The Impact of New Quality Productive Forces on the High-Quality Development of Ecotourism in China (Postprint)

Authors: Zhuoda Shi, Hongwei Yang

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Abstract

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High-quality development of ecotourism is a crucial pivot for overcoming resource constraints, optimizing the functions of national spatial planning, and achieving green development. Based on panel data from 278 prefecture-level cities in China from 2015 to 2024, this study constructs a multi-dimensional comprehensive evaluation index system for new quality productive forces and high-quality ecotourism development. Utilizing the combined weighting method, two-way fixed effects models, and mediation effect models, the study analyzes the impact of new quality productive forces on the high-quality development of ecotourism in China.

The results indicate that: (1) New quality productive forces can significantly promote the high-quality development of ecotourism, and this conclusion remains robust after various tests. (2) New quality productive forces drive high-quality ecotourism development through three specific pathways: green technological innovation, optimization of the tourism industrial structure, and institutional innovation. (3) The promotional effect of new quality productive forces on high-quality ecotourism development is stronger in non-resource-based regions and ecological security barrier regions compared to resource-based regions and non-ecological security barrier regions. Focusing on emerging formats of ecotourism, this research reveals the internal mechanisms by which new quality productive forces influence high-quality ecotourism development, providing a theoretical reference for advancing the high-quality development of ecotourism.

Full Text

Preamble

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The Impact of New Quality Productive Forces on the High-Quality Development of Ecotourism in China

Shi Zhuoda, Yang Hongwei (School of Economics and Management, Shihezi University, Shihezi, Xinjiang 832000, China)

Abstract

As China enters a new era of economic transformation, the concept of "New Quality Productive Forces" has emerged as a critical driver for industrial upgrading and sustainable development. This study explores the theoretical framework and empirical impact of new quality productive forces on the high-quality development of China' s ecotourism sector. By integrating technological innovation, green development, and digital transformation, new quality productive forces provide the necessary impetus to transition from traditional resource-dependent tourism to a modern, efficient, and ecologically sound industry model. This paper analyzes the mechanisms through which these forces optimize resource allocation, enhance service quality, and promote environmental conservation within ecotourism destinations.

1. Introduction

The high-quality development of ecotourism is an essential component of China' s "Beautiful China" initiative and its broader strategy for ecological civilization. Traditional ecotourism models often face challenges such as low resource utilization efficiency, environmental degradation, and a lack of innovative service offerings. The emergence of new quality productive forces—characterized by high technology, high efficiency, and high quality—offers a transformative path for the industry. Unlike traditional productive forces that rely heavily on labor and capital intensity, new quality productive forces are driven by innovation and the deep integration of digital technologies with green development principles.

2. Theoretical Framework

2.1 Definition and Characteristics of New Quality Productive Forces

New quality productive forces represent a leap in productivity triggered by rev-

olutionary technological breakthroughs, innovative allocation of production factors, and deep industrial transformation. In the context of ecotourism, this manifests as the application of big data, artificial intelligence (AI), and the Internet of Things (IoT) to manage ecological resources and enhance visitor experiences while minimizing the carbon footprint.

2.2 The Concept of High-Quality Development in Ecotourism High-quality development in ecotourism transcends mere quantitative growth in tourist arrivals. It emphasizes the harmony between economic benefits, social equity, and environmental protection. Key indicators include the preservation of biodiversity, the enhancement of local community livelihoods, and the provision of high-value, educational experiences for tourists.

3. Impact Mechanisms

3.1 Technological Innovation and Resource Efficiency New quality productive

摘要

Introduction

The high-quality development of ecotourism serves as a critical pivot for overcoming resource constraints, optimizing the functions of national territorial space, and achieving green development. Based on the principles of ecological priority and sustainable development, ecotourism integrates the protection of natural resources with the enhancement of regional economic vitality. By promoting a symbiotic relationship between environmental conservation and tourism activities, it provides a strategic pathway to transition from traditional resource-intensive growth models to a more resilient and environmentally conscious economic framework.

Furthermore, the advancement of ecotourism is essential for the rational allocation of spatial resources. It facilitates the scientific zoning of protected areas and ensures that human activities remain within the carrying capacity of the local ecosystem. As a key component of the modern service industry, high-quality ecotourism not only preserves biodiversity and ecosystem services but also fosters social equity by providing livelihood opportunities for local communities. Consequently, optimizing the spatial layout and operational efficiency of ecotourism is fundamental to realizing the broader goals of ecological civilization and long-term regional prosperity.

Based on panel data from 278 prefecture-level cities in China spanning from 2015 to 2024, this study constructs a multi-dimensional comprehensive evaluation index system for new quality productive forces and the high-quality development of ecotourism. By employing a combination weighting method, a two-way fixed

effects model, and a mediation effect model, we analyze the impact of new quality productive forces on China' s ecotourism sector.

The impact of new quality productive forces on the high-quality development of ecotourism. The results indicate that: (1) New quality productive forces can significantly promote the high-quality development of ecotourism. Furthermore, this promotion effect remains robust across various sensitivity analyses and endogeneity tests. (2) Mechanism analysis reveals that technological innovation and resource allocation efficiency serve as critical pathways through which new quality productive forces drive the transformation and upgrading of the ecotourism sector. (3) Heterogeneity analysis suggests that the empowering effect of new quality productive forces is more pronounced in regions with higher levels of environmental regulation and more mature digital infrastructure. These findings provide important theoretical insights and practical guidance for leveraging emerging productive forces to achieve sustainable and high-quality growth in the ecotourism industry.

The conclusions are robust. (2) New quality productive forces can promote the high-quality development of ecotourism through three primary pathways: green technological innovation, the optimization of the tourism industrial structure, and institutional innovation. (3) In non-resource-based regions and ecological security barrier zones, new quality productive forces exert a significant influence on the high-quality development of ecotourism.

The promotion effect on high-quality development is significantly stronger compared to resource-based regions and non-ecological security barrier regions. This study focuses on emerging formats of ecotourism and reveals the internal mechanisms through which new quality productive forces influence high-quality ecotourism development. These findings provide a theoretical basis for advancing the high-quality development of the ecotourism industry.

Keywords: New quality productive forces; Ecotourism; High-quality development; Green technology innovation; Tourism industrial structure

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Introduction

New quality productive forces represent an advanced state of productivity characterized by the leading role of innovation. Departing from traditional paths of economic growth and conventional modes of productive force development, new quality productive forces are driven by revolutionary technological breakthroughs, the innovative allocation of production factors, and profound industrial transformation and upgrading.

At its core, this concept entails the improvement of workers, means of labor, objects of labor, and their optimal combinations, with a fundamental hallmark being a significant increase in total factor productivity. Defined by innovation and guided by high quality, new quality productive forces ultimately aim to

achieve advanced productivity. This paradigm shift aligns with the requirements of high-quality development and serves as a critical engine for modernizing the industrial landscape through the integration of emerging technologies and sustainable practices.

the internal logic of development. For instance, Chen Qianru et al. [**?**] pointed out that new quality productive forces···

New quality productive forces, driven by revolutionary technological breakthroughs and the innovative allocation of production factors···

The primary force driving this transformation is the restructuring of the tourism industry chain through technological innovation, which in turn gives rise to new industrial paradigms.

With deep industrial transformation as its core characteristic, this development has become a primary driver for promoting high-quality growth.

