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Retraction

Retracted: Application of Intelligent Optimization Technology for Territorial Spatial Planning Based on Edge Network

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] Y. Mei, "Application of Intelligent Optimization Technology for Territorial Spatial Planning Based on Edge Network," *Wireless Communications and Mobile Computing*, vol. 2021, Article ID 4409706, 10 pages, 2021.

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Research Article

Application of Intelligent Optimization Technology for Territorial Spatial Planning Based on Edge Network

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As a new type of planning after the national sectoral adjustment, there is an overall lack of methodological research on the preparation of territorial spatial planning, and scholars mainly focus on the endowment of natural resources themselves, using traditional statistics, spatial and survey data and statistical analysis, spatial analysis and inductive deduction to statically evaluate the spatial carrying capacity and suitability of the national and provincial level and to make a static evaluation of ecological red line, basic farmland protection line, and The existing studies, however, have not taken into account the human and the environment. However, the existing studies seldom consider the dynamic impact of human activities on the spatial utilization of national land and lack scientific arrangement of ecological space, agricultural space, and urban space under the new development trend. This paper introduces big data that can directly reflect the spatial and temporal changes of human activities and discusses the direction and specific methodological framework of edge network-based optimization technology from four aspects: spatial suitability evaluation, ecological spatial planning, agricultural spatial planning, and urban spatial planning, emphasizing that "natural space" + "socio-economic activities" are mutually beneficial. The scientific path of territorial spatial planning under the interaction of "natural space" + "socio-economic activities" is emphasized.

1. Introduction

The rapid development of new technologies has contributed to the emergence of a smart society. From American sociologist, Daniel Bell's "post-industrial society" in the 1970s to the Nordic "information society" in the late 1990s, these concepts have emphasized the important contribution of knowledge and technological innovation to economic and social development. The latest concept of "smart society" places more emphasis on the development and application of new-generation information technologies such as the Internet, big data, and artificial intelligence as the basis for the formation of a digital, networked, and intelligent society, and focuses on the impact of the application of new technologies on economic and social development, residents' working life and social and spatial governance. It can be seen that, although the application of new technologies is very crucial, it is more important to go beyond technology to understand innovation, openness, and sharing for the construction of a smart society.

With the development of science and technology, a variety of services and applications are connected to the Internet, and there is a spurt of data growth in the network, and the growth is dominated by video traffic data. Edge network refers to the edge of the public network, which means it reduces the service delay and offloads the load pressure of the core network, and edge caching is one of its key technologies. Edge caching means that some resources are cached on the edge side, and when the service associated with it comes again, the resources are directly fetched from the cache, without the need to fetch them from the core network. Based on the edge network for territorial spatial planning, it continuously improves the data collection capability of the perception layer, ensures the data resources are real and effective, improves the basic information platform for intelligent territorial spatial planning, builds the monitoring and evaluation management system for the implementation of territorial spatial planning, and overall improves the integration capability of territorial spatial big data, intelligent analysis capability for planning preparation, network-driven capability for governance implementation, and accurate capability for monitoring and evaluation, to effectively support The whole process of spatial planning preparation, approval, implementation, monitoring, and evaluation of early warning. Promote the integration of information technology personnel and planning personnel, focus on strengthening the research and application of models and algorithms, and serve the work of planning implementation supervision and monitoring and early warning of resource and environment carrying capacity single evaluation and integrated evaluation.

For intelligent territorial spatial planning, it can be considered as the comprehensive application of information technology in the whole process of analysis and evaluation of the current situation, preparation of plans, monitoring and management, and evaluation of territorial spatial planning, especially through the integrated application and innovation of various new technologies to realize humanized, digital and intelligent territorial spatial planning process. Firstly, intelligent territorial spatial planning is reflected in intelligent decision-making supported by information technology, including the process of territorial spatial evaluation, planning, monitoring, and management supported by information systems and data analysis, as well as multi-departmental business collaboration and multi-body participation in territorial spatial planning and management. Secondly, intelligent territorial spatial planning is to promote the coordination of human-land relationship and the synergistic development of mobile space and material space through the integrated innovation and comprehensive application of information technology in the framework of intelligent society, facing the highly mobile and shared mobile space, and the requirements of ecological civilization. Thirdly, intelligent territorial spatial planning should emphasize human-oriented information application, integrated innovation of technology, and institutional innovation.

