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# RESOURCE–ENVIRONMENT–ECONOMY COORDINATION UNDER HIGH-QUALITY DEVELOPMENT: MEASUREMENT APPROACHES, RESEARCH GAPS, AND FUTURE DIRECTIONS

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**Abstract:**

In the era of high-quality advancement, the synchronization of assets, ecosystems, and prosperity has gained significant prominence for ecological transition and enduring progress. This synthesis integrates domestic and foreign literature regarding theoretical bases, appraisal metrics, quantification techniques, and driving factors. Primary methodologies fulfill diverse objectives: the degree of coupling coordination evaluates subsystem integration; entropy weighting alongside TOPSIS facilitate holistic assessment and prioritization; DEA/SBM calculates productivity under ecological and environmental limitations; and geographic and econometric frameworks uncover spatial diversity and diffusion impacts. Three primary deficits are recognized: divergent assessment benchmarks, inadequate temporal and mechanism-focused investigation, and restricted focus on novel catalysts and global contrasts. Subsequent inquiry must enhance metric consistency, reinforce multi-level temporal scrutiny, and incorporate multi-origin spatial information, artificial intelligence, and spatial econometrics. By defining the utility and constraints of key strategies, this analysis offers a pragmatic framework for choosing variables and tools for resource-environment-economy alignment evaluation.

**Keyword:**

High-Quality Development; Resource–Environment–Economy Coordination; Coordination Measurement; Coupling

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Coordination Degree; Spatial Econometrics; Sustainable Development

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## Introduction

With the in-depth progress of the high-quality development strategy and the continuous optimisation of ecological civilisation construction, the Report to the 20th National Congress of the Communist Party of China clearly states that China will continue to take high-quality development as its main theme, accelerate the construction of a new development paradigm, and strive to achieve effective qualitative improvement and reasonable quantitative growth in the economy. It also advocates for the principle of ecological priority, intensive and economical use, and green and low-carbon development to promote the modernisation drive of harmonious coexistence between humanity and nature. The Central Economic Work Conference in 2023 further emphasized that we must adhere to the path of ecological priority and green development without deviation, continuously enhance resource use efficiency and ecological environmental quality, and promote all-round green transformation of economic and social development. The Opinions on Accelerating the Comprehensive Green Transformation of Economic and Social Development issued in 2024 further clarify that, under the guidance of high-quality development, China should accelerate the construction of resource-conserving and environmentally friendly industrial structures, production modes and lifestyles, comprehensively promote the green and low-carbon transformation of the economy and society, and provide strong support for achieving the goals of carbon peaking and carbon neutrality. Given the above, how to coordinate the relationship among resource use, ecological environmental protection and economic and social development, and promote the coordinated development of resource, environmental and economic systems, has become a key research issue for advancing high-quality development in the new era.

Since the reform and opening up, China has achieved high-speed economic growth and significantly improved the general level of living for its people. However, the long-standing model of large-scale growth has also led to relatively scarce resources, increased ecological and environmental problems, and uneven regional development. With the development of industrialisation, urbanisation and modernisation, China has been facing problems of high energy consumption, intensive resource use and persistent pollution. The resources and ecological support capacity of some areas have reached or exceeded their limits. The old development model of GDP has not met the development needs of the new era. Therefore, in order to promote Chinese-style modernisation, the coordinated development of resource conservation, environmental friendliness and high-quality economic development is now unavoidable.

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High-quality development is in line with the development philosophy of innovation, coordination, greenness, openness and sharing, and aims to promote the coordinated development of high-quality economic growth, efficient resource allocation, ecological environment improvement and people's well-being. To some extent, resources, the environment and the economy are interdependent and mutually constraining. Resources are the basic material basis for economic development; the environment imposes ecological constraints and provides supportive conditions for the progress of economy and society, and at the same time, economic development offers technical and financial support for resource conservation and environmental governance. At the same time, economic activities are also resource-intensive and have damaged the environment; thus, ecological environmental improvement can promote the restructuring of industry and economy. Therefore, the joint development of resources, the environment and the economy is a typical case of implementing the new development philosophy and an essential path for promoting the modernisation of harmonious coexistence between humanity and nature.

With the continuous enrichment and improvement of the theory of sustainable development, ecological civilisation theory and high-quality development theory have gradually become important interdisciplinary research directions that integrate resource science, regional economics, ecological economics and environmental science in the coordinated development of resources, environment and economy. At home and abroad, scholars have carried out many studies on its theoretical connotations, evaluation systems, measurement methods and influencing factors, gradually building a relatively systematic analytical system. Theoretically, the existing studies have mainly explored the interaction mechanisms of the three major systems through sustainable development theory, system theory, collaborative development theory and resource and environmental carrying capacity theory. Methodologically, many models have been applied in empirical research at different spatial scales, including the coupling coordination degree model, entropy method, comprehensive evaluation index method, TOPSIS model, DEA and SBM models, as well as spatial econometric and GIS analysis methods. At the same time, with the addition of factors such as the digital economy, green technological innovation, ecological compensation, green finance and environmental regulation, related research has gradually expanded from static assessments to dynamic evolutionary analyses, from single-spatial-scale studies to multi-scale spatial correlation analyses, and from single-system analysis to integrated collaborative analysis of multiple systems.

Although the previous studies have achieved good results, there are still some deficiencies in light of high-quality development. First, the construction of evaluation index systems varies greatly, and unified and standardised criteria have not been established; thus, the research results are difficult to compare. Second, most of the previous studies have only measured the degree of coordination and failed to investigate how the internal system works together or develops dynamically. A systematic characterisation of the new factors is also lacking, such as the digital economy, green innovation, artificial intelligence and new-energy technologies. Third, current research scales are predominantly concentrated on provincial, municipal, and urban agglomeration levels, with relatively insufficient holistic investigations on watershed and cross-regional systems. Fourthly, more research can be conducted on the system of regional differences, spatial spillover effects and policy synergy.

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Based on foreign studies, the main contents of research abroad include the Sustainable Development Goals (SDGs), green growth, the circular economy, resource efficiency and ecosystem services. They focus on the coordinated relationship among resource use efficiency, environmental governance capacity and economic growth, and use methods such as ecological footprint analysis, environmental efficiency evaluation, multi-objective optimisation and comprehensive sustainable development assessment for empirical analysis. In contrast, Chinese research has focused more on the problem of system coordination in the context of ecological civilisation construction, high-quality development, and the dual-carbon goals, and is thus highly practical. However, there are still some deficiencies in the domestic research at present, such as a lack of international comparative studies, no unified evaluation standards, no multi-scale dynamic analysis, and insufficient integration of new-generation technologies.

