Implementation Paths of Territorial Spatial Planning under the Sustainable Development Goals

Jiang Jun

Chunxi Road Fashion and Vitality District Management Committee, Planning and Construction Department, Chengdu, 610031, China

383919617@qq.com

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Abstract: In the context of accelerating the global sustainable development agenda, as a key spatial governance tool to achieve sustainable development goals, the optimization of the implementation path of territorial spatial planning needs to be studied in depth. Based on the United Nations Sustainable Development Goals Report 2024 and the data of the Ministry of Natural Resources of China in 2024, this paper analyzes the practical problems of the connection between the current territorial spatial planning and the sustainable development goals. The study points out that the lack of multi-objective coordination, the lack of dynamic adaptability of implementation mechanism and the imperfection of technical support system restricts the spatial landing. To solve these problems, we should strengthen the spatial transformation and transmission of sustainable development goals and indicators in planning, build a cross-sectoral collaboration and dynamic evaluation system in the implementation mechanism, and promote digital twins and artificial intelligence empowerment at the technical level. The study shows that by systematically optimizing the implementation path of territorial spatial planning, the contradiction between protection and development can be effectively solved, and China's plan for global sustainable development can be provided.

1. Introduction

The United Nations 2030 Agenda for Sustainable Development is the development blueprint of global consensus, but the United Nations Sustainable Development Goals Report 2024 shows that only 16.9% of the world's sustainable development goals are expected to be achieved in six years before the expiration of the goals, while the remaining 83% of the goals are slow, stagnant or even retrogressive. As a responsible country, China has incorporated the localization of sustainable development into its national development strategy, and territorial spatial planning, as the core tool of spatial governance, has become the key carrier of sustainable development [1].

According to the data of the Ministry of Natural Resources in 2024, 1.865 billion mu of cultivated land, 1.546 billion mu of permanent basic farmland and 3.19 million square kilometers of ecological protection red line have been delineated nationwide to lay a solid space bottom line for sustainable development. However, the contradictions in reality are still prominent: the protection of cultivated land is facing multiple pressures, the phenomenon of occupying ecological space by the disorderly expansion of construction land still exists, and the internal tension between development and protection has not been fundamentally alleviated; The UNDP's Progress Report on China's Sustainable Development Goals 2023 points out that the core objectives of sustainable development in China, such as land ecological protection and regional coordinated development, are not deeply integrated with the index system and spatial layout of territorial spatial planning, and that some of the planning contents still emphasize economic growth and neglect eco-social coordination. The coordination mechanism of spatial governance across administrative regions is still not perfect, and it is difficult to meet the requirements of sustainable development for overall planning and systematic promotion.

Integrating sustainable development into the implementation of territorial spatial planning is not

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only a realistic need to solve the contradiction between "development and protection" and to cope with the constraints of resources and environment, but also a strategic choice to enhance the modernization level of spatial governance. Based on the convergence of theory and practice, this study explores the implementation path of the deep integration of the two, which can not only provide support for improving the theoretical system of territorial spatial planning, but also provide operational reference for the implementation of local planning, and has important theoretical value and practical significance for ensuring the realization of national sustainable development strategy.

2. Sustainable Development Goals and Territorial Spatial Planning

2.1 Sustainable Development Goals

The Sustainable Development Goals are the core content of the 2030 Agenda for Sustainable Development, which was unanimously adopted by all Member States of the United Nations in 2015, aiming to provide a common blueprint for all countries in the world to achieve sustainable development by 2030. The agenda contains 17 interlinked sustainable development goals, covering the economic, social and environmental pillars, as shown in Table 1. Its core connotation is to meet the needs of the present without compromising the ability of future generations to meet their own needs, emphasizing that while promoting economic growth and social inclusion, we should strictly protect the environment and achieve harmonious coexistence between man and nature [2]. The Sustainable Development Goals inherit and upgrade the Millennium Development Goals implemented from 2000 to 2015, and their breadth, depth and strength are far greater than former. They require a fundamental change in the traditional development model of one-sided pursuit of economic growth, and a new path of pursuing inclusive growth and coordinated development of economy, society and environment. China has shown a positive attitude in promoting the implementation of sustainable development goals, not only internalizing the concept of sustainable development into its national strategy, but also putting forward such principles as building an open and pluralistic world economy, building an inclusive and happy society based on people, and protecting the environment to achieve harmony between man and nature. It provides an important way of thinking for global sustainable development.