2. Related Work

Edge networking as a technology with great potential has been widely studied in traditional telecommunication networks and cloud computing environments, and in recent years, academia and industry have started to focus on the combination of edge computing and homeland space optimization and conducted a series of studies. Figure 1 shows the deployment architecture diagram of computing services based on edge networks. In computing networks based on edge network architecture, different types of edge computing service components are widely distributed in the network path from end-users to the cloud in the form of VNFs, and in NFV-enabled edge networks, service requests need to use some network functions to achieve task offloading. These service requests often have strict quality-of-service requirements, while various network resources in the edge network are limited. Service providers have to satisfy task offloading for each service request while taking into account the network state characteristics to avoid situations such as network congestion, and also to handle as many service requests as possible to maximize their profits. Different types of edge computing services are deployed on edge computing nodes in different locations in the form of VNFs, and different types of virtual network functions are connected through the NFV orchestration and scheduling mechanism to form a Service Function Chain (SFC) to satisfy end users Specific edge computing service requirements.

The literature [1] constructs a reliability-aware and delay-constrained routing optimization framework called READ for data center networks supporting homeland network optimization. The authors formulate the research problem in terms of mixed-integer linear programming (MILP). To overcome the complexity of MILP, the authors then propose a greedy algorithm GSP based on k shortest paths. A comprehensive numerical analysis and comparison conclude that the GSP algorithm outperforms existing schemes in terms of reduced reliability improvement and end-to-end delay reduction.

The literature [2] investigates the problem of reliability-aware joint optimization of homeland spatial chain deployment and traffic routing in a carrier-grade software network. To ensure the required reliability of the service, the authors propose an incremental approach to determine the number of required homeland space resource backups. The authors also propose a shared resource-based homeland space allocation strategy that weighs all reliability, bandwidth, and computational resource consumption for a given service chain, and thus the authors design a heuristic algorithm to solve the current complexity problem. Through in-depth numerical analysis and simulation, the authors verify the correctness and effectiveness of the proposed heuristic algorithm.

The literature [3] investigates the spatial optimization problem in spatial networks. The authors first describe an energy model for NFV-based telecommunication networks and then represent the studied problem in terms of an integer linear programming model. Due to the complexity of the study problem, the authors design a polynomial algorithm using Markov approximation techniques to find near-optimal solutions. Simulation results show that the algorithm designed by the authors reduces more energy consumption and optimizes traffic routing compared to existing related algorithms.

The authors of the literature [4] constructed an objective function that can be easily adapted to various applications using graphical pattern matching. To reduce the running time, the authors investigated the feasibility and effectiveness of path pre-computation, where the path is computed before placement. For this purpose, the authors propose an online algorithm called OPA to place the edge network algorithm on the underlying physical network. This approach supports the online placement of edge network algorithms in the SDN, allowing edge network algorithm requests to be processed as they arrive. In addition, the authors propose an OPA algorithm for cost minimization. Simulation results show that the OPA algorithm has a better performance compared to offline algorithms.

In the literature [5], to successfully apply edge network algorithms to homeland spatial optimization, a new edge network platform, called GNF, is proposed that combines edge network computing and homeland spatial optimization

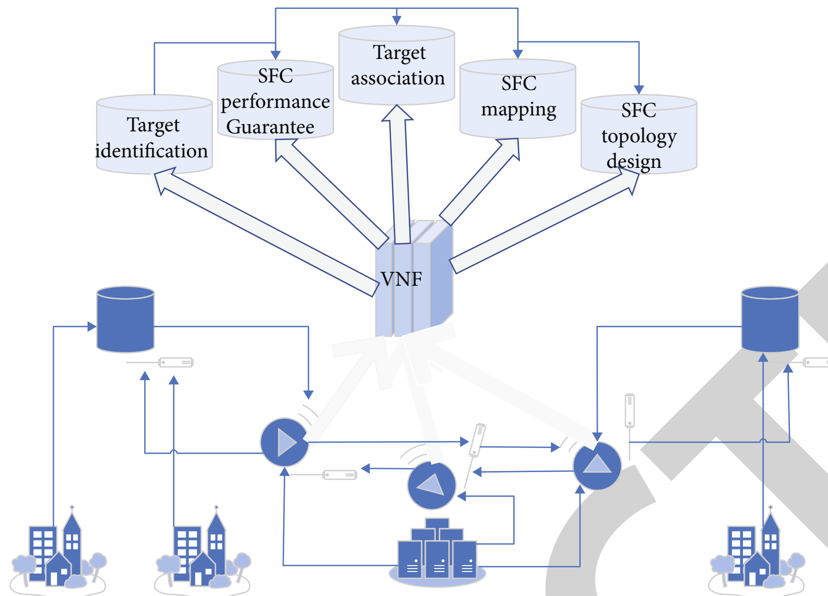

FIGURE 1: The deployment architecture of edge network-based computing services.