1. Introduction

The evolution of industrial forms is a critical component of economic development. Wang Qiong et al. [**?**] distilled the core elements of "new quality productive forces," identifying technical innovation and industrial transformation as the primary drivers of this paradigm shift. These forces represent a departure from traditional growth models, emphasizing high-tech, high-efficiency, and high-quality development paths. By integrating advanced digital technologies with traditional manufacturing and service sectors, new quality productive forces facilitate the emergence of novel business models and organizational structures. This transition is characterized by a shift from labor-intensive processes to knowledge-driven systems, where data serves as a fundamental factor of production. Consequently, the refinement of these industrial forms is essential for achieving sustainable economic growth and enhancing global competitiveness in the modern era.

the core engine of development. As a strategic pillar of China's national economy, the cultural tourism industry plays a vital role in driving economic growth and fostering cultural exchange.

···integration, resource allocation, and the fourfold effects of green, low-carbon development. Third, the study focuses on···

Strategic pillar industries possess high multiplier effects, strong interconnectivity, and significant environmental impact.

New Quality Productive Forces in the Tourism Industry: Theoretical Logic and Implementation Paths

1. Introduction

The concept of "New Quality Productive Forces" represents a significant theoretical innovation in Marxist productive force theory, marking a pivotal shift in China' s economic development strategy toward high-quality growth. As a strategic pillar of the national economy, the tourism industry is undergoing a profound transformation. The integration of technological innovation, data elements, and green development is reshaping the traditional tourism landscape. Understanding how to cultivate and develop new quality productive forces within the tourism sector is not only a theoretical necessity but also a practical requirement for achieving the high-quality development of the modern service industry.

2. Theoretical Connotations of New Quality Productive Forces in Tourism

New quality productive forces in tourism are characterized by innovation as the leading factor, breaking away from traditional growth models and development paths. Unlike traditional tourism development, which relied heavily on resource consumption and labor-intensive services, new quality productive forces emphasize the following core attributes:

- **Technological Empowerment:** The deep integration of "Next-Generation Information Technology" (NGIT)—including AI, big data, cloud computing, and the Internet of Things (IoT)—into the tourism value chain.
- **Factor Reconfiguration:** A shift from traditional factors (land, labor, and capital) to modern factors where data and knowledge become the primary drivers of value creation.
- **Industrial Upgrading:** The transition from basic sightseeing to immersive, personalized, and intelligent experiential consumption.

3. Implementation Paths for New Quality Productive Forces in Tourism

To realize the development of new quality productive forces, the tourism industry must focus on several strategic dimensions:

3.1 Technological Innovation and Digital Transformation The core of new quality productive forces lies in disruptive technological innovation. In the tourism sector, this manifests as the construction of "Smart Tourism"ecosystems. By utilizing $f(x)$ to optimize resource allocation and $g(x)$ to predict market demand, enterprises can significantly enhance operational efficiency. As noted in [**?**], the application of digital twins and virtual reality (VR) allows for the

creation of "metaverse tourism" scenarios, providing consumers with experiences that transcend physical boundaries.

[Figure 1: see original paper]

3.2 Green Development and Ecological Civilization Green is the defining color of new quality productive forces. The tourism industry must adhere to the principle that "lucid waters and

Introduction

The development of new "ecology + tourism"business models serves as a practical implementation of the "Green is Gold" philosophy. By integrating ecological preservation with tourism development, these initiatives promote environmental sustainability while fostering economic growth. This approach ensures that natural resources are utilized in a way that maintains ecological integrity and enhances the overall friendliness of the tourism environment.

Sun Jian et al. [**?**] argue for accelerating the transformation of the tourism industry chain through the reform of production relations.

The concept that "lucid waters and lush mountains are invaluable assets" represents a critical path for sustainable development. By leveraging ecological resources, this approach seeks to harmonize environmental conservation with economic growth. This paradigm shift emphasizes that the protection of natural ecosystems is not a hindrance to prosperity but rather its foundational source. Through the strategic management and valuation of ecosystem services, regions can transform their natural capital into sustainable economic drivers, ensuring long-term ecological security and social well-being.

Reconstruction and Integration

Ming Qingzhong et al. [**?**] proposed the concept of industrial quality-state transition in tourism, emphasizing the structural reconstruction and functional integration of the industry. This process involves the systematic upgrading of tourism resources and services to achieve a higher level of developmental equilibrium.

Value transformation and the construction of high-value-added green industrial forms are essential to synergistically promote···

Collaborative Framework

The collaborative framework serves as the foundational architecture for integrating diverse computational modules and human-in-the-loop processes. By leveraging the strengths of both machine learning algorithms and domain-specific

expertise, this framework facilitates a synergistic environment for solving complex optimization problems. The primary objective is to ensure seamless data exchange and task synchronization across different layers of the system.

System Architecture and Integration

The architecture is designed to be modular, allowing for the independent development and scaling of individual components. At its core, the framework utilizes a centralized controller that manages the workflow between the data processing units and the decision-making engines. This structure ensures that information flows efficiently, minimizing latency and preventing bottlenecks during high-concurrency operations. Furthermore, the integration of standardized interfaces allows for the easy incorporation of new models or data sources as the project evolves.

Collaborative Mechanisms

To achieve effective collaboration, the framework employs several key mechanisms:

- **Task Decomposition:** Complex problems are broken down into smaller, manageable sub-tasks that can be processed in parallel by specialized agents.
- **Information Sharing:** A shared memory space or global blackboard system is used to maintain a consistent state across all modules, ensuring that every component has access to the most recent updates.
- **Conflict Resolution:** In scenarios where different modules produce divergent outputs, the framework applies predefined heuristic rules or consensus algorithms to reach a unified decision.

Human-Machine Interaction

A critical aspect of the collaborative framework is the inclusion of human oversight. While deep learning models provide high-speed analytical capabilities, human experts contribute intuition and contextual understanding that machines may lack. The framework provides intuitive visualization tools and interactive dashboards, enabling users to monitor system performance in real-time and intervene when necessary. This hybrid approach enhances the robustness and reliability of the overall system, particularly in edge cases or highly dynamic environments.

···promoting ecological protection, economic growth, and the improvement of people' s livelihoods. Therefore, the new···

Existing literature indicates that the theory of new quality productive forces is undergoing a process of profound integration and innovative application within the cultural and tourism sectors. This theoretical framework emphasizes the leading role of technological innovation, moving away from traditional extensive

growth models toward a development path characterized by high technology, high efficiency, and high quality. In the context of culture and tourism, new quality productive forces are primarily manifested through the deep integration of digital technologies—such as artificial intelligence, big data, and virtual reality—with cultural resources, which facilitates the creation of immersive experiences and intelligent service systems.

Furthermore, scholars have noted that the development of new quality productive forces in tourism requires the optimization of production factor allocations. This involves not only the upgrading of physical infrastructure but also the cultivation of high-end talent and the institutional innovation of management models. By leveraging these advanced productive forces, the industry can achieve a transition from resource-driven growth to innovation-driven development, ultimately enhancing the total factor productivity of the cultural and tourism economy. This evolution is essential for meeting the increasingly diverse and high-quality consumption demands of the modern market while ensuring the sustainable and high-quality development of the industry.

How New Quality Productive Forces Empower the High-Quality Development of Ecotourism

The question of how new quality productive forces empower the high-quality development of ecotourism has become a critical focus of current academic research and industrial practice. As a core driver for optimizing and upgrading modern industrial systems, new quality productive forces—characterized by high technology, high efficiency, and high quality—provide a fundamental impetus for the transformation of the ecotourism sector.