Based on the above, this paper reviews Chinese and foreign studies on resource-environment-economy coordination in the context of high-quality development, paying attention to conceptual foundations, evaluation indicators, measurement methods, spatial characteristics and influencing mechanisms. It also lists the main methodological deficiencies and research gaps, and proposes future directions for joint research.

This review makes three main contributions. First, it presents the analysis content of resource-environment-economy coordination. Second, it compares the applicability and limitations of the main measurement methods rather than just listing them. Third, it identifies the recurring deficiencies in evaluation standards, dynamic and mechanism-oriented analysis, and new drivers. Therefore, this paper provides a reference for selecting appropriate indicators and methods in all types of research at different scales.

To enhance the openness of the review, this study will conduct an organised literature review of Chinese and foreign studies on high-quality development and resource-environment-economy coordination. Relevant studies were collected from CNKI between 2000 and 2026 by using combinations of keywords such as "resource-environment-economy coordination", "high-quality development", "coupling coordination", "entropy method", "TOPSIS", "DEA/SBM", and "spatial econometrics". Research directly concerned with coordination measurement, indicator construction, spatial changes or influencing factors was selected. Based on the conceptual development, evaluation indicators, measurement methods, spatial scales and research deficiencies, the selected literature was then synthesised.

## Concept Definition

### *High-Quality Development*

High-quality development serves as the main theme for China's economic and social development in the new era, and it is the top task to build a modern socialist country in all aspects. The Report to the 20th National Congress of the Communist Party of China clearly puts forward advancing high-quality development, fully and accurately applying the new development philosophy, accelerating the formation of a new development paradigm, and promoting the all-round green transformation of economic and social development (CPC Central Committee, 2022).

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High-quality development no longer refers to the speed of economic growth; now, the focus is on enhancing development efficiency and structure optimisation, strengthening innovation ability and green transformation, and achieving harmonious development of the economy, society and ecology. At the core is to improve the quality and sustainability of development by reducing excessive reliance on resource consumption and environmental costs (Jin, 2018; CPC Central Committee, 2022). Globally, the main theoretical expressions of high-quality development are sustainable development and green growth. The 2030 Agenda for Sustainable Development of the United Nations advocates for economic development that promotes high-efficiency use of resources and ecological environmental protection (United Nations, 2015). Further research by the OECD has shown that to improve the long-term quality of economic growth, one should increase resource efficiency, promote green technological innovation and optimise institutional arrangements (OECD, 2023).

In short, high-quality development refers to the combination of development quality, efficiency and sustainability, and provides a basic theoretical basis for research on the coordinated development of the resource-environment-economy system.

***Coordinated Development of Resource-Environment-Economy System***

Resource-Environment-Economy coordinated development refers to the harmonious and mutually reinforcing development of resource use, environmental quality and economic development under resource and environmental constraints. It also needs to be reasonable that the subsystems have a good structure and function, work well together, and can be changed dynamically; otherwise, progress in one subsystem may be achieved at the expense of others. The structure of the system, in terms of resources, provides the fundamental factors for economic development, such as energy, water, land and minerals; the environment system offers ecological carrying capacity and constraints on environmental quality for economic activities; and the economic system adjusts to changes in resource consumption and environmental quality through industrial structure optimisation, technological progress and institutional arrangements (Daly, 1991). The three systems are interdependent and mutually constraining, so they are a typical complex coupling system.

Sustainable development theory advocates for the integration of intergenerational equity and resource- and environmental-limitations in the course of development (WCED, 1987). Ecological economics further indicates that the economic system is part of the natural ecological system, and its development is limited by the ecological carrying capacity (Daly, 1991). Therefore, the aim of resource-environment-economy coordinated development is to achieve a dynamic equilibrium between economic growth and ecological protection under the constraints of resources and the environment.

Chinese studies have shown that such coordination is reflected in both the improvement of the general development level and structural optimisation and enhanced functional synergy of the system (Jiang, 2017). In the context of high-quality development, the main purpose is to achieve the unity of efficient resource use, ecological environment improvement and high-quality economic growth.

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### *Coordinated Development and Coupling Coordination Measurement*

Coordinated development refers to the process by which several subsystems move from a state of disorder to order and from a low-level equilibrium to a high-level equilibrium through interactive effects, and its essence is the structural matching and functional synergy of the systems.

Coupling coordination measurement is obtained from the coupling theory in physics, and the strength of interaction and coordination in a system can be determined this way. Coupling is the connection among systems, and coordination refers to the extent of alignment in the development of these systems. The scope of coupling coordination refers to the total synergistic effect of a system (Liu et al., 2016).

Recently, this method has been applied to a large number of studies on the resource-environment-economy system. In combination with the entropy method and spatial econometric models and GIS analysis, research has gradually been conducted to explore the spatiotemporal development features and spatial correlation mechanisms of multi-system development.

### *Connotations of Resource, Environmental and Economic Systems*

The total amount of natural resources available in the area to support the economy and society is called the resource system; this includes energy, water, land, minerals, etc., and its basic characteristics are the supply capacity and utilisation efficiency of these resources.

The Environment System is everything in nature and includes components such as the atmosphere, hydrosphere, lithosphere, etc. The first two are to provide ecological carrying capacity and environmental capacity constraints for human society and economy.

An economy refers to the system of social and economic activities that produce, distribute, exchange and use resources; it generally refers to the structure of industry, economic efficiency and the level of technological progress.

Together, the three systems form a resource-environment-economy system and have provided a foundation for measuring coordinated development and analysing mechanisms in related studies.

### *Research Status in China and Internationally*

#### *Research on High-Quality Development*

High-quality development is now the primary direction of China's economic and social development in the new era, and thus also provides a theoretical foundation for evaluating the coordination of resources, environment and economy. At the 19th National Congress of the Communist Party of China, it was determined that China's economy had moved from a period of high-speed growth to a stage of high-quality development. The 20th National Congress also raised the demand for high-quality development in the construction of a modern socialist country in all areas. Different from the traditional development model that focused on the speed and scale of economic growth, high-quality development now prioritises the quality of

development, structural optimisation, efficiency improvement, innovation-driven growth, green transformation and shared benefits. It promotes the coordinated development of high-quality economic development, ecological environmental protection and high-quality living for the people under resource and environmental constraints.