by hosting edge network computing in a distributed, heterogeneous edge infrastructure using a common lightweight Linux container, thus saving core network utilization and providing lower latency while ensuring that it can run smoothly on a variety of edge devices. While ensuring that it can run smoothly on a variety of edge devices. The authors demonstrate through three typical use cases that the platform can be used in edge network algorithms to achieve a new paradigm of efficient collaboration, intensive development, and fine-grained governance for territorial spatial planning, enabling territorial spatial optimization departments to run customized, high-performance edge network services while also reducing the cost of territorial spatial optimization.

3. Intelligent Optimization Research of Territorial Spatial Planning Based on Edge Network

3.1. Edge Network Computing Model. With the rapid development and widespread adoption of the Internet of Everything, data is increasingly being generated at the network edge, which will change from a single role as a data consumer to multiple roles as both a data producer and a data consumer [6]. Since cloud computing is not always effective for data processing at the network edge, the industry has begun to explore a new computing model that leverages the computing power of network edge devices. As a result, a new computing paradigm called edge computing is rapidly gaining a lot of attention in the current wave of information technology development. Edge computing is a new computing model that allows computing at the edge of the network, on downstream data representing cloud services and upstream data representing IoT services. The "edge" is defined as any computing and networking resource in the path between the data source and the cloud data center. The basic principle of edge computing is that computation should occur close to the data source.

Figure 2(a) represents the traditional cloud computing model, where source data is sent to the cloud by the producer, and consumers such as end-users and smartphones send usage requests to and receive results from the cloud center. However, this computing model is not sufficient in the era of the Internet of Everything. Many edge devices generate massive amounts of data that need to be processed on time, and the network bandwidth and computing resources of the existing cloud computing model have difficulty in processing these data in a real-time and efficient manner [7]. The edge computing model is very different from this traditional cloud computing model, and Figure 2(b) represents the edge computing model based on bi-directional computational flows. In this model, the edge device is both a data producer and a data consumer. The cloud collects data not only from the database but also from the edge devices, while the edge devices can not only request services and content from the cloud but also perform some of the computational tasks. Therefore, the request transmission between the end device and the cloud center is bidirectional [8].

3.2. Strategies for Optimizing Homeland Space Combined with the Edge Network Computing. Combined with the edge network computing model, the concept of territorial spatial planning in the new era should follow "combining top-down and bottom-up", "combining static analysis and dynamic simulation", "combining physical spatial planning and socio-economic planning", and "combining rigid control and flexible layout", and combining "rigid control and flexible layout", and establishing the data resource system of territorial spatial planning as shown in Figure 3.