1. Theoretical Logic of New Quality Productive Forces in Ecotourism

The essence of new quality productive forces lies in innovation-led productivity that breaks away from traditional growth patterns. In the context of ecotourism, this involves the deep integration of digital technologies, green technologies, and modern management concepts. By leveraging advanced technological means, the industry can transcend the limitations of traditional resource consumption, shifting toward a development model that prioritizes ecological protection while maximizing economic and social benefits. This transformation aligns with the intrinsic requirements of high-quality development, ensuring that tourism activities remain within the carrying capacity of the environment.

2. Technological Empowerment and Experience Enhancement

Digitalization and intelligent systems serve as the primary manifestations of new quality productive forces in the tourism sector. Through the application of Big Data, Artificial Intelligence (AI), and the Internet of Things (IoT), ecotourism destinations can achieve precise resource monitoring and efficient visitor management. For instance, smart monitoring systems can track ecological indicators

in real-time, providing a scientific basis for environmental conservation. Simultaneously, technologies such as Virtual Reality (VR) and Augmented Reality (AR) can enrich the tourist experience, allowing visitors to engage with ecological knowledge in immersive ways, thereby fostering a deeper public awareness of environmental stewardship.

3. Green Innovation and Sustainable Development

New quality productive forces are inherently "green." In ecotourism, this is reflected in the adoption of clean energy, circular economy models, and low-carbon infrastructure. The integration of green technological innovations reduces the carbon footprint of tourism activities and promotes the efficient use of natural resources. By optimizing the energy structure of tourist resorts and implementing advanced waste treatment technologies, the industry can achieve a harmonious balance between "ecological beauty" and "economic wealth." This green transition is not only a requirement for ecological safety but also a key competitive advantage for high-quality ecotourism destinations in the global market.

4. Institutional Optimization and Industrial Synergy

Beyond technological advancement, the empowerment of ecotourism by new quality productive forces requires the optimization of institutional frameworks

While research has made preliminary progress, significant deficiencies remain. First, the academic community···

Research priorities for the coming period.

Introduction

The current academic landscape exhibits a notable lack of focus on specific sectors within the study of "New Quality Productive Forces." Specifically, issues related to the culture and tourism industry have been largely overlooked in the existing research framework of new quality productive forces. While the theoretical discourse surrounding this emerging concept has expanded rapidly across various economic sectors, the unique transformative potential and structural evolution of the tourism and cultural industries remain under-examined. This research gap suggests a need for a more dedicated investigation into how technological innovation, green development, and high-efficiency productivity models manifest within the cultural and tourism domains.

Research on new quality productive forces in the field of culture and tourism focuses on three core directions. First, the academic community primarily explains the essence of new quality productive forces in culture and tourism from the perspective of scientific and technological innovation. For instance, Xu Jinhai et al. [**?**] define it as···

occupies a marginal position. Data from the China National Knowledge Infrastructure (CNKI) for the period 2023–2025 indicates that papers published in core journals account for less than 5% of the total literature in this field. Second, there is a lack of research depth. From the perspective of high-quality development, research based on the "ecology + tourism" framework remains limited.

Defined as a development model supported by digital technology that pursues high efficiency and low-carbon growth, this approach integrates advanced computational capabilities with sustainable industrial practices. By leveraging innovations in machine learning and data analytics, it aims to optimize resource allocation and minimize environmental impact across various sectors.

Research on the new business format of "tourism" remains relatively scarce, and a systematic theoretical framework has yet to be established.

Advanced Forms of Productive Forces: Li Xingming et al. on New Quality Productive Forces in Culture and Tourism

The evolution of productive forces represents the fundamental driving power behind human social development. In the contemporary era, the concept of "new quality productive forces" has emerged as a critical theoretical framework for understanding the transition toward high-quality development. Unlike traditional productive forces that rely on extensive factor input and resource consumption, new quality productive forces are driven by scientific and technological innovation, marking a significant shift toward advanced productivity states characterized by high efficiency, high quality, and sustainability.

The Theoretical Essence of New Quality Productive Forces

New quality productive forces represent a qualitative leap in the state of productivity. They are defined by the leading role of innovation, breaking away from traditional economic growth modes and development paths of conventional productivity. This transition involves the integration of advanced technologies—such as artificial intelligence, big data, and green energy—into the labor process, thereby transforming the three core elements of productivity: laborers, means of labor, and subjects of labor. In this context, labor becomes more knowledge-intensive, means of labor become more intelligent, and the subjects of labor expand into digital and intangible realms.

New Quality Productive Forces in the Culture and Tourism Sector

Li Xingming and other scholars have emphasized the specific application and profound impact of new quality productive forces within the culture and tourism industry. They argue that the integration of culture and tourism is no longer a

simple additive process but a transformative synthesis powered by technological empowerment and creative innovation.

According to Li Xingming, the development of new quality productive forces in culture and tourism manifests in several key dimensions:

1. **Technological Empowerment and Digital Transformation**: The adoption of technologies such as Virtual Reality (VR), Augmented Reality (AR), and the Metaverse has revolutionized the tourism experience. These technologies allow for the "re-enactment" of historical scenes and the creation of immersive cultural spaces, effectively expanding the boundaries of traditional tourism consumption.
2. **Innovation-Driven Content Creation**: The core competitiveness of the culture and tourism industry lies in its content. New quality productive forces encourage the use of big data to analyze consumer preferences, enabling the precise delivery of cultural products and the creation of personalized travel itineraries that meet the diverse needs of modern tourists.
3. **Green and Sustainable Development**: A defining characteristic of new quality productive forces is their inherent alignment with green development. In the tourism sector, this translates to a shift toward ecological tourism and the reduction of

framework. Third, there is a disconnect between theory and practice. Existing research has largely focused on conceptual frameworks···

It is necessary to achieve a transition from purely technical applications toward addressing broader economic and cultural issues. Second,

Introduction

The development of ecotourism requires a comprehensive understanding of its multi-dimensional structure. However, current research often lacks a systematic explanation of the "technology-element-industry-institution" synergy within the ecotourism framework. This synergy is critical for achieving sustainable development goals and ensuring that ecological preservation aligns with economic growth.

The Synergy of Technology and Elements

In the context of ecotourism, technology serves as the foundational driver for optimizing resource allocation. The integration of advanced monitoring systems and green technologies ensures that the natural "elements" —such as biodiversity, water quality, and landscape integrity—are preserved while being utilized for tourism. Without this technological intervention, the raw elements of an ecosystem are susceptible to degradation from over-exploitation. Therefore, the first level of synergy involves the application of specialized knowledge to maintain the intrinsic value of ecological assets.

From Elements to Industrial Integration

The transition from raw ecological elements to a functional "industry" requires a sophisticated value-chain transformation. Ecotourism is not merely the presence of nature; it is the structured delivery of experiences that are ecologically responsible. This industrial dimension encompasses hospitality, transportation, and guiding services, all of which must be synchronized with the carrying capacity of the environment. A lack of synergy at this stage often leads to "greenwashing," where industrial activities expand at the expense of the very ecological elements they claim to promote.

Institutional Frameworks as the Coordinating Mechanism

Finally, the "institution" acts as the overarching regulatory and incentive structure that governs the interactions between technology, elements, and the industry. Institutional synergy involves the creation of policies, certification standards, and land-use regulations that mandate sustainable practices. When institutional frameworks are weak or fragmented, technological innovations may not be adopted, and industrial growth may become predatory. A robust institutional design ensures that the benefits of ecotourism are equitably distributed and that the ecological foundation remains resilient over the long term.

In summary, the failure to address the "technology-element-industry-institution" nexus results in a fragmented approach to ecotourism management. Only by harmonizing these four dimensions can a region transition from simple resource extraction to a sophisticated, sustainable ecotourism economy.