Based on foreign research, although international scholars rarely use the specific term "high-quality development", studies on sustainable development, green growth, inclusive growth and resilient development are closely related to the theoretical connotations of it. The 2030 Agenda for Sustainable Development of the United Nations advocates for the coordination of economic growth, social inclusion and environmental protection to achieve all-around development that is both sustainable and resilient (United Nations, 2015). OECD's Economic Policy Reforms 2023: Going for Growth points out that structural reforms should enhance productivity and people's livelihoods by promoting more efficient resource allocation, digitalisation and the zero-carbon transition (OECD, 2023). Therefore, foreign studies have provided necessary theoretical support for high-quality development research from the perspectives of sustainable development goals, green growth, resource efficiency and inclusive development.

Early Chinese research on high-quality development focused on interpreting the connotations and theoretical logic of the concept. Jin (2018) was one of the first scholars to analyze the inherent connotations of high-quality development from an economic perspective, and he pointed out that high-quality development does not only seek to increase the speed of growth but also attaches greater importance to development efficiency, structural optimisation, innovation capacity and value creation. Relevant studies show that high-quality development is, in fact, an all-encompassing manifestation of the new development philosophy in socioeconomic progress. At the core are changes in the structure of economic growth, an increase in innovation-driven capabilities, optimisation of industrial structure, an improvement in the level of green development, and the promotion of public welfare.

Recently, many research groups have begun to change from a single-economic-indicator system to a multi-dimensional all-encompassing evaluation system for assessment and measurement. Ma et al. (2019) have built an evaluation indicator system for regional high-quality economic development in line with the new development philosophy, integrated innovation, coordination, green development, openness and sharing into a single framework, and provided a systematic indicator basis for comparative research on regional high-quality development. Fu and Yang (2024) have also explored the spatiotemporal differentiation features and reasons for change in urban high-quality development in Chinese cities. According to the above results, high-quality development shows significant spatial differences, and urban high-quality development can be influenced by quantitative growth, environmental regulation, the digital economy, and the optimisation of urban scale systems.

In terms of influencing factors and realisation paths, recent studies have expanded their research scope beyond the traditional factors of capital and labour to include new elements such as the digital economy, green finance, green technological innovation and institutional environment. Based on panel data of 222 prefecture-level and above cities in China, Zhao et al. (2020) found that the digital economy promotes high-quality development of urban areas through the vitality of entrepreneurship. The effect of the digital economy is also non-linear and has a spatial spillover. Green finance and green technological innovation have also promoted high-quality development by helping to improve the quality of economic growth through support for green innovation (Wen et al., 2022).

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Generally speaking, Chinese and foreign studies on high-quality development have provided strong theoretical and methodological support. Foreign studies have focused on sustainable development, green growth, inclusive development and climate resilience, and stressed coordinating economic growth with resource and environmental constraints, social equity and long-term resilience. At the same time, Chinese studies focus on theoretical interpretation, indicator measurement and mechanism analysis in light of the new development philosophy, Chinese-style modernisation, ecological civilisation construction and regional coordinated development. The existing studies have provided strong support for measuring resource-environment-economy coordination, but some deficiencies remain. First, a unified and standardised evaluation indicator system for high-quality development has not been established; there are inconsistencies in the selection of indicators, their weights and research scopes across different studies. Second, most research has focused on measuring the level of development but has not explored the coupling mechanism, dynamic feedback effect and nonlinear relationship among resources, environment and economy. Third, the all-encompassing influence of new factors such as the digital economy, artificial intelligence, new quality productive forces and green finance under resource and environmental constraints have yet to be fully explored. In the future, more high-quality development theory should be integrated with resource-environment-economy coordination research, multi-dimensional indicator systems need to be improved, and analysis of spatial correlation, dynamic evolution and mechanism identification should be strengthened to provide a more scientific theoretical basis for promoting the coordinated improvement of high-quality economic development and ecological environment.

***Research on Resource-Environment-Economy Coordination***

Early international studies based on ecological economics and system coupling theory argue that the economic system is embedded in natural ecological systems, and economic growth is constrained by resource supply capacity and ecological environmental carrying capacity. Grossman and Krueger (1995) put forward the Environmental Kuznets Curve hypothesis and, in doing so, stimulated further research by scholars around the world. Porter and van der Linde (1995) have explored how to reduce the harm of environmental regulations on corporate competitiveness, and they believe that reasonable environmental regulations can promote technological innovation and improve resource use efficiency to enhance corporate performance.

With the deepening of research on green growth and the decoupling theory of the circular economy, foreign scholars have also been studying how economic development relates to changes in resource and environmental pressures. Tapio (2005) has divided the relationships among economic growth, traffic volume, energy consumption and carbon emissions into several categories of decoupling according to decoupling theory and proposed an effective analytical system to determine whether economic development has been decoupled from resource and environmental dependence. The OECD (2011) has put forward in its Green Growth Strategy that the aim of Green Growth is to continue supplying resources and ecosystem services for economic development through natural assets. Geissdoerfer and others (2017) believe that, in terms of the circular economy, economic and ecological systems can be synergistically developed by extending the life cycle of products, promoting reuse and remanufacturing, and reducing resource consumption and waste emissions. Generally speaking, foreign studies have gradually shifted their focus from the resource and environmental costs of economic development in the early days to all-encompassing interactions among resource

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efficiency, green technological innovation, the circular economy and green economic transformation.

In recent years, foreign empirical studies have gradually focused on multi-system coupling, spatial heterogeneity and policy mechanism analysis. Sui and others (2023) took the Yellow River Basin as the research case and built an analytical framework for resource-economy-ecology relationships. According to the coupling coordination degree model and the geographical detector method, it was determined that the overall coordination level of the basin's resource-economy-ecology system has risen; however, there are significant spatial disparities between the upper and lower reaches. Water supply and demand balance, resource allocation, and socioeconomic conditions are all related to coordination performance. The above studies show that the development of resource-environment-economy coordinated development depends on the development level of individual subsystems as well as the degree of matching among resource endowments, ecological constraints, economic structure and governance capacity.

Chinese studies on resource-environment-economy coordination have been closely related to China's rapid industrialisation, urbanisation and construction of ecological civilisation. Early studies mainly focused on resource and environmental carrying capacity, constraints to economic growth and regional sustainable development, and believed that socioeconomic activities should be limited to the scope of resource and environmental carrying capacity. With the proposal of the new development philosophy, ecological civilisation construction, dual-carbon goals and major regional strategies, Chinese research has gradually shifted from single-resource and environmental constraint analysis to multi-system coupling and coordination analysis of resources, environment and economy. The research scope covers resource utilisation efficiency, ecological environmental quality, level of economic development, green technological innovation, green finance, digital economy and spatial governance.