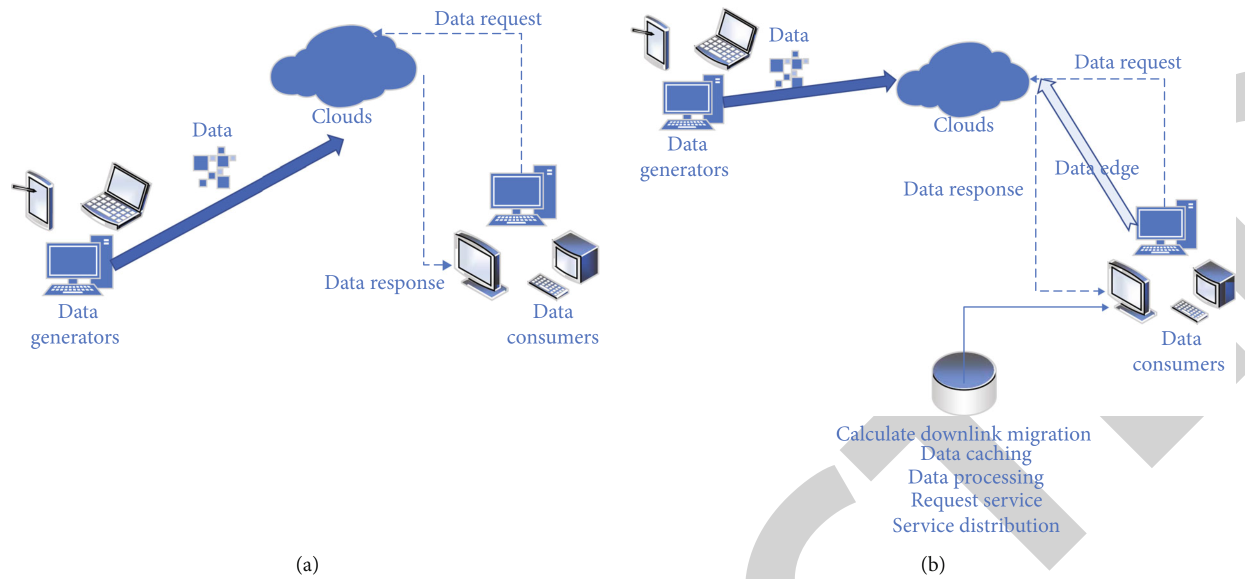

FIGURE 2: a Traditional cloud computing model. b. network computing model.

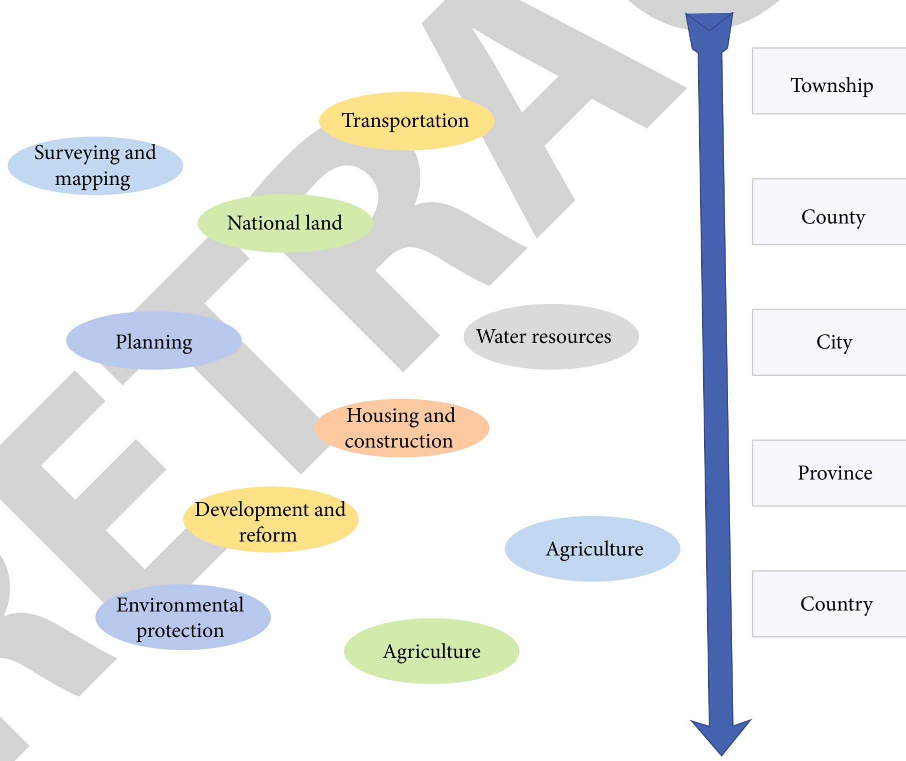

FIGURE 3: The data resource system of territorial spatial planning based on edge network.

(1) Combining top-down and bottom-up planning. From the viewpoint of planning subjects, the new era of territorial spatial planning needs to consider not only the development strategies and goals of the government and related departments but also the needs of residents and enterprises. On the one hand, the current situation and potential of natural resources development at the national, regional, and city levels should be evaluated, and on the other hand, the daily activities and rules of residents and enterprises in the national spatial planning should be explored, allocate the national spatial resources in a more scientific, reasonable and fair manner

(2) Combination of static analysis and dynamic simulation. From the perspective of data and methods, the new era of territorial spatial planning requires the collection of traditional data such as statistics, space and surveys, and big data of residents and enterprises' activities to statically assess the carrying capacity and suitability of territorial spatial resources, various types of territorial spatial patterns and land use on the one hand, and dynamically simulate the temporal and spatial changes of various types of territorial spatial patterns, land use patterns, and intensity, on the other hand, to scientifically predict the future, On the other hand, the dynamic simulation simulates the temporal and spatial changes of various spatial patterns, land use patterns, and intensity, to scientifically predict the future development and protection scale of land space, and reasonably optimize the spatial structure and land use layout