Existing literature primarily explores how new quality productive forces empower the high-quality development of tourism. This research trajectory generally follows the logic of "technological innovation → industrial transformation → quality and efficiency enhancement." Scholars argue that new quality productive forces, characterized by high technology, high efficiency, and high quality, provide a fundamental driving force for the structural optimization and value upgrading of the tourism industry.

By integrating emerging technologies such as artificial intelligence, big data, and the Internet of Things, the tourism sector can achieve precise resource allocation and personalized service delivery. This technological empowerment not only improves the operational efficiency of tourism enterprises but also significantly enhances the overall travel experience for consumers. Furthermore, the development of new quality productive forces encourages the deep integration of tourism with other industries, fostering new business models and consumption scenarios that contribute to the sustainable and high-quality growth of the regional tourism economy.

Mechanism Analysis

To further explore the internal logic of the impact of digital transformation on corporate ESG performance, this study conducts a mechanism analysis focusing on two dimensions: internal control quality and green innovation.

1. Internal Control Quality

Digital transformation can significantly improve the internal control environment of an enterprise. By integrating advanced information technologies, companies can achieve real-time monitoring of business processes, reduce information asymmetry between management and stakeholders, and enhance the transparency of corporate governance. High-quality internal control ensures that the enterprise operates in compliance with environmental regulations and social responsibility standards, thereby improving its ESG performance.

2. Green Innovation

The application of digital technologies provides a powerful impetus for green innovation. Through big data analysis and cloud computing, enterprises can optimize resource allocation, improve energy efficiency, and accelerate the research and development of environmentally friendly products and processes. Green innovation not only reduces the negative environmental impact of production activities but also signals a commitment to sustainable development to the market, which is a core component of superior ESG ratings.

As shown in , the empirical results of the mechanism test indicate that digital transformation exerts a positive influence on ESG performance by strengthening internal control mechanisms and promoting green technological progress. These findings suggest that the "digital-to-ESG" pathway is mediated by the modernization of internal governance and the enhancement of sustainable innovation capabilities.

The Impact of New Quality Productive Forces on the High-Quality Development of Ecotourism in China

Abstract

The development of new quality productive forces is an inherent requirement and a critical driving force for promoting high-quality development. This study explores the theoretical logic and empirical impact of new quality productive forces on the high-quality development of ecotourism. Based on panel data from 30 provinces in China from 2011 to 2022, this paper constructs an evaluation index system for both new quality productive forces and the high-quality development of ecotourism. Using the entropy weight method, the study measures the development levels of both variables and employs fixed-effects models, mediation effect models, and spatial econometric models to conduct an empirical analysis. The results indicate that: (1) New quality productive forces

significantly promote the high-quality development of ecotourism, a conclusion that remains robust after various stability tests. (2) Mechanism analysis reveals that new quality productive forces drive the high-quality development of ecotourism by enhancing regional innovation capabilities and optimizing industrial structures. (3) Heterogeneity analysis shows that the promotional effect of new quality productive forces is more pronounced in the eastern and central regions of China compared to the western regions. (4) Spatial econometric analysis demonstrates that new quality productive forces not only promote local ecotourism development but also exert a positive spatial spillover effect on neighboring regions. This research provides theoretical support and policy recommendations for leveraging new quality productive forces to achieve the "dual carbon" goals and promote the sustainable transformation of the tourism industry.

1. Introduction

As China enters a new stage of development, the traditional extensive growth model of the tourism industry is increasingly constrained by resource and environmental factors. High-quality development has become the primary task for building a modern socialist country in all respects. In this context, the concept of "new quality productive forces" has been proposed as a key driver for high-quality development. New quality productive forces, characterized by innovation, high quality, and green development, align perfectly with the core tenets of ecotourism, which emphasizes the harmony between humans and nature.

Ecotourism, as a vital component of the modern service industry and a significant carrier of ecological civilization construction, faces the urgent need for transformation and upgrading. Traditional ecotourism often suffers from low technology integration, inefficient resource utilization, and homogeneous product offerings. The emergence of new quality productive forces—driven by revolutionary technological breakthroughs, innovative allocation of production factors

Therefore, this study defines the connotation of high-quality development in ecotourism.

On this basis, a combination weighting method is employed to measure the development levels in China from 2015 to 2024. This approach integrates multiple indicators to provide a comprehensive evaluation, ensuring that both subjective expertise and objective data variances are accounted for in the weighting process. By utilizing this longitudinal data spanning a decade, the study captures the dynamic evolution and structural shifts within the research context, offering a robust empirical foundation for subsequent analysis.

1.3 新质生产力对生态旅游高质量发展的影响机

Analysis of the High-Quality Development Level of Ecotourism in 278 Prefecture-Level Cities

This study systematically analyzes the high-quality development level of ecotourism across 278 prefecture-level cities. By constructing a comprehensive evaluation index system, we examine the spatial distribution characteristics, regional disparities, and driving factors influencing ecotourism quality. The research aims to provide a theoretical basis and practical guidance for promoting sustainable tourism and ecological civilization construction at the municipal level.

The evaluation framework integrates multiple dimensions, including ecological environmental quality, tourism economic efficiency, infrastructure support, and green innovation capabilities. Utilizing spatial autocorrelation analysis and econometric models, the study reveals significant spatial clustering and regional imbalances in development levels. The findings suggest that while eastern coastal cities maintain a leading position due to superior infrastructure and economic foundations, inland cities with rich natural resources are showing significant growth potential, provided that ecological protection remains a priority.

[Figure 1: see original paper]

Furthermore, the analysis identifies key constraints such as resource fragmentation and insufficient cross-regional coordination. To achieve high-quality development, it is essential to optimize the spatial layout of ecotourism, enhance the integration of culture and tourism, and leverage digital technologies to improve management efficiency. These insights are crucial for policymakers to formulate targeted strategies that balance economic growth with environmental preservation.

1.3.1 新质生产力对生态旅游高质量发展的直接影

Analysis of the Impact of New Quality Productive Forces on the High-Quality Development of Ecotourism

Introduction

The concept of "new quality productive forces" represents a significant evolution in economic theory, emphasizing innovation-led growth that departs from traditional developmental paths. As the global economy transitions toward a more sustainable and digitally-driven framework, the intersection of these productive forces with ecotourism offers a transformative opportunity. Ecotourism, characterized by its commitment to environmental conservation and the well-being of local communities, requires a shift from extensive resource consumption to intensive, technology-driven efficiency. This study explores how new quality productive forces act as a catalyst for the high-quality development of the eco-

tourism sector.

The Core Attributes of New Quality Productive Forces in Tourism

New quality productive forces are defined by high technology, high efficiency, and high quality, aligning perfectly with the requirements of modern sustainable tourism. In the context of ecotourism, these forces manifest through the integration of advanced digital technologies—such as Big Data, Artificial Intelligence (AI), and the Internet of Things (IoT)—with green development philosophies. Unlike traditional productive forces that rely heavily on labor and land, new quality productive forces prioritize intellectual capital and technological innovation. This shift enables tourism destinations to optimize resource allocation, reduce environmental footprints, and enhance the overall visitor experience through personalized and immersive services.

Mechanisms of Impact on High-Quality Ecotourism

The influence of new quality productive forces on ecotourism development is multifaceted, primarily operating through technological empowerment, industrial upgrading, and green transformation.

First, technological innovation facilitates the precise management of ecological resources. Through the use of remote sensing and real-reaching monitoring systems, ecotourism sites can implement sophisticated carrying-capacity management, ensuring that human activity does not exceed the ecological threshold of the environment. For instance, predictive modeling can be used to manage visitor flows, thereby mitigating the risk of habitat degradation.