Table 1. Core dimensions of the Sustainable Development Goals

Core dimensions	Core Connotation	Examples of representative targets
Economy	Promote inclusive and sustainable economic growth and ensure sustainable consumption and production patterns	Decent work and economic growth, industry, innovation and infrastructure
Society	Eradicate poverty, reduce inequality, enhance well-being and achieve social equity	Eradicate poverty, zero hunger, good health and well-being, quality education
Environment	Addressing climate change, protecting life on land and underwater, and ensuring environmental sustainability	Climate Action, Terrestrial Life, Clean Water and Sanitation

2.2 Territorial Spatial Planning

Territorial spatial planning, as an important public policy tool, refers to the strategic allocation and systematic management of spatial resources and elements within the territory of a country or region in order to achieve multiple objectives such as economy, society and environment. Its core is to coordinate the policies of different departments and various development and protection actions through the carrier of "space", aiming at realizing the sustainable development and efficient utilization of space, and ultimately improving the overall quality of human settlements and regional competitiveness. At present, there are several obvious trends in international spatial planning [3]. First, more attention is paid to addressing climate change and enhancing resilience. For example, the Netherlands places water security and adaptation to climate change at the core of its national spatial

interests. Second, actively embrace the digital and intelligent transformation, such as the European Union's ESPON and the "smart planning" technology being explored by various countries, aiming to enhance the scientific nature of planning and the ability to implement monitoring. Thirdly, in mature urbanized areas, the focus of planning has shifted from incremental expansion to stock optimization and quality improvement, focusing on the renewal and activation of the built environment.

2.3 Coupling Relationship between the Two Concepts

Both of them respond to the historical inevitability of the transformation from industrial civilization to ecological civilization. The goal of sustainable development emphasizes the coordination of the three pillars of economy, society and environment, which is highly consistent with the optimization of the spatial layout of production, life and ecology pursued by territorial spatial planning. Through the rational allocation of space resources, territorial spatial planning aims to promote the formation of green development and lifestyle, which is the core path to achieve the goal of sustainable development. At the functional support level, as a basic tool of spatial governance, territorial spatial planning transforms the macro-requirements of sustainable development goals into operational and assessable spatial strategies and control indicators through its dual roles of strategic guidance and rigid control. The delineation of the "three lines" is a concrete spatial initiative to implement the goals of ecological protection (corresponding to terrestrial organisms), food security (corresponding to zero hunger) and sustainable cities (corresponding to sustainable cities and communities). At the practical path level, the establishment and implementation of territorial spatial planning system provides a systematic platform for the localized application of sustainable development goals. The evaluation of the carrying capacity of resources and environment and the suitability of land space development in the process of planning provides a scientific basis for identifying the spatial constraints and potentials of regional sustainable development. At the same time, the construction of the supervision information system for the implementation of the "one map" of territorial spatial planning provides technical support for monitoring and evaluating the progress of sustainable development goals at the spatial level.

3. Problems of Territorial Spatial Planning with Sustainable Development Goals

3.1 Problems at the Planning Level

Sustainable development goals require the systematic integration and coordination of economic, social and environmental goals, but in terms of technical methods, the ability of overall planning and quantitative embedding of such cross-domain goals still needs to be strengthened, and it is difficult to fully achieve the precise coordination and spatial landing of multiple goals. The formulation of territorial spatial planning relies on the evaluation of the carrying capacity of resources and environment and the suitability of territorial spatial development. However, the existing evaluation system still needs to be deepened in comprehensively and accurately reflecting the complexity of ecosystems, the long-term risks brought by climate change and the dynamic evolution needs of sustainable development goals. At the same time, the plan emphasizes "bottom line constraints" to ensure security, but in dealing with uncertainties such as future technological change, industrial transformation and low-carbon development path, the flexible reservation and dynamic response mechanism of the plan are not perfect, and it is difficult to flexibly adapt to the long-term realization process of sustainable development goals. Sustainable development goals themselves emphasize global consensus and cross-regional synergy, but the current planning is mostly based on administrative boundaries as the main unit, lacking effective regional, watershed and other larger-scale synergy mechanisms, resulting in difficulties in coordination in dealing with cross-border issues such as climate change and biodiversity conservation. In addition, how to balance the local current development demands and the long-term goal of sustainable development in planning formulation, and avoid damaging long-term sustainability for short-term interests, is an important obstacle to be overcome in planning formulation.