(3) Combination of physical spatial planning and socio-economic planning. From the spatial level, the new era of territorial spatial planning is not only the re-optimization and allocation of physical spatial resources but also the analysis and simulation of the socio-economic activities carried above the space. The latter includes the analysis of the spatial trajectories of individuals and groups recorded by the daily activities of residents and enterprises, as well as the exploration of the macroscopic laws of deep-seated socio-spatial structure and differentiation, economic spatial structure, and factor flow reflected by the activities of groups

(4) Combination of rigid control and flexible layout. At the level of rights, the new era of territorial spatial planning requires rigid spatial governance lines such as ecological red line, basic farmland protection line, and urban development boundary to achieve the goal of strict protection of territorial spatial resources, but also requires the flexible arrangement of internal land layout in general ecological space and general agricultural space to adapt to national development strategies such as rural revitalization, leisure era or However, there is also a need to flexibly arrange the internal land-use layout in general ecological space and general agricultural space to accommodate national development strategies such as rural revitalization, leisure era or new lifestyles of future residents; and to mix functional land use within urban space to accommodate the creation of new spaces such as co-working space, crowdsourcing space, and transportation hub space

In short, the new era of territorial spatial planning is to take the common needs of the government, residents, and enterprises as the guide, use edge network optimization algorithm to carry out dynamic analysis and simulation of the current situation and trend of territorial spatial development, scientifically optimize the allocation of various resources of territorial material and socio-economic space, and focus on the combination of rigid control and flexible guidance of land use management measures or layout strategy formulation [9].

In the context of smart society, territorial spatial planning has been given a more profound meaning. The Spatio-temporal flexibility and mobility of human activities supported by information technology are constantly changing, and the relationship between humans and land is continuously reconstructed [10]. As the carrier of resources, environment and human activities, the planning of national land space should not only provide effective control, scientific management, and long-term planning of national land space resources, but also grasp the basis of "ecological civilization", highlight the "people-oriented The core of "human-centeredness" should be emphasized, and the connotation and understanding of human-land relationship should be strengthened. As an important support, "technology-driven" not only affects the relationship between the elements of the internal system of land and space but also manifests itself in the coordination and control of the relationship between people and land. Computer technology can monitor and simulate human activities, changes in spatial resources, and other contents more accurately, provide a reference for the rational layout of production, living and ecological space, and realize the intelligent preparation of national spatial planning with temperature [11, 12].

3.3. Spatial Optimization Modeling of Homeland Based on Edge Network. The "three lines" of ecological protection red line, permanent basic agricultural land, and urban development boundary correspond to the core parts of ecological space, agricultural space, and construction and development space, respectively. In the management of the three lines, it is an important task to monitor illegal land use within the lines and to provide early warning for suspected illegal land use, to intervene in advance through early warning, to stop further expansion of illegal land use from the source, and to strengthen the supervision and prevention of illegal land use in high-risk areas [13–15]. The edge network model compares the exploration of domestic urban and rural planning and land use planning dynamic monitoring, both of which have established a five-stage technical path of "data collection - data analysis - external verification - database update - monitoring result analysis". It is clear that the dynamic monitoring method based on remote sensing images has become more mature and laid the foundation for the supervision and prevention of illegal land use breaking through the rigid control line.

A commonly used model for predicting land-use change is the meta-automaton Markov model (CA-Markov). Among them, the beta cellular automaton (CA) is a spatio-temporally discrete, state-limited, local rule-controlled lattice dynamical model with the ability to simulate the Spatio-temporal evolution process of complex systems [16–19]. Each cell's T-temporal state is determined by the temporal state of T-1 neighboring cells; Markov chain (Markov chain) is a stochastic process in state space that undergoes a transition from one state to another, and the