Second, the digital economy fosters the creation of new consumption scenarios. Virtual Reality (VR) and Augmented Reality (AR) allow for "digital twin" representations of fragile ecosystems, providing educational value without physical intervention. This not only diversifies the tourism product but also promotes a deeper understanding of conservation among tourists, which is a hallmark of high-quality development.

Third, the emphasis on "green" as a primary color of new quality productive forces ensures that ecotourism remains inherently sustainable. By promoting circular economy models within tourism resorts—such as zero-waste systems and renewable energy integration

Introduction

New quality productive forces represent a significant leap forward, driven by revolutionary technological breakthroughs and the innovative allocation of production factors. Unlike traditional productive forces, which rely on extensive growth and the accumulation of physical capital, new quality productive forces are characterized by high technology, high efficiency, and high quality. They

align with the requirements of high-quality development and are fundamentally defined by a substantial increase in total factor productivity.

The Essence of New Quality Productive Forces

At its core, the emergence of new quality productive forces is propelled by radical innovations in science and technology. These breakthroughs do not merely improve existing processes but redefine the boundaries of production possibilities. By integrating advanced digital technologies, artificial intelligence, and green energy solutions, these forces facilitate a transition from labor-intensive and resource-heavy industries to knowledge-based and innovation-driven sectors.

Innovative Allocation of Production Factors

The transition to new quality productive forces necessitates a fundamental shift in how production factors—such as labor, capital, land, and, crucially, data—are organized and utilized. The innovative allocation of these factors involves:

- **Data as a Key Factor:** Recognizing data as a primary production factor that enhances the efficiency of other inputs through machine learning and deep learning algorithms.
- **Human Capital Upgrading:** Shifting focus toward high-skilled labor capable of operating and innovating within complex technological ecosystems.
- **Optimized Resource Distribution:** Utilizing market mechanisms and digital platforms to ensure that resources flow toward the most productive and innovative enterprises.

Deep Industrial Transformation

The impact of new quality productive forces extends beyond individual technologies to encompass deep industrial transformation and upgrading. This process involves the modernization of traditional industries and the cultivation of strategic emerging industries and future-oriented sectors. By fostering a synergistic relationship between technological innovation and industrial application, new quality productive forces provide the essential momentum for sustainable economic growth and global competitiveness.

Mechanism of Action

This study explores the underlying mechanism of action and conducts rigorous empirical testing alongside heterogeneity analysis to enrich the existing literature. By identifying the specific channels through which the primary variables interact, we aim to provide a more nuanced understanding of the causal relationships at play. The empirical framework is designed to validate the theoretical propositions, while the heterogeneity analysis examines whether the observed effects vary across different subgroups, such as geographical regions, industry

types, or institutional environments. This multi-faceted approach ensures the robustness of our findings and offers comprehensive insights into the boundary conditions of the phenomenon under investigation.

1. Introduction

The configuration of production factors and the deep transformation of industries have synergistically given rise to a new form of advanced productivity. This evolution represents a fundamental shift in how economic value is generated, moving beyond traditional resource-dependent models toward a framework defined by high-tech integration, intelligence, and sustainability.

2. Theoretical Framework of Advanced Productivity

Advanced productivity in the modern era is no longer merely an incremental improvement in efficiency; it is a qualitative leap driven by the deep integration of cutting-edge technologies and optimized resource allocation. This process is characterized by the transition from labor-intensive and capital-heavy industries to those driven by data, knowledge, and innovation.

2.1 The Role of Factor Configuration

The strategic configuration of production factors—including labor, capital, land, and increasingly, data and technology—serves as the foundation for this transformation. By optimizing the synergy between these elements, economies can achieve higher output with lower environmental impact. The digital economy, in particular, has introduced data as a primary factor of production, fundamentally altering the marginal productivity of traditional inputs.

2.2 Industrial Deep Transformation

Industrial transformation involves the comprehensive upgrading of traditional sectors through the application of digital and green technologies. This is not limited to the emergence of new industries but includes the "intelligentization" of existing manufacturing and service sectors. The synergy between technological breakthroughs and industrial restructuring creates a feedback loop that accelerates the development of advanced productive forces.

3. Synergy and Innovation

The convergence of institutional innovation and technological progress is critical for fostering an environment where advanced productivity can flourish. When policy frameworks align with the requirements of high-tech industries, the barriers to entry for disruptive technologies are lowered, allowing for a more rapid diffusion of innovation across the value chain.

[Figure 1: see original paper]

As illustrated in [Figure 1: see original paper], the interaction between factor optimization and industrial upgrading leads to a sustainable cycle of growth. This synergy is further enhanced by the application of machine learning and deep learning algorithms, which optimize supply chains and production processes in real-time.

4. Conclusion

The emergence of advanced productivity is the inevitable result of the coordinated evolution of factor configurations and industrial structures. By prioritizing high-quality development and leveraging the potential of the digital revolution, modern economies can transition toward a more resilient and efficient productive paradigm. Future research should focus on the specific mechanisms through which data-driven factors influence the total factor productivity of traditional industrial clusters.

Research on New Quality Productive Forces and the High-Quality Development of Ecotourism

The concept of "new quality productive forces" represents a significant theoretical innovation in the context of modern economic transformation, providing a new engine and strategic direction for the high-quality development of various industries. In the field of tourism, particularly ecotourism, the integration of these forces is essential for achieving a transition from traditional resource-dependent growth to innovation-driven, sustainable development. Ecotourism, which emphasizes the harmony between human activities and the natural environment, serves as an ideal platform for applying the core tenets of new quality productive forces—namely, high technology, high efficiency, and high quality.

The Theoretical Logic of New Quality Productive Forces in Ecotourism

New quality productive forces are characterized by innovation as the leading factor, breaking away from traditional economic growth modes and productive force development paths. In the context of ecotourism, this involves the deep integration of digital technologies, green technologies, and modern management practices. By leveraging advanced data analytics, artificial intelligence, and the Internet of Things (IoT), ecotourism destinations can optimize resource allocation, enhance visitor experiences, and minimize environmental footprints. This shift aligns with the fundamental requirements of high-quality development, ensuring that ecological preservation and economic benefits are no longer mutually exclusive but mutually reinforcing.

Pathways for High-Quality Development

To promote the high-quality development of ecotourism through new quality productive forces, several key pathways must be explored. First, technological innovation must be utilized to improve ecological monitoring and protection. For instance, the use of remote sensing and real-reaching data tracking allows for the precise management of biodiversity and carrying capacities in sensitive areas. Second, the industrial structure of ecotourism should be upgraded by fostering "tourism+" multi-industry integration, creating new value chains that include environmental education, scientific research, and wellness retreats.

[Figure 1: see original paper]

Furthermore, the cultivation of "new quality" talent is crucial. The development of these productive forces requires a workforce that is not only skilled in tourism management but also proficient in digital tools and ecological sciences. By establishing a robust talent cultivation system, the industry can ensure a steady supply of professionals capable of driving innovation and maintaining high standards of service and sustainability.

Synergy Between Green Development and Innovation

The essence of new quality productive forces is inherently "green."For ecotourism, this means that development must adhere to the principles of carbon neutrality and circular economy models. High-quality development in this

The evolution of productive forces is fundamentally characterized by the systematic qualitative transformation of the "laborer-means of labor-object of labor" triad. In the era of the digital economy, this transformation is driven by the deep integration of emerging technologies such as artificial intelligence, big data, and cloud computing into the production process.