3.2 Problems at the Implementation Level

The implementation of territorial spatial planning involves many departments, such as natural resources, ecological environment, development and reform, housing, urban and rural construction, transportation, etc. However, the responsibility barriers and information barriers between departments still exist, and coordination is difficult. This can easily lead to the lack of cohesion between various special plans and the overall land and space planning, and the limited effectiveness of coordinating spatial contradictions and conflicts on the "one map", which makes it difficult to form the resultant force of planning implementation. At the same time, in the process of planning transmission between higher and lower governments, due to differences in development demands or deviations in policy understanding, the strategic intentions of national and provincial planning may be decomposed, weakened or implemented at the city and county levels, affecting the overall realization of planning objectives. The realization of sustainable development goals is a long-term and dynamic process, during which socio-economic conditions, technological level and environmental conditions may change significantly. However, the current planning implementation still has the characteristics of "static blueprint" to a certain extent, and its dynamic evaluation, feedback regulation and optimization adjustment mechanism are not sensitive enough. It is still an urgent problem to solve how to use the big data obtained from monitoring in real-time and effective evaluation, early warning and dynamic maintenance of planning to ensure that planning can flexibly adapt to the new requirements of new productivity development and climate change response. Planning is also often ill-prepared to deal with sudden environmental events or long-term risks, such as the transformation of some resource-exhausted cities.

3.3 Problems at the Technical Level

In the face of the multi-dimensional, nonlinear and interrelated complex system involved in sustainable development, the traditional planning and analysis models and tools seem to be inadequate. Although artificial intelligence technology is highly expected, its application in the field of territorial spatial planning is still in the exploratory stage. Professional models and algorithms that can effectively simulate sustainable development scenarios such as resource and environment carrying capacity, carbon emission trajectory and regional coordinated development are still scarce and immature [4]. In particular, the lack of forward-looking simulation and intelligent research and judgment capabilities that can couple natural systems with human social and economic activities and support the optimization of spatial strategies under the "double carbon" goal makes it necessary to strengthen the support of scientific decision-making in planning to cope with long-term and uncertain challenges. The feedback mechanism of dynamic monitoring and evaluation is not perfect, which affects the adaptability of the planning implementation process. The construction goal of the monitoring network for the implementation of territorial spatial planning is to achieve "perceptibility, learning, good governance and self-adaptation", but from the technical point of view, the "one map" system of planning still focuses on the display and management of static "blueprint of planning", and its ability to transform to dynamic "process of planning implementation" monitoring, evaluation and early warning is weak. The data circulation mode has not been fully opened, and it is difficult to continuously evaluate and quickly feedback the implementation effect of the plan based on real-time monitoring data.

4. Implementation Paths of Territorial Spatial Planning under the Goal of Sustainable Development

4.1 Planning Optimization Path

To effectively implement the goal of sustainable development, the compilation of territorial spatial planning needs to be systematically optimized. In the top-level design of planning, the concept of economic, social and environmental synergy contained in the goal of sustainable development should be fully transformed into the strategic objectives, core indicators and spatial strategies of land and space protection and development [5]. This means that it is necessary to establish a spatial

development framework corresponding to the sustainable development goals at the overall planning level, and scientifically transmit its core requirements to the detailed planning level by means of planning unit division, functional zoning guidance and control index decomposition to ensure that the macro-strategy can be accurately implemented through spatial layout. We should break through the limitations of the traditional single element or department perspective, and strengthen the overall coordination ability of the overall land and space planning for all kinds of special planning under the framework of "multi-planning integration". The planning process needs to actively identify and reconcile the potential conflicts that may exist in different spatial needs, such as ecological protection, agricultural development, urban construction, infrastructure, historical and cultural heritage, so as to achieve effective coordination of various spatial policies on the "one map". In particular, we need to pay attention to the planning of systematic issues across administrative regions, such as ecological security, climate change response and infrastructure interconnection, on a larger scale, such as regions and river basins, and explore the establishment of an effective mechanism for regional coordination and balance of interests to promote the formation of a territorial spatial pattern with complementary advantages and high-quality development. While adhering to the bottom-line constraints, the planning content should reserve appropriate flexible space for uncertainties such as future technological innovation, industrial transformation and social change, explore the establishment of dynamic evaluation and optimization adjustment mechanism of planning, and enhance the adaptability of planning to the long-term process of sustainable development.