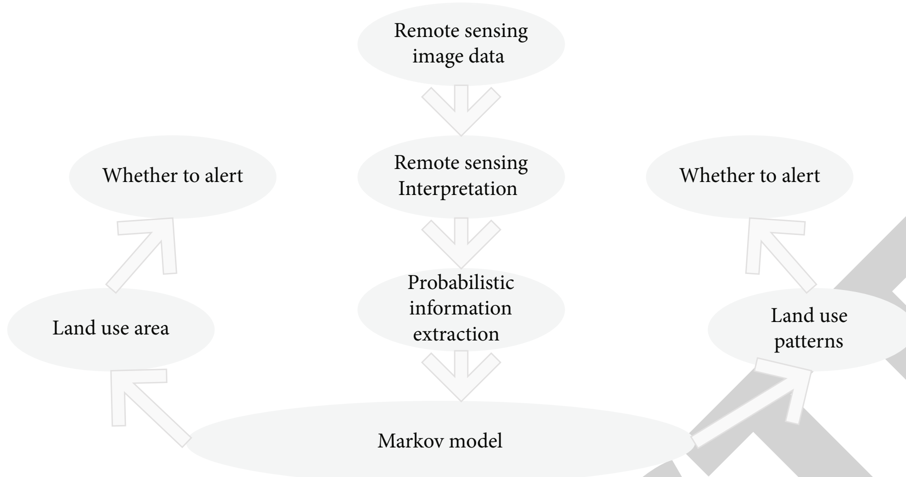

FIGURE 4: Technology roadmap for prediction and warning based on the meta-automata-Markov model for land use.

probability distribution of the next state can only be determined by the current state. The Markov chain is time-sensitive and has a significant advantage in simulating the continuity of data; the CA-Markov model combines the advantages of the Markov chain and CA model and can effectively predict the quantity and spatial distribution of land use structure.

The transfer between land-use types in a certain time phase is regarded as the "possible state" in the Markov process, and the transfer area between land-use types in a certain time phase is regarded as the transfer probability matrix [20–23]. Therefore, the first step is to establish and determine the transfer probability matrix P between land types, which is as follows.

$$P = P_{ij} = \begin{bmatrix} P_{11} & P_{12} & \cdots & \cdots & P_{1n} \\ P_{21} & P_{12} & \cdots & \cdots & P_{2n} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ P_{m1} & \cdots & \cdots & \cdots & P_{mm} \end{bmatrix} \quad (1)$$

In equation (1), n is the number of land-use types; P_{ij} is the probability that the area of type I land-use type is transferred to the area of type j land-use type in unit time, and P should satisfy greater than 0 and less than 1. The future land use pattern can be predicted, and its expression is

$$R_n = {R_{n\text{-}1}}^2 - \sum P_{ij} \quad (2)$$

where R_{n+1}andR_n correspond to the land-use states at moments n and n+1, respectively, and P is the probability transfer matrix of the land.

The application of the cellular automata-Markov model (CA-Markov) can rely on the IDRISI software to handle it. The system simulation of the rational environment. The working path of using the model for site prediction and warning is shown in Figure 4.

The application of the model can predict the spatial distribution of land use and the land-use area transfer matrix after a certain time. Among them, its land-use transfer matrix table can calculate the predicted values of the land category indicators involved in the early warning indicators, and through comparison with the planning values, provide early warning for indicators with slow progress or break through the target values [24–26]; through the overlay comparison of the spatial distribution of land use in the predicted year with the vector map of rigid control lines such as the ecological protection red line, early warning is provided for boundary breakthrough or illegal land use.

3.4. Analysis of Results. Urban development boundary can reasonably guide the compact development of urban land, can effectively protect regional arable land and ecological environment, and is an important factor for spatial layout optimization. Generally speaking, most of the towns are based on the existing town areas and expand outward. According to the edge network model, to control the disorderly expansion of town scale in the simulation process, the ideal state town model is established with full reference to the results of the general land use planning (2010-2020), and the development trend of the future town development boundary is predicted. Therefore, by setting the town development boundary area, the development constraint of town space is increased to limit the spatial disorderly expansion of town development, and the results are shown in Figure 5.

The expansion of rural living space far exceeds the constraints of the quantitative optimization results. To alleviate the situation of an extensive expansion of rural living space, the distance to rural settlements influence factor is added in the optimization process to limit the disorderly expansion of rural living space. According to the edge network model, the prediction of future distance to rural settlements was combined with the data of the past ten years (2010-2021), and the results are shown in Figure 6. From Figure 6, it can be seen that the distance to rural settlements gradually increases with the year, which predicts the decrease of rural population density and the increase of rural population