At the level of scope, domestic research has established a multi-level analysis system that includes provinces and cities, urban agglomerations, river basins, economic belts, etc. Research in the province has studied how all kinds of regional resource endowments, industrial structure, environmental governance ability and stage of economic development affect coordination level. Most urban-scale studies generally focus on the overall impact of urbanisation, land-use change, energy consumption and pollution control in combined systems. Research on urban agglomerations, river basins and economic belts has found cross-regional resource flow, industrial coordination, joint ecological governance and spatial spillover effects.

In terms of research content and methods, the coupling coordination degree model, entropy method, comprehensive evaluation index method, spatial autocorrelation model, spatial econometric model and geographical detector model have become the main analytical tools for Chinese research on resource-environment-economy coordination. In recent years, relevant studies have moved beyond the measurement of coordination level to explore the driving forces and implementation paths of coordinated development. Sun and Zhang (2024) have studied the coupling coordination of regional innovation-ecology-economy systems from a configurational perspective and pointed out that to improve regional coordination, the deficiencies in subsystems need to be addressed and synergistic links among internal system components strengthened. Deng et al. (2024) studied the coupling coordination relationship between the digital economy and green development in China, identified obvious spatiotemporal evolution

features and prominent regional disparities, and confirmed that the digital economy has become an important new force driving resource-environment-economy coordinated development.

Many reasons limit the combined development of resources, environment and economy, such as industrial structure, technological innovation, environmental regulation, green finance, the digital economy and institutional environment. Optimisation of the industrial structure can reduce resource consumption and pollution emission intensity; technological innovation can improve resource utilisation and the efficiency of environmental governance; and environmental regulation can motivate corporate green transformation by means of constraints and incentives. From the perspective of green finance and green innovation, Wen et al. (2022) found that green finance enhances the quality of economic growth by supporting green innovation, and thus financial resource allocation and green technological innovation are the main paths for promoting resource-environment-economy coordinated development. With the development of the digital economy and artificial intelligence technology, data elements, digital infrastructure and intelligent governance tools have gradually become necessary support systems to improve the efficiency of resource allocation, strengthen the capacity of environmental governance, and promote the green transformation.

In general, domestic and foreign research on the coordinated development of resources, environment and economy has achieved many results. Foreign studies have explored theories and methods such as sustainable development, ecological economics, the Environmental Kuznets Curve, decoupling theory, green growth and circular economy, etc., focusing on how to change the interactive relationship between economic growth and resource-environment pressure. On the other hand, Chinese studies focus on the connection among resources, environment and economy in the context of ecological civilisation construction, high-quality development, dual-carbon goals and regional coordinated development strategies. Although some studies have provided strong theoretical support and an index system for investigating the reasons of joint development, some deficiencies still exist. First, a unified evaluation index system has not been established, and thus the research results lack comparability. Second, most existing studies are limited to provincial and urban scales, and cross-regional coordination mechanisms for metropolitan areas, urban agglomerations and river basins have not been explored. Third, the nonlinear feedback mechanisms and dynamic evolution processes of the resource-environment-economy system are not well understood. Fourth, the all-encompassing mechanisms of new factors such as the digital economy, artificial intelligence, new quality productive forces, green finance and institutional environment have yet to be fully explored. In the future, further optimise the theoretical system and evaluation mechanism for resource-environment-economy coordinated development, strengthen multi-scale, dynamic and spatial correlation analysis, and apply big data, remote sensing monitoring, machine learning and spatial econometric models to enhance the scientificity and explanatory power of coordination measurement, thus providing strong theoretical support for high-quality development and ecological civilisation construction.

***Research on Coordination Measurement Models***

Research on coordination measurement models provides the methodological foundation for the literature on resource-environment-economy coordinated development. It will be an all-encompassing, easy-to-understand result of many indicators, such as resource use, ecological environment quality and the level of economic development. Most previous research has established evaluation indicator systems for the resource, environment and economy

subsystems first, calculated the overall development level of each subsystem using weighting methods, and then applied multiple approaches such as the coupling coordination degree model, TOPSIS method, DEA/SBM model, GIS spatial analysis and spatial econometric models to examine the coordination status, efficiency level, spatial distribution and influencing factors of the system. Coordination measurement models have generally developed from early single-comprehensive evaluation systems to now employ multi-model integrated frameworks that integrate "comprehensive measurement–spatial identification–mechanism explanation–path optimisation".

***Coupling Coordination Degree Model***

One of the most popular ways to study the coordination degree model of resource-environment-economy coordination is used here. In accordance with the coupling theory in physics, the extent of connection and cooperation among several subsystems can be determined by all-around development indices, coupling degrees and coordination degrees in this model. In research on resource-environment-economy composite systems, scholars generally measure the development levels of the resource, environmental and economic subsystems separately, and then apply the coupling coordination degree model to determine the evolutionary stages of the system from imbalance and low-level coordination to good coordination.

In recent years, the coupling coordination degree model has been increasingly combined with remote sensing data, geographical detectors, obstacle degree models and prediction models, and its application range has expanded from single cities or provinces to cross-regional scales such as urban agglomerations, river basins and economic belts. Sui and others (2023) took the Yellow River Basin as the research object, built a resource-economy-ecology analytical framework based on panel data and remote sensing data, and applied the coupling coordination degree model and geographical detector to analyze the level of system coordination and its influencing factors. Focusing on the water-receiving areas of the lower Yellow River, Qu et al. (2024) built an all-encompassing analytical framework for water resources, ecological environment and socioeconomic system, and further verified the applicability of the coupling coordination degree model in describing the combined connections among resource constraints, ecological environment and socioeconomic development. Xiang et al. (2024) integrated the entropy-weighted TOPSIS method with the coupling coordination degree model, spatial autocorrelation, kernel density estimation and geographical detector to analyze the coordination level, spatial agglomeration and driving mechanisms of the population-resource-environment-economy system in the Yellow River Basin and showed that multi-model integration is a trend in recent studies.