4.2 Implementation Optimization Path

The concept of life cycle management should be carried out throughout the planning and implementation. Through real-time monitoring and regular assessment, timely insight into the changes of population, industry, facility service capacity, ecological quality and other factors, as well as the implementation of sustainable development goals, provides a scientific basis for the dynamic maintenance and optimization of planning, so that planning can flexibly respond to the uncertainty of internal and external conditions [6]. Innovation of diversified policy tools and incentive mechanisms is the key to enhance the effectiveness of implementation. On the premise of adhering to the bottom-line constraints, we should actively explore and use market-oriented tools to effectively stimulate the enthusiasm of various subjects. This includes improving the horizontal ecological compensation mechanism for ecological protection areas, exploring flexible policies such as transfer of development rights and land replacement that are conducive to the development of green low-carbon industries, and guiding social capital to participate in ecological restoration and urban renewal. At the same time, we will continue to deepen the reform of the examination and approval system for planned land use, promote the integration of multiple examinations, multiple certificates and multiple inspections, improve the efficiency of the integrated allocation of natural resources and optimize the business environment. Perfecting the guarantee of the rule of law and the mechanism of supervision and assessment is the cornerstone of maintaining the seriousness of planning. It is necessary to speed up the legislative process of the law on territorial spatial planning and clarify the rights, responsibilities and obligations of all parties in the implementation of the plan. Higher-level governments should strengthen supervision over the implementation of territorial spatial planning by lower-level governments, incorporate the completion of the planning’s main objectives and key tasks into the performance appraisal system of local governments and leading cadres, and establish an effective incentive and accountability mechanism. This will ensure that sustainable development goals are effectively advanced through spatial governance.

4.3 Technology Optimization Path

Data is the foundation of digital governance. At present, the primary task is to build a unified large data platform for territorial spatial planning, aiming at breaking departmental barriers and data islands, and realizing the effective convergence, standardized governance and orderly sharing of massive multi-source heterogeneous data such as ecology, economy and society. Specifically, it is necessary to establish and improve an authoritative and efficient data acquisition and updating mechanism, promote the integration and management of cross-sectoral and cross-level spatial-temporal data, such

as natural resources survey and monitoring, geographic national conditions census, socio-economic statistics, remote sensing monitoring, and so on, so as to form a "data lake" covering all elements of territorial space. We will build an information network that is connected horizontally and vertically, strengthen the interconnection and data collaboration of platform systems at the national, provincial, municipal and county levels, and provide a solid data base for the whole life cycle management of land and space planning, implementation and supervision. On the premise of consolidating the data base, the innovative application of technical tools is the key to enhance the scientificity and predictability of planning. Digital twin technology should be actively promoted to construct a digital territorial space that can accurately map, simulate inversion and interactive feedback, that is, the territorial spatial information model to realize the accurate three-dimensional expression and dynamic visual analysis of the current situation and blueprint of the territorial space. At the same time, we should keep up with the frontier of artificial intelligence technology development, especially increase the research and development and application of general artificial intelligence and large models in the field of land and space planning. The deep integration of these intelligent technology tools with the professional model of territorial spatial planning can spatially and quantitatively simulate and predict the key indicators closely related to the sustainable development goals, such as the carrying capacity of resources and environment, the trajectory of carbon emissions, and the coordinated development of regions.

5. Conclusions

This paper systematically discusses the coupling relationship between sustainable development goals and territorial spatial planning, and reveals the core problems existing in the formulation, implementation and technical support of current planning. The study suggests that spatial planning should shift from static blueprint to dynamic governance tools, and realize the localization of Sustainable Development Goals through quantitative transmission of objectives, innovation of cross-sectoral collaborative mechanism and technological empowerment. Practice has proved that China's spatial governance system based on the bottom lines delineation provides a basic guarantee for sustainable development, but it needs to further strengthen planning flexibility and regional synergy. In the future, we can focus on promoting the innovative application of artificial intelligence technology in planning simulation and prediction, and enhance the scientificity and foresight of spatial decision-making. Finally, through the modernization of the territorial spatial planning, China will contribute its wisdom to the global sustainable development.

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