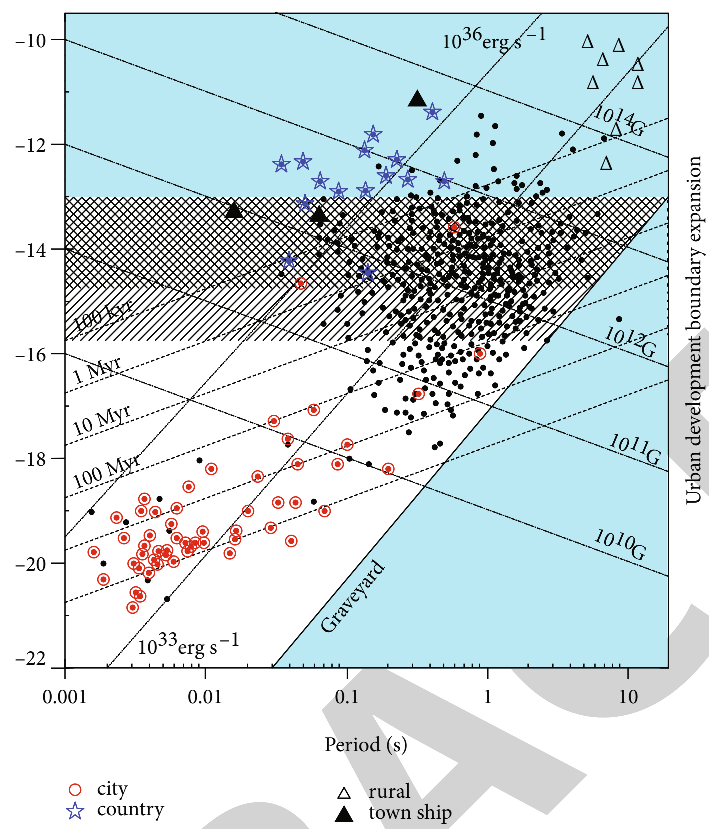

FIGURE 5: The trend of urban development boundary expansion.

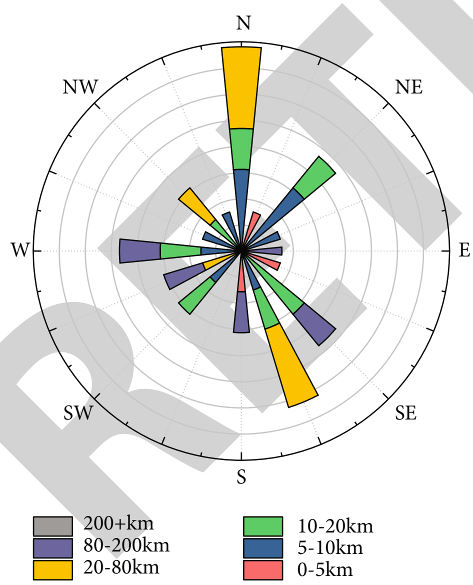

FIGURE 6: Rural settlement distance.

migration to towns in the future. In the process of future spatial optimization of the countryside, the vacant rural land needs to be used rationally to improve the land utilization rate and avoid the phenomenon of wasting land resources. It caused the following results:1. Reasonably adjust the urban construction land and optimize the urban spatial layout; 2. Promote the intensive use of rural living space to ensure the sustainable development of agricultural production; 3. Practice the concept of ecological civilization and vigorously carry out ecological protection.

As shown in Table 1, by comparing the results of 2022 territorial space optimization in the model county with the simulation results in 2022, it can be found that: after optimization, the urban development space decreases by 1739.02hm^2, accounting for a decrease of 0.48%; the rural living space decreases by 7740.89hm^2, accounting for a decrease of 0.215%; the agricultural production space decreases by 112.87hm^2, accounting for a decrease of 0.08%. Ecological water space is unchanged; ecological land space is increased by 7890.87hm^2, with an increase of 2.5%. After optimization, the ecological land space has increased from 68.7% to 72.1%, which has been significantly improved, while the urban development space and rural living space have decreased.

In terms of economic benefits, the model county 2022 optimization results compared with the 2022 simulation results, the model county economic benefits decreased from 131.82 billion yuan to 129.11 billion yuan, a decrease of 2.7 billion yuan; the optimized model county ecological benefits increased from 139.66 billion yuan to 145.87 billion yuan, an increase of 6.21 billion yuan; the combined economic and ecological benefits increased by 3.5 billion yuan. It can be seen that the optimization results in 2022, compared with the simulation result in 2022, shows a small decrease in economic benefits, an increase in ecological benefits, and an increase in combined economic and ecological benefits,

Table 1: Changes of geographical spaces area during simulation-optimization.