The coupling coordination degree model has a simple structure and easy-to-calculate features; it can show the coordination status of multiple subsystems intuitively and is suitable for stage division and regional comparison of resource-environment-economy coordination levels. However, there are some deficiencies. First, the coupling degree may be too high for the actual system coordination level; two subsystems with low development levels can also have high coupling correlations. Second, the comprehensive development index and coordination degree are sensitive to indicator weights, standardisation methods and parameter settings. Third, the model only shows the results and does not explain why there is a change or development. Therefore, follow-up studies have generally combined the coupling coordination degree model with spatial econometrics, obstacle degree diagnosis, geographical detectors or configuration analysis to improve the explanatory power of measurement results.

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### *Entropy Method and TOPSIS Method*

Entropy is a general-purpose objective function that can be derived from information-theoretic principles. Shannon (1948) proposed the idea of information entropy, and it can be used to assign weights in multi-index evaluation. In resource-environment-economy coordination measurement, the entropy method determines weights according to the dispersion degree of indicator data; that is, indicators with larger differences contain more information and are thus assigned higher weights. Entropy method is less influenced by subjective judgment in the evaluation results than expert weighting method and is therefore frequently used in all-around assessments of resource utilisation efficiency, ecological environmental quality, green development and high-quality development.

Hwang and Yoon (1981) proposed a system to determine the relative advantages of evaluation objects by calculating their distances from the positive-ideal and negative-ideal solutions in the TOPSIS method. In research on resource-environment-economy coordination, the TOPSIS method is often combined with the entropy method to form an entropy-weighted TOPSIS model, and then the development levels of subsystems and composite systems are calculated using this model. This way can solve the problems of multi-index, multi-region and multi-year evaluation effectively, provide clear ranking results, and is widely used in the evaluation of regional coordinated development, ecological civilisation construction and sustainable development.

Both the entropy method and the TOPSIS method are good general-purpose evaluation tools, but they also have some defects. Entropy method is based on the fluctuation of sample data, and highly correlated indicators or poor-quality data may have weights that deviate from their theoretical values. TOPSIS is sensitive to the choice of indicator normalisation and the ideal solution; therefore, the evaluation results generally only show relative differences and not the internal structure of the system. Therefore, in the measurement of resource-environment-economy coordination, the entropy method and TOPSIS method generally serve as tools to calculate overall development levels and are often combined with coupling coordination degree models, spatial analysis or driving mechanism models for empirical studies.

### *DEA and SBM Models*

DEA is a non-parametric efficiency assessment method proposed by Charnes, Cooper and Rhodes (1978) to determine the relative efficiency of decision-making units without assuming a production function. Research on resource-environment-economy coordination examines both the degree of organised coordination and whether economic output can be achieved at a low-resource-consumption and low-environmental-damage level. Therefore, the DEA model can be used to measure the efficiency of resource use, environmental efficiency, green economic efficiency and high-quality development efficiency.

The SBM model is an improved method developed on the basis of the DEA model. Tone (2001) proposed a slack-based SBM model to directly address the problems of input redundancy and output insufficiency and thus solved the problem of ignoring slack variables in traditional radial DEA models. In research on green development and resource-environmental efficiency, the SBM model can be extended to include undesirable outputs, such as pollutant emissions and carbon emissions, to meet the requirements for efficiency evaluation under resource and environmental constraints more effectively. DEA and SBM models are used to extend the

interpretation of the operational quality of resource-environment-economy systems beyond simple coordination degree measurement by adding an input-output efficiency perspective.

DEA and SBM models have some deficiencies; they are strongly sample-dependent, require high comparability among evaluation objects, and are easily affected by extreme samples. In addition, the traditional DEA/SBM models are mainly static efficiency measures and lack explanatory power for the sources of efficiency changes, spatial spillovers, and causal mechanisms. Therefore, in recent years, many studies have combined DEA/SBM models with the Malmquist index, super-efficiency models, spatial econometric models and threshold models to explore green total factor productivity, the development path of resource environmental efficiency and their spatial influence mechanisms.

### *GIS Spatial Analysis and Spatial Econometric Models*

Resource-environment-economy coordinated development has prominent spatial characteristics, and regional interactions, such as the flow of resources, pollution diffusion, industrial transfer and policy linkage, occur among different areas. GIS spatial analysis can intuitively show the distribution, agglomeration pattern and evolution trend of coordination degree, and is often used in conjunction with kernel density analysis, standard deviation ellipse analysis, hot spot analysis and spatial autocorrelation analysis. Moran's (1950) theory of spatial autocorrelation provides the basis for Moran's I index and spatial agglomeration analysis to identify high-value agglomeration, low-value agglomeration, and spatial heterogeneity in coordination levels in resource-environment-economy coordination research.

Spatial econometric models also explain interregional interaction at the level of statistics. Anselin (1988) was the first to systematically put forward the concepts of spatial dependence and spatial heterogeneity, and LeSage and Pace (2009) have promoted the application of spatial lag models, spatial error models and spatial Durbin models in regional economic and environmental studies. Spatial econometric models can be used to study the coordination of resources, environment and economy, and at the same time, spatial spillover effects of factors such as the digital economy, green innovation, environmental regulation and industrial structure on neighbouring areas can also be examined.

In recent years, domestic studies have gradually begun to integrate spatial analysis and coordination measurement models. Deng et al. (2024) used the coupling coordination degree model, GIS spatial analysis, spatial autocorrelation analysis, Dagum Gini coefficient and QAP regression to explore the coupling coordination relationship between the digital economy and green development in China and revealed their spatiotemporal characteristics and driving forces. Research on coordination measurement has therefore moved from determining the extent of coordination to investigating spatial patterns and driving forces.

### *Multi-Model Integration and Methodological Development Trends*

The main measurement methods address different research questions and are not interchangeable alternatives. A general model of coupling coordination degree is used to study the synergistic effects of the development levels of sub-systems; entropy weighting and TOPSIS support composite evaluation and regional ranking; DEA/SBM evaluates input-output efficiency under resource and environmental constraints; GIS and spatial autocorrelation methods show the distribution and clustering of space; and spatial econometric models explore

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spatial dependence, spillover effects, and potential influencing factors. Therefore, the choice of method depends on whether one wishes to discover cooperative levels, an all-around ranking, efficiency, spatial distribution or factors affecting these. Several models are suitable for problems that require both measurement and mechanism identification.