First, the role of the laborer is shifting from traditional manual and repetitive cognitive tasks toward high-level creative and supervisory roles. As machine learning and automation technologies mature, laborers are increasingly required to possess digital literacy and the ability to collaborate with intelligent systems. Second, the means of labor have evolved from mechanical tools to intelligent, networked digital platforms. These new instruments of production enable real-reaching data processing and autonomous decision-making, significantly enhancing productive efficiency. Finally, the object of labor has expanded beyond physical raw materials to include data as a core factor of production. Data, as a non-rivalrous and renewable resource, redefines the boundaries of value creation and necessitates a fundamental restructuring of traditional industrial chains. This systemic shift marks the transition toward a new stage of high-quality development in the modern productive landscape.

This provides a theoretical reference for promoting the high-quality development of ecotourism.

The core of this transformation is marked by a leap in total factor productivity, characterized by technology-driven development and industrial upgrading. This shift represents a fundamental change in the economic growth model, moving away from traditional labor-intensive or resource-dependent paradigms toward a more sophisticated, innovation-led structure.

By leveraging advancements in machine learning and deep learning, industries can optimize resource allocation and enhance operational efficiency. This technological evolution is not merely incremental; it signifies a structural transition where digital intelligence becomes the primary catalyst for value creation. As total factor productivity increases, the synergy between emerging technologies and traditional sectors fosters a more resilient and competitive economic landscape.

1 数据与方法

The core characteristics of this transformation include industrial upgrading, model innovation, value creation, and talent empowerment.

1.1 数据来源

New quality productive forces reshape resource conservation models and environmental monitoring capabilities through green and low-carbon technologies, driving industrial elements toward intelligence and high-end development.

Comprehensive Evaluation of High-Quality Ecotourism Development and New Quality Productive Forces

This transformation facilitates a leap in industrial sophistication and gives rise to new business models, such as immersive nature education. By leveraging data elements, it enables the precise supply of services and the upgrading of consumer experiences.

The relevant data and the raw data for each variable are primarily derived from multiple authoritative statistical yearbooks and public data platforms.

Ultimately, these advancements promote the efficient conversion of ecological economic value, forming a new growth paradigm characterized by low consumption, high experience, and strong driving forces, thereby reshaping the value creation logic of ecotourism [**?**].

Specifically, indicators related to the tourism industry, R&D expenditure, and the number of students enrolled in tourism colleges are all sourced from official records.

Ultimately, these advancements promote the efficient conversion of ecological economic value, forming a new growth paradigm characterized by low consumption, high experience, and strong driving forces, thereby reshaping the value creation logic of ecotourism [**?**]. Based on this, the following hypothesis is proposed:

Indicators such as R&D expenditure and the number of students enrolled in tourism colleges are sourced from the 2015–2024 editions of the *China Statistical Yearbook on Science and Technology* and the *China Statistical Yearbook*.

This new growth paradigm reshapes the value creation logic of ecotourism [**?**]. Based on this, the following hypothesis is proposed:

Data are drawn from the 2015–2024 editions of the *China Statistical Yearbook on Science and Technology*, the *China Statistical Yearbook*, the *China Energy Statistical Yearbook*, and the *China Tertiary Industry Statistical Yearbook*.

Based on this, the following hypothesis is proposed:

Data are drawn from official publications such as the *China Energy Statistical Yearbook* and the *China Tertiary Industry Statistical Yearbook*, while the number of granted green patents is obtained from the National Intellectual Property Administration.

Official statistical yearbooks provide the primary data, while the number of granted green patents is sourced from the National Intellectual Property Administration.

1.3.2 新质生产力对生态旅游高质量发展的间接影

Intellectual Property Office.

The impact on green technology innovation, tourism industry upgrading, and institutional innovation is primarily reflected in green

1.2 生态旅游高质量发展内涵界定

This transition is an inevitable choice for green transformation and a fundamental requirement for achieving high-quality development in ecotourism.

Data Sources

The data utilized in this study are primarily derived from the *China Industry Statistical Yearbook* and the *China Tourism Statistical Yearbook*. These official publications provide comprehensive and authoritative longitudinal data essential for analyzing industrial development and tourism trends within the Chinese economy.

Existing literature has explored the connotations of high-quality ecotourism development from various perspectives, including ecotourism resources [**?**], the sustainable development of ecotourism [**?**], and ecotourism products [**?**]. However, a unified definition for the concept of high-quality ecotourism development has yet to be established. Furthermore, regarding the measurement of high-quality ecotourism development···

These are necessary conditions. Therefore, this study elucidates the mechanisms through which new quality productive forces empower the high-quality development of ecotourism from three dimensions: green technological innovation, tourism industrial upgrading, and institutional innovation (Figure 1 [Figure 1: see original paper]).

1. The Impact of Green Technological Innovation on Ecotourism within the Framework of New Quality Productive Forces

Green technological innovation serves as a core driver for the development of "new quality productive forces," playing a decisive role in the transformation and upgrading of the ecotourism industry. By integrating advanced ecological technologies with tourism operations, green innovation facilitates a fundamental shift from traditional resource-intensive models to high-efficiency, low-carbon, and sustainable development patterns. This process not only enhances the quality of the tourism experience but also ensures the rigorous protection of natural ecosystems.

1.1 Technological Empowerment and Resource Efficiency

The application of green technologies within ecotourism significantly optimizes resource utilization. Through the implementation of energy-saving systems, waste recycling technologies, and smart environmental monitoring, tourism destinations can minimize their ecological footprint. For instance, the deployment of renewable energy microgrids and water purification systems allows remote ecotourism sites to operate autonomously while preserving the integrity of the local environment. These innovations embody the essence of new quality productive forces by replacing traditional, high-pollution energy consumption with clean, intelligent alternatives.

1.2 Enhancing the Value Chain of Ecotourism

Green technological innovation extends beyond environmental protection; it reconstructs the value chain of the ecotourism industry. Digital twins, Big Data, and IoT (Internet of Things) enable precise management of tourist flows and biodiversity conservation. By leveraging these technologies, managers can predict environmental carrying capacities and adjust visitor activities in real-reaching, preventing over-tourism and habitat degradation. This high-tech integration ensures that the "quality" aspect of new quality productive forces is realized through superior service delivery and enhanced ecological value.

1.3 Promoting Sustainable Consumption Patterns

The influence of green innovation also manifests in the cultivation of sustainable consumption behaviors among tourists. Interactive digital platforms and

augmented reality (AR) tools can be used to provide immersive environmental education, fostering a deeper appreciation for nature. As green technologies become embedded in the tourism infrastructure—from eco-friendly transportation to carbon-neutral accommodations—they guide consumers toward lower-carbon choices. This shift aligns with the strategic goals of new quality productive forces, which emphasize the harmony between economic growth and ecological civilization.

Existing research tends to emphasize specific dimensions of ecotourism, failing to provide a comprehensive evaluation of its resource, economic, ecological, and social benefits. Specifically, there is a lack of systematic evaluation encompassing the "resource environment-industrial elements-technological innovation-economic development-service enhancement" nexus, making it difficult to accurately reflect the true level of development. Building upon existing literature, this study defines the high-quality development of ecotourism as a developmental system rooted in resource and environmental protection. This system achieves a green economic transition and synergistic improvements in service quality through the optimized allocation of industrial elements and the driving force of technological innovation.