Type of land space	Simulation		Optimization		Optimization-simulation	
	Area	Proportion	Area	Proportion	Area changes	Proportion changes
Urban development center	5488.58	1.53	3749.56	1.05	-1739.02	-0.48
Rural living space	16147.56	4.51	8406.67	2.36	-7740.89	-0.215
Rural production space	81703.13	22.85	81590.26	22.9	-112.87	-0.08
Ecological watershed space	7945.06	2.22	7945.17	2.23	0.11	0.01
Ecological terrestrial space	246340.8	68.88	254231.68	71.4	7890.87	2.5
Economic benefits	131.82		129.11		-2.71	
Ecological benefits	139.66		145.87		6.21	

Unit: hm^2, %, billion.

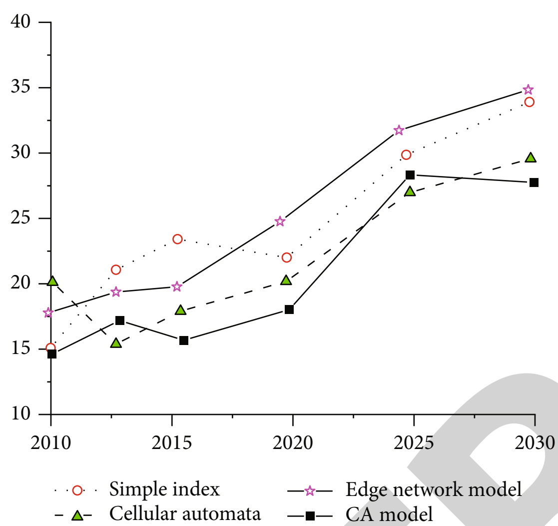

Figure 7: The model predicted economic curve and optimized economic curve.

and the optimization result is beneficial to the sustainable and healthy development of ecology and economy in the model county.

From Figure 7, it can be seen that the economic curve has a rising trend, and after the model optimization, the economic curve is lower and then higher than the model curve, and the growth rate is greater than the original model, presumably because there is a certain adaptation period for economic transformation just after the economic optimization, and after the adaptation period is over, the economic growth accelerates and exceeds the original economic growth rate. Make rational use of rural vacant land, improve land utilization, and avoid waste of land resources. High land utilization and resource utilization have promoted economic development.

4. Conclusion

Combined with the edge network computing model, improving the capacity of territorial spatial governance and promoting higher quality, more efficient, more equitable, and more sustainable economic and social development is the ultimate goal of realizing intelligent territorial spatial planning. Fully mobilize the potential of the three elements - government, enterprises, and the public - to cooperate collaboratively, with clear responsibilities and powers, to establish an efficient and interoperable collaborative governance model, to practice the purpose of harmonious coexistence between human beings and nature with an all-rounded posture, to share the fruits of ecological civilization construction among all people, to establish a consensus among government, enterprises and the public to serve ecological civilization, and to implement the principle of both meeting people's demand for a better life and doing a good job in natural resource The principle of protection. In the later stage, based on systematic top-level design and complete data resource system, we will continuously improve the data collection capacity of the perception layer, ensure that the data resources are real and effective, improve the basic information platform of intelligent territorial spatial planning, build a monitoring and assessment management system for the implementation of territorial spatial planning, and overall improve the capacity of territorial spatial data integration, intelligent analysis capacity of planning preparation, network-driven capacity of governance implementation, monitoring and assessment The spatial data integration capability, planning intelligent analysis capability, governance implementation network-driven capability, and monitoring and assessment accuracy capability can effectively support the whole process of spatial planning preparation, approval, implementation, and monitoring and assessment warning. Promote the integration of information technology personnel and planning personnel, focus on strengthening the research and application of models and algorithms, and serve the work of planning implementation supervision and monitoring and early warning of resource and environment carrying capacity single evaluation and integrated evaluation.

Information construction is very important but not the only one for the planning, construction, and governance of smart land and space. As more new technologies are applied in the national economy, social development, human activities, and development and management of land resources, integrated application and innovation of new technologies and institutional innovation are important driving forces for smart territorial spatial planning. Based on this understanding, this paper proposes a general framework of intelligent territorial spatial planning based on ecological civilization, with human-centeredness as the core and technology application and institutional innovation as the support, and its technical framework. On this basis, the wisdom of the whole process of territorial spatial planning preparation and the wisdom of planning implementation are discussed. Under the dual background of spatial planning system reform and digital transformation, it is necessary to make full use of digitalization and information technology to create an informatization system of territorial spatial planning that supports the whole process of planning preparation, implementation and supervision, to realize the progress of planning work toward digitalization, precision, and wisdom, and help innovate the methods and means of territorial spatial planning and upgrade the governance capacity in the new era.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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