Recently, coordination measurement models have been developing all-roundly and exploring the mechanisms in more detail. On one hand, scholars integrate entropy-weighted TOPSIS, coupling coordination degree models, spatial autocorrelation, geographical detectors, and obstacle degree models to simultaneously reveal coordination levels, spatial differentiation, and influencing factors. At the same time, configuration analysis, system dynamics, machine learning and multi-source spatial data are gradually being added to coordination measurement research. Sun and Zhang (2024) conducted dynamic qualitative comparative analysis to identify multiple paths for the coupled coordinated development of regional innovation-ecology-economy systems from a configurational perspective and found that coordinated development is driven by the combination of several conditional factors rather than a single reason.

Future research on measurement models for resource-environment-economy coordination should strengthen the following three areas. First, strengthen the system of indicators and weights to improve the comparability of research results in different areas and at different scales. Second, integrate coordination-level measurements with mechanism identification to avoid displaying only static results. Thirdly, actively incorporate remote sensing data, night-light data, carbon emission monitoring data, micro-enterprise data and machine-learning methods to enhance the dynamism, precision and foresight of coordination measurement. Only by integrating all-encompassing evaluation, spatial analysis and mechanism explanation can the synergistic relationships among the resource, environmental and economic systems be accurately revealed, providing reliable methodological support for regional coordinated governance under the background of high-quality development.

### *Research on Resource-Environment-Economy Coordination Under the Background of High-Quality Development*

With the continuous progress of China's high-quality development strategy and ecological civilisation construction, resource-environment-economy coordinated development has gradually changed from a general problem of sustainable development to an essential indicator for evaluating regional high-quality development. The Opinions on Accelerating Comprehensive Green Transformation of Economic and Social Development issued by the CPC Central Committee and the State Council in 2024 clearly state that, in line with the goals of carbon peaking and carbon neutrality, China should coordinate carbon reduction, pollution abatement, ecological enhancement and economic growth, and accelerate the formation of resource-conserving and environment-friendly spatial patterns, industrial structures, production modes and lifestyles. This policy direction indicates that, in light of high-quality development, resource-environment-economy coordination is no longer a single problem of ecological protection or economic growth; rather, it has become a system of projects that address resource allocation efficiency, ecological environmental quality, industrial green transformation, regional coordinated governance and development quality improvement.

Based on foreign studies, although few international scholars have used the specific concept of "high-quality development" in their research, many studies on sustainable development goals, green growth, circular economy and dual digital-green transformation are closely related to this research topic. In 2015, the United Nations' 2030 Agenda for Sustainable Development advocates for coordinating economic growth, social inclusion and environmental protection to promote all-round sustainable development of society (United Nations). Recently, many scholars have begun to study how digital transformation and the green transition can work together to improve resource allocation efficiency, strengthen environmental governance, and promote low-carbon innovation. Research on resource-environment-economy coordination has expanded from the traditional constraints of resources and the environment to technology-enabled green transformation.

In recent years, foreign empirical studies have gradually moved away from single-dimension environmental performance assessment to multi-system coupling and spatial mechanism analysis. Sui and others (2023) took the Yellow River Basin as the research object, used panel data and remote sensing data, and built an analytical framework for resource-economy-ecology relationships. Based on the above results, resource use, ecological protection and economic development are closely related; the degree of coordination depends on the availability of resources, ecological constraints and the economic foundation. Based on Chinese urban data, He et al. (2024) have built an evaluation system for digital technology and environmental governance capacity. Using an improved coupling coordination degree model and a spatial Durbin model, they found that the coordination level between digital technology and environmental governance exhibits obvious spatial agglomeration characteristics, and digital infrastructure and digital applications significantly promote the improvement of environmental governance capacity. Ma et al. (2025) investigated the ternary coordination relationship among the digital economy, green finance and green urbanisation in the Yellow River Basin, and found that, although there are still regional differences, the overall coupling coordination level has been rising. These studies show that research on resource-environment-economy coordinated development has moved from a static analysis of "resource constraints–environmental pressure–economic growth" to a dynamic comprehensive analysis focusing on "technology empowerment–financial support–spatial synergy–green transformation".

Chinese studies on resource-environment-economy coordinated development under the background of high-quality development started relatively late but have developed rapidly in recent years. With the implementation of major national strategies, such as the dual-carbon goals, ecological protection and high-quality development of the Yellow River Basin, the development of the Yangtze River Economic Belt, and regional coordinated development, scholars have gradually paid more attention to the coupling and evolutionary relationship between resource utilisation efficiency, ecological environmental quality and the quality of economic development. Most existing studies have built evaluation indicator systems according to the new development philosophy and integrated resources consumption, environmental governance, economic benefits, green innovation, industrial structure and people's livelihood into a single analytical framework. Entropy method, coupling coordination degree model, spatial autocorrelation, spatial econometric model and geographical detector are all commonly used to explore the spatiotemporal distribution, regional differences and driving forces of coordinated development in resource-environment-economy at the regional level.

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In terms of research scales, cities, urban agglomerations, river basins and economic belts have become the main spatial units for research at present. Based on empirical analysis of urban high-quality development in China, Fu and Yang (2024) found that urban high-quality development has obvious spatial differences and is significantly affected by economic foundations, population agglomeration, innovation capacity, public services and geographical location. Liu (2025) selected eight major urban agglomerations in China as the research subjects and studied the coupling coordination relationship between the digital economy and green development efficiency. Based on the above results, the level of coordination is generally unstable and fluctuating, and staged gaps and regional imbalances exist in all urban agglomerations. The above research indicates that resource-environment-economy coordination in the high-quality development of a region requires the alignment of internal subsystems within that area as well as coordination of cross-regional resource flow, industrial collaboration, joint ecological governance and spatial spillover effects in urban agglomerations, river basins and economic belts.

In terms of driving forces, the digital economy, green finance, green technological innovation and environmental governance capacity have gradually become the main research directions. Zhao and others (2020) used Chinese urban panel data to confirm that the digital economy promotes high-quality development of cities by boosting entrepreneurial vitality and has significant spatial spillover effects. Wen and others (2022) have pointed out that, in terms of green finance and green innovation, green finance promotes high-quality economic growth by supporting green innovation, and they have revealed the main path through which green finance achieves resource-environment-economy coordination. Deng et al. (2024) have explored the coupling coordination between the digital economy and green development in China and proposed that mutual empowerment and coordinated progress of the two are necessary conditions for high-quality development; the digital economy promotes green development by optimising resource allocation, adjusting industrial structure, and promoting the diffusion of green technologies. Sun and Zhang (2024) have further examined the multiple paths of regional innovation-ecology-economy coupling coordination from a configurational perspective and found that coordinated development is promoted by the combined effects of innovation capability, ecological governance, economic foundation and institutional environment, rather than a single cause.