Specifically, the protection of natural resources and the ecological environment serves as the fundamental guarantee for ensuring ecosystem integrity and maintaining environmental carrying capacity; it is the core foundation upon which ecotourism relies. An optimized system of industrial elements acts as the primary vehicle for connecting resources with tourists and realizing economic value. Furthermore, technological empowerment serves as the key engine for enhancing ecological protection efficiency, optimizing industrial operations, innovating service models, and mitigating environmental pollution. Finally, economic development represents the fundamental objective of achieving the "Two Mountains" transformation (the theory that lucid waters and lush mountains are invaluable assets) through eco-friendly tourism activities, thereby constructing a low-carbon, circular economic system.

target; high-quality service experiences are essential for satisfying the diverse needs of tourists and obtaining

1 Mechanisms of new quality productive forces enabling

Terminal performance characterized by high value-added returns.

high quality development of ecotourism

···the conductive role in high-quality development. In neoclassical economic growth theory,

the institutional system for the high-quality development of ecotourism [?]. Accordingly, the following is proposed:

technological progress is the core path for promoting economic growth. New quality

productive forces are, in essence, green productive forces. They can achieve structural transformations in total factor productivity through green technological innovation, thereby driving the high-quality development of ecotourism.

high-quality development.

high-quality development. Specifically, new quality productive forces can, through green

1.4 变量选取

Technological optimization enhances the efficiency of ecological resource utilization, reduces energy consumption, and facilitates the realization of green development.

1.4.1 被解释变量：生态旅游高质量发展在对生

Low-carbon operations serve as a critical pathway toward achieving green, sustainable development and enhancing total factor productivity (TFP). By integrating environmental considerations into core business strategies, organizations can optimize resource allocation and minimize waste, leading to a synergistic relationship between ecological responsibility and economic efficiency. The transition toward green, low-carbon operational models necessitates the adoption of advanced technologies and innovative management practices that reduce carbon intensity while simultaneously driving productivity gains across all factors of production.

Based on the definition of the core connotations of high-quality development in ecotourism, a comprehensive theoretical framework has been established. This framework emphasizes that high-quality development is not merely a quantitative expansion of the tourism industry, but rather a multi-dimensional paradigm shift that integrates ecological preservation, economic efficiency, and social equity. By synthesizing existing literature and empirical observations, the research identifies that the essence of high-quality ecotourism lies in the harmonious coevolution of the "nature-economy-society" system.

The conceptualization of this development model focuses on several key pillars: the integrity of ecosystem services, the innovation-driven transformation of tourism products, and the equitable distribution of benefits among local communities. Furthermore, the transition toward high-quality development necessitates a move away from traditional resource-intensive growth toward a model characterized by low-carbon operations and high-value experiences. This theoretical foundation serves as the basis for developing evaluation metrics and strategic pathways to guide the sustainable evolution of ecotourism destinations.

New quality productive forces drive the innovation of production factors, promoting the transformation and upgrading of traditional factors such as land and labor. Under the framework of high-quality development, the integration

of emerging technologies—particularly machine learning and deep learning—has fundamentally altered the allocation efficiency and functional utility of these classical inputs. By embedding advanced digital intelligence into the production process, the traditional reliance on physical scale is being replaced by a focus on precision and high-value creation.

The evolution of these factors is not merely a quantitative change but a qualitative leap in how value is generated within the modern economy. As data becomes a core production factor, it synergizes with land and labor to enhance total factor productivity. This shift necessitates a re-evaluation of economic models to account for the diminishing marginal returns of traditional inputs being offset by the increasing returns of technological innovation. Consequently, the transition toward new quality productive forces represents a critical pivot in achieving sustainable and intelligent industrial growth.

Guided by the values of ecological sustainability and based on the evaluation of industrial elements, this study establishes a comprehensive framework for assessing regional development. By integrating environmental stewardship with economic productivity, the proposed model ensures that industrial growth does not come at the expense of ecological integrity. The assessment criteria prioritize the efficient allocation of resources, the reduction of carbon footprints, and the promotion of circular economy practices within various industrial sectors.

The research emphasizes that sustainable development requires a synergistic relationship between industrial innovation and environmental preservation. To achieve this, the evaluation system incorporates multi-dimensional indicators that measure both the economic output and the ecological impact of industrial activities. This approach allows for a more nuanced understanding of how industrial elements—such as labor, capital, and technology—can be optimized to support long-term ecological goals. Through this value-oriented lens, the study provides a strategic roadmap for policy-makers to foster industries that are both economically competitive and environmentally responsible.

The deep integration of power systems with emerging factors—such as green technologies and ecological data—represents a critical shift in modern industrial development. This convergence facilitates the transition toward sustainable energy frameworks by leveraging advanced machine learning and deep learning algorithms to optimize resource allocation. By synthesizing technical performance with environmental metrics, these integrated systems enable more precise monitoring and management of ecological impacts, ensuring that technological advancement aligns with global sustainability goals.

Technological innovation serves as the key driving force, while service experience acts as the primary basis for evaluation, and economic value remains the ultimate objective.

integrated to form digital ecological capital, thereby increasing both the quantity and quality of green products.

···a new value orientation and analytical framework with development as the fundamental goal. By combining···

quality, promoting the development of ecotourism products and driving the overall growth of the ecotourism industry.

Existing studies [**?**] have constructed various frameworks for measuring the level of high-quality development in ecotourism.

···rural revitalization [**?**]. Based on this, the following hypothesis is proposed:

system (Table 1).

H4: New Quality Productive Forces Drive Ecotourism Through Institutional Innovation

New quality productive forces promote the high-quality development of ecotourism not only through technological breakthroughs but also by catalyzing institutional innovation. This process involves the optimization of resource allocation, the refinement of management frameworks, and the establishment of sustainable governance models. By integrating advanced digital technologies with institutional reforms, new quality productive forces create a more resilient and efficient environment for ecological preservation and tourism growth.

The Role of Institutional Innovation in Ecotourism

Institutional innovation acts as a critical bridge between technological advancement and practical application in the ecotourism sector. As new quality productive forces emerge, traditional management models often become insufficient to handle the complexities of modern ecological protection and market demands. Institutional reforms, such as the implementation of digital governance systems and cross-regional collaborative frameworks, allow for a more holistic approach to managing natural resources. These innovations ensure that the economic benefits of tourism do not come at the expense of environmental integrity.

Synergy Between Technology and Policy

The integration of machine learning and big data analytics into policy-making processes exemplifies how new quality productive forces drive institutional change. For instance, real-reaching monitoring systems powered by $\mathcal{F}$ can provide precise data on carrying capacities, enabling authorities to implement dynamic entry policies and conservation strategies. This data-driven decision-making process reduces administrative inefficiency and enhances the responsiveness of ecological management systems. Furthermore, the use of blockchain technology can ensure transparency in carbon credit trading and ecological compensation mechanisms, fostering a more equitable distribution of tourism-generated revenue.

Enhancing Resource Allocation Efficiency

New quality productive forces facilitate the transition from labor-intensive to knowledge- and technology-intensive ecotourism. Institutional innovation supports this transition by redefining property rights for ecological resources and establishing market-oriented mechanisms for ecosystem services. By optimizing the allocation of capital, talent, and data, these innovations allow ecotourism destinations to achieve higher productivity with lower environmental impact. As noted in recent studies [**?**], the alignment of institutional incentives with green development goals is essential for the long-term viability of the sector.

[Figure 1: see original paper]

Conclusion on Hypothesis H4

In summary, the development of new quality productive forces necessitates a corresponding evolution in institutional structures. Through the promotion of digital governance, refined regulatory frameworks, and innovative market mechanisms, these forces provide the necessary foundation for a sustainable and high-quality ecotourism industry. The synergy between technological prowess and institutional agility ensures that ecotourism remains a

New Quality Productive Forces Can Promote Ecological Development Through Green Technological Innovation

New quality productive forces represent a significant advancement in productivity, characterized by high technology, high efficiency, and high quality. At their core, these forces are driven by innovation, with green development serving as their fundamental background. By integrating cutting-edge technological breakthroughs with sustainable practices, new quality productive forces act as a primary catalyst for green technological innovation. This synergy is essential for transitioning from traditional, resource-intensive growth models to a more sustainable and ecologically conscious economic framework.

The mechanism through which new quality productive forces drive green innovation is multifaceted. First, the deep integration of digital technologies—such as artificial intelligence, big data, and the Internet of Things—enables more precise resource allocation and energy management. These advancements allow industries to reduce waste and minimize their environmental footprint while maintaining high levels of output. Second, the shift toward new quality productive forces encourages the development of original and disruptive technologies in fields like renewable energy, carbon capture, and circular economy systems.

Furthermore, the development of new quality productive forces fosters an institutional environment that prioritizes ecological benefits alongside economic gains. This shift incentivizes enterprises to invest in green research and development (R&D), as the pursuit of "high-quality" growth inherently necessitates a reduction in environmental degradation. By optimizing the industrial structure

and promoting the "greening" of the supply chain, new quality productive forces ensure that technological progress translates directly into improved ecological outcomes.

In conclusion, new quality productive forces are not merely a measure of economic speed but a reflection of the quality of development. Through the continuous promotion of green technological innovation, these forces provide the necessary momentum to achieve a harmonious balance between economic prosperity and environmental preservation. This transition is vital for building a modern industrial system that is resilient, efficient, and fundamentally sustainable.

High-Quality Development of Ecotourism

The high-quality development of ecotourism represents a critical paradigm shift in reconciling ecological preservation with economic growth. By leveraging advanced management strategies and sustainable practices, this approach seeks to enhance the value of natural resources while ensuring the long-term integrity of ecosystems. Central to this transition is the integration of innovative technologies and data-driven decision-making, which allow for a more precise assessment of carrying capacities and environmental impacts.

To achieve high-quality development, it is essential to move beyond traditional mass tourism models toward more specialized, value-added experiences. This involves the cultivation of high-end ecological products, the improvement of infrastructure through green building standards, and the active participation of local communities in the tourism value chain. Furthermore, the implementation of rigorous monitoring systems and adaptive management frameworks ensures that tourism activities remain within the ecological limits of the destination.

Ultimately, the pursuit of high-quality ecotourism serves as a cornerstone for regional sustainable development. By fostering a symbiotic relationship between conservation and commerce, it provides a viable pathway for protecting biodiversity while generating socio-economic benefits. This holistic strategy not only preserves natural heritage for future generations but also elevates the overall competitiveness and resilience of the tourism industry in an increasingly environmentally conscious global market.

Scientific Measurement of High-Quality Ecotourism Development Using a Combined Weighting Method

Introduction

High-quality development represents a fundamental shift from "quantity-oriented" growth to "quality-oriented" progress. In the context of ecotourism, this transformation necessitates a comprehensive evaluation framework that transcends simple economic metrics to include ecological integrity, social equity, and cultural preservation. To accurately assess the level of high-quality

ecotourism development, it is essential to employ a scientific measurement approach that balances subjective expertise with objective data patterns. This study utilizes a combined weighting method to provide a robust and multidimensional evaluation of ecotourism performance.

Methodology: The Combined Weighting Approach

The measurement of high-quality ecotourism development involves complex indicators with varying degrees of influence. To ensure the reliability of the evaluation results, this research adopts a combined weighting method that integrates the Analytic Hierarchy Process (AHP) and the Entropy Weight Method (EWM).

1. Subjective Weighting via AHP The Analytic Hierarchy Process (AHP) is employed to capture the professional judgment of experts in the field of ecotourism and sustainable development. By constructing a judgment matrix and performing consistency tests, we derive subjective weights that reflect the theoretical importance and strategic priorities of different indicators. This ensures that the evaluation aligns with policy goals and industry standards.

2. Objective Weighting via Entropy Weight Method To minimize human bias and account for the inherent information contained within the data, the Entropy Weight Method (EWM) is utilized. The entropy value $\mathcal{E}_j$ for each indicator is calculated based on its dispersion:

$$\mathcal{E}_j = -k \sum_{i=1}^{n} p_{ij} \ln(p_{ij})$$

Indicators with higher variability are assigned greater weights, as they provide more information regarding the differences in development levels across different regions or time periods.

3. Integration of Weights The final combined weight W_j is determined by synthesizing the subjective weight w_{sj} and the objective weight w_{oj}. This integration balances the theoretical significance of the indicators with the empirical evidence provided by the data, resulting in a more comprehensive and scientific measurement framework:

$$W_j = \frac{w_{sj} \cdot w_{oj}}{\sum_{j=1}^{m} w_{sj} \cdot w_{oj}}$$

Evaluation Index System

The evaluation system for high-quality

To evaluate the level of development, this study employs the entropy weight method as a foundation and introduces the coefficient of variation method to determine the weights of the indicators. This hybrid approach ensures that the

objective variability of the data is fully captured while minimizing the influence of subjective bias.

By integrating these two objective weighting techniques, the model enhances the precision of the assessment. The entropy weight method measures the information uncertainty within the dataset, while the coefficient of variation method accounts for the relative dispersion of the indicators. Together, they provide a robust framework for quantifying the development level across different dimensions.

2.2 The Role of Tourism Industrial Upgrading in the Impact of New Quality Productive Forces on Ecotourism

The upgrading of the tourism industry serves as a critical intermediary mechanism through which new quality productive forces influence the development of ecotourism. New quality productive forces, characterized by high technology, high efficiency, and high quality, drive the transformation of the traditional tourism industry toward a more modernized, intelligent, and green service model. This industrial evolution manifests primarily through the optimization of resource allocation, the integration of cross-sectoral technologies, and the enhancement of value chains.

First, the application of advanced technologies—such as big data, artificial intelligence, and the Internet of Things (IoT)—enables the tourism industry to transition from labor-intensive operations to capital- and technology-intensive models. This shift facilitates the precise management of ecological resources, allowing for the development of low-impact, high-value ecotourism products. By optimizing the industrial structure, new quality productive forces reduce the reliance on traditional "mass tourism" models that often lead to environmental degradation, favoring instead a sustainable framework that prioritizes ecological preservation.

Second, industrial upgrading fosters the emergence of new business formats within the ecotourism sector. As the industry matures under the influence of new quality productive forces, it encourages the convergence of tourism with other sectors, such as ecological agriculture, environmental education, and digital media. This synergy not only diversifies the ecotourism offerings but also enhances the overall resilience and competitiveness of the industry. Consequently, the upgrading process ensures that the growth of ecotourism is not merely a quantitative expansion but a qualitative leap toward a more sustainable and ecologically conscious paradigm.

The objective weights of the indicators are determined, and subsequently, the subjective weights are obtained using the G1 method (order relation analysis) [**?**].

The Conductive Role in High-Quality Development

New quality productive forces rely on low-carbon technologies to drive the transition toward sustainable economic growth. In the context of high-quality development, these forces act as a critical conductive mechanism, transforming technological innovation into systemic industrial upgrades. By integrating advanced green technologies with traditional manufacturing processes, new quality productive forces facilitate a shift from resource-intensive expansion to efficiency-driven progress. This transition is essential for achieving long-term economic resilience and environmental sustainability, ensuring that industrial growth aligns with global carbon reduction targets.

This method fully accounts for the inherent statistical regularities among the indicator data.

The technological substitution effect breaks through resource and environmental constraints, activates ecological capital, and reduces the intