the world has entered the era of intelligence, and smart land use planning is gradually moving from pure theoretical concepts to practical applications. The biggest feature of smart land use planning is the integrated application of multi-source big data and diverse tools. However, there are issues in the current application of smart land use planning, such as outdated planning theories, lack of innovative planning tools, and insufficient practical experience, which severely restrict the further development of smart land use planning. If we do not promote profound changes in theories, tools, and

practical aspects of smart land use planning, the practical application of land use planning will fail to keep pace with the pace of societal development.

Based on the content of this Special Issue, we have found that in promoting the theories and practices of smart land use planning, it is necessary to fully consider issues such as land use transition and land use mix in land use planning processes [5]. This should be followed by a theoretical analysis of land planning throughout its entire lifecycle. At the same time, it is also important to adapt to local conditions and consider the social and cultural elements [6], socio-economic activities [7], and objective needs for social equity and justice [8] in different countries and regions. Based on this foundation, the development and improvement of smart land use planning can be promoted.

In addition, land use planning should also prioritize the interests of multiple stakeholders, taking into account the interests and demands of end-users, planners, government departments, developers, community residents, and other entities. Currently, there is still a lack of active stakeholder participation in land use planning on a global scale [9,10]. Land use decisions are primarily made by local authorities, excluding various stakeholders who are affected by these decisions [11]. However, involving stakeholders in land use planning contributes to strengthening the planning process, ensuring responsible land use planning, and finding a balance between development needs and social wellbeing [12]. The degree of stakeholder participation, level of influence, and decision-making space are crucial for achieving responsible land use planning. The active involvement of stakeholders is a key requirement for effective land use planning, and engaging stakeholders in land use planning is a way to redistribute decision-making power and ensure social justice in land management interventions [13]. This can be achieved by establishing a "participatory planning" and "collaborative governance" model, thereby promoting breakthroughs in theories and practices of smart land use planning.

Furthermore, we have found that in innovating tools and practices of smart land use planning, it is crucial to fully utilize the existing big data platforms and couple multiple tools used in land use planning processes. By coupling multiple planning tools from both "top-down" and "bottom-up" approaches, and incorporating interdisciplinary approaches, as well as incorporating more precise algorithmic procedures, the development and improvement of smart land use planning in terms of tools and practices can be further advanced. This can be achieved by coupling and developing planning statistical tools, planning evaluation tools, and planning simulation tools, enhancing their integration and synergy. For example, studies have utilized the integration of logistic regression, Markov chains, and cellular automata [14] to simulate urban expansion in the metropolitan area of Tehran, Iran. Another approach coupled cellular automata, Markov chains, and artificial neural networks [15] to enhance the predictive capability of land use change.

We hope that this Special Issue will achieve desirable results by contributing to new theories, tools, and practices in smart land use planning while also providing an academic platform for exchange among experts, scholars, social organizations, policymakers, and managers. It is through the mutual exchange and collaboration of different individuals that we can advance the exploration and improvement of smart land use planning in terms of theories, tools, and practices.

We look forward to seeing more diverse achievements in the field of smart land use planning, especially practical experiences from around the world. We believe that through our collective efforts, there will be further research within and expansion of new theories, tools, and practices of smart land use planning.

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Appendix A

1. Jia, C.; Feng, S.; Chu, H.; Huang, W. The Heterogeneous Effects of Urban Form on CO_2 Emissions: An Empirical Analysis of 255 Cities in China. *Land* **2023**, *12*, 981, doi:10.3390/land12050981.
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