Overall, existing studies have comprehensively explored resource-environment-economy coordination under the background of high-quality development from the perspectives of theoretical logic, quantitative evaluation, spatial evolution and driving mechanisms. international research focuses on sustainable development, green growth, digital-green transformation and multi-system collaborative governance, while domestic studies highlight the coupling coordination of resource-environment-economy systems under the strategic context of ecological civilization construction, high-quality development, dual-carbon goals and regional high-quality strategies. Based on the research results above, the main characteristics of high-quality development are resource-environment-economy coordinated development, and its realisation requires improving resource utilisation efficiency and environmental governance capacity, optimising industrial structure, promoting green technological innovation, developing the digital economy, and strengthening institutional policy support.

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However, the current studies have also left some deficiencies. First, unified evaluation indicator systems have not been established, and the selection of indicators for resource, environmental and economic subsystems vary significantly across studies, thus reducing the comparability of empirical results. Second, most research focuses on measuring the level of coordination and fails to explore dynamic feedback, nonlinear relationships and causal mechanisms among the three subsystems. Third, although the scale of research has expanded from provinces and cities to urban agglomerations and river basins, cross-regional studies on resource flow, pollution transfer, ecological compensation and policy coordination are still lacking. Fourth, the all-encompassing impact mechanisms of new factors such as the digital economy, artificial intelligence, new quality productive forces and green technological innovation have not been fully revealed. Strengthen the multi-dimensional evaluation system in the future and conduct multi-scale spatial analysis and dynamic evolution studies. Combine coupling coordination measurement with spatial econometrics, configuration analysis, machine learning and multi-source data in subsequent studies to explore the internal evolutionary mechanism of resource-environment-economy system coordination under the background of high-quality development.

## Literature Review

Research on resource-environment-economy coordination has gradually moved from the initial single-system study of resource and environmental constraints to multi-system coordination, spatial evolution, and mechanism-oriented analysis. Foreign research has mainly provided theoretical support through sustainable development, green growth, resource efficiency and ecological economics; at the same time, Chinese studies have placed more emphasis on coupling and coordination under the context of ecological civilisation and high-quality development. Researchers have shifted away from using a single, all-encompassing evaluation method and introduced coordination indicators, efficiency analysis, spatial identification, etc.
There are still some deficiencies in the current work, such as non-comparable evaluation criteria. The subsystems, indicators, normalisation procedures, weights and coordination classification criteria in the existing studies are all different. Some studies focus on energy, water and land-use efficiency; others give more weight to pollution emissions, ecological quality, economic output or innovation capacity. Entropy-based weights are also affected by sample variation, and coupling coordination results are sensitive to indicator weights, standardisation methods and parameter settings. Therefore, the differences in the studies may be due to various reasons other than regional coordination.

The second is that it has not analysed the dynamic changes and internal reasons. Many studies have calculated coordination levels for different regions or periods and then described their temporal and spatial differences; however, such analyses do not necessarily explain causal relationships, nonlinear feedback, or path dependence in resource use, environmental quality, technological change and economic restructuring. In addition, there are often cross-border flows of resources and pollution, industrial relocation and technological diffusion. Static or single-region models will thus underestimate the spatial spillover and cross-regional effects. Strengthen the application of extended analysis, space-time econometrics, dynamic models and mechanism-oriented methods.

The third limitation is new drivers and international comparability. Digitalisation, green finance, artificial intelligence, green technological innovation and other factors have been gradually added to coordination research, but their interaction, threshold, spillover and heterogeneous effects are still not well understood. At the same time, a large proportion of the empirical

evidence is concentrated in Chinese provinces, cities, urban agglomerations and river basins, and direct comparisons across different institutional and development contexts are lacking. In short, the three main deficiencies in this review are thus inconsistent evaluation norms, a lack of dynamic and mechanism-oriented analysis, and limited coverage of new drivers and foreign studies. The above deficiencies provide the foundation for the future research directions presented in the following section.

**Research Suggestions and Prospects**

Based on the systematic review of literature related to high-quality development, resource-environment-economy coordination and coordination measurement models, resource-environment-economy coordinated development has gradually become a key research direction in the construction of ecological civilisation, regional coordinated development and high-quality development. The 2030 Agenda for Sustainable Development advocates for the combined realisation of economic growth, social inclusion and environmental protection (United Nations, 2015). OECD (2011) believes that green growth should provide a long-term supply of resources and ecosystem services for economic development from natural assets. Research on the circular economy also proposes reducing resource input, waste discharge and energy consumption through the practice of the three Rs: reduce, reuse and recycle (Geissdoerfer et al., 2017). Against the backdrop of high-quality development and all-encompassing green transformation in China, the "Opinions on Accelerating Comprehensive Green Transformation of Economic and Social Development" released in 2024 advocate for the coordinated promotion of carbon reduction, pollution abatement, ecological enhancement and economic growth, providing clear practical demands and policy guidance for resource-environment-economy coordination research. Based on the existing achievements, future research should further optimise and deepen in terms of the theoretical system, indicator system, spatial scale, influencing mechanism, methodological innovation and policy application.

First, strengthen the theoretical system of resource-environment-economy coordinated development in the context of high-quality development. Most existing studies on the connections among resources, environment and economy use concepts such as sustainable development, ecological economics, green growth theory and system coordination theory. However, the interactive logic of the three subsystems in the context of high-quality development has not been fully explored. Future research should fully demonstrate the inherent unity of efficient resource use, ecological environment improvement and economic quality enhancement, and integrate resource carrying capacity, environmental capacity constraints, green and low-carbon transformation, economic resilience and people's well-being into a unified analytical system. In addition, the following studies should not only present the three subsystems side by side but also explore how resources, environment and economy are transmitted, feedback-related and evolve in stages. Improve the use efficiency of resources to reduce the demand for resources in economic development and promote environmental protection through industrial restructuring and technological innovation. Strengthening the capacity of ecological governance will also impose certain constraints on economic development and promote high-quality economic growth by creating a good business environment, improving the living standards of the people, and fostering green industries.

Second, further optimise the evaluation indicator system for resource-environment-economy coordinated development. Current studies use different criteria for selecting indicators and inconsistent measurement standards in the resource, environment and economy subsystems, so

the empirical results are not comparable. Based on the three core dimensions of resources, environment and economy, the future indicator system should fully reflect the requirements of high-quality development and all-weather green transformation. In terms of the resource subsystem, high priority should be given to energy consumption intensity, water and land-use efficiency, the level of resource recycling and energy structure optimisation. In terms of the environmental subsystem, indicators such as pollutant emission intensity, carbon emission intensity, air quality, water environmental quality, ecosystem service functions and ecological restoration effects should be included. The old mode of GDP-centric evaluation should be abandoned for the economic subsystem, and more weight should be given to green total factor productivity, industrial structure upgrading, innovation capability, residents' income, public service quality and economic resilience. Xiang et al. (2024) studied the population-resource-environment-economy system of the Yellow River Basin and found that green innovation, openness and population density all positively affect the coordinated development of the system; therefore, future indicator systems should comprehensively include innovation, openness, population carrying capacity and regional development quality.

Third, strengthen multi-scale, multi-region and cross-regional cooperative research. The spatially heterogeneous distribution of Resource-Environment-Economy coordination is due to differences in regional endowments of resources, industrial structure, ecological carrying capacity, innovation level and governance ability. Although the scope of the existing research has expanded from provinces and cities to urban agglomerations and river basins, cross-regional coordination mechanisms have not been studied. Sui and Qu have shown that the coupling coordination relationships among resources, the water environment and the socioeconomic system in the Yellow River Basin and its downstream water-receiving areas can be revealed at the watershed scale, and this scale is more conducive to reflecting spatial linkages among resource flow, ecological constraints and economic activities. Future research should overcome the limitations of single administrative divisions, strengthen empirical studies on composite spatial units such as urban agglomerations, metropolitan areas, river basins and economic belts, and focus on cross-regional resource allocation, industrial transfer, pollution diffusion, ecological compensation and collaborative governance mechanisms to reveal the spatial linkage characteristics of coordinated development.

Fourth, further study the process of dynamic evolution and spatial spillover effect. The cooperation of resources, environment and economy changes continuously with economic development and industrial restructuring, technological progress and policy changes, and is not a fixed state. Most traditional studies focus on measuring the static coordination level in a particular year and neglect systemic stage transitions, path dependence and nonlinear evolutionary rules. Deng et al. (2024) found obvious spatiotemporal evolution features and regional differences in the coupling coordination between the digital economy and green development in China. Fu and Yang (2024) have also found considerable spatial disparities in urban high-quality development. Future research can apply Markov chain, dynamic panel model, spatial Durbin model, threshold model and complex network analysis to systematically study the stage transition, source of regional differences, spatial spillover effects and policy linkage effects of resource-environment-economy coordination levels.

Fifth, increase research on new driving forces such as the digital economy, green finance and green technological innovation. With the development of digital construction and green low-carbon transformation, the driving forces for resource-environment-economy coordinated development have been changing substantially. The digital economy promotes the all-round

synergistic development of the system by optimising resource allocation, improving production efficiency, driving industrial digitalisation and strengthening environmental governance. He and others (2024) have confirmed a coupling coordination relationship between the development of digital technology and environmental governance capacity, and shown that digital infrastructure and digital applications enhance the performance of environmental governance. Liu (2025) selected eight major urban agglomerations in China as the research subjects and found that the coordination level of the digital economy and green development efficiency has been generally rising. Green finance provides capital support and risk control for green technological innovation and industrial green transformation. Wen and others (2022) have clarified the path through which green finance promotes high-quality development of the economy. Future research should build an all-encompassing analytical system that integrates the digital economy, green finance, green technological innovation, artificial intelligence and new quality productive forces to explore their direct and indirect effects, threshold effects and spatial spillover effects on resource-environment-economy coordinated development.

Sixth, promote methodological innovation and multi-model integration in coordination measurement. Although many models have been employed to evaluate coordination, such as the entropy method, coupling coordination degree model, TOPSIS model, DEA-SBM model, GIS spatial analysis and spatial econometric models, none of them can fully reveal the nonlinear relationships, dynamic feedback and multi-factor interactions in complex composite systems. Ma et al. (2025) used spatial convergence analysis and coupling coordination models to study the ternary coordination of the digital economy, green finance and green urbanisation in the Yellow River Basin, and pointed out the value of multi-model integration. In the future, many sources of spatial data and high-end analysis methods will be added for coordination measurement. Remote Sensing, nighttime light and carbon-emission monitoring, etc., can provide time- and space-resolved data for traditional indices. Machine-learning methods can uncover non-linear relationships, interactions and potential threshold effects, and spatial econometric and dynamic models are still used to explore the reasons behind spatial spillovers. Together, the above methods will enhance both the accuracy and explanatory power of coordination assessment.

Seventh, enhance the policy application value of research results. Research on resource-environment-economy coordination should promote the development of theory and provide scientific decision-making support for regional high-quality development, ecological civilisation construction and the achievement of dual-carbon goals. Future research should be problem-oriented and policy-oriented, and specific and differentiated policy suggestions should be proposed according to the development deficiencies and obstacle factors of different areas. For the developed eastern region, focus should be placed on promoting industrial upgrading, digitalisation and green transformation, enhancing green innovation capabilities, and improving global resource allocation efficiency. The central and western areas will be optimised for resource utilisation efficiency, the ecological compensation mechanism reformed, and the development of green industries and digital infrastructure promoted. The resource-based city needs to promote industrial restructuring and reduce its dependence on the old path of resource extraction. For urban agglomerations and metropolitan areas in river basins, strengthen cross-regional ecological co-governance, industrial collaboration and infrastructure interconnection to shift the model of regional coordinated development from single-point improvement to all-around optimisation. Sun and Zhang (2024) pointed out from a configuration perspective that the coupling coordination of regional innovation-ecology-economy is determined by the combination of multiple conditional factors rather than a single

element; therefore, future policy design should place greater emphasis on multi-factor synergy and regional differentiated governance.

In short, this paper has introduced the conceptual basis, main indicators, measurement methods and research deficiencies of resource-environment-economy coordination. Choose a way that meets the specific requirements of the research goals: Coupling coordination models are suitable for assessing subsystem synergy; entropy-TOPSIS supports composite evaluation and ranking; DEA/SBM evaluates resource and environmental efficiency; and spatial analytical methods are appropriate for studying spatial heterogeneity and spillover effects. Enhance the comparability of the indices and, in the future, carry out dynamic, cross-regional and mechanism-oriented studies. Considering the strengths and weaknesses of all these methods and the appropriate applications in various spaces and areas, some practical references for selecting indicators and conducting research are provided in this review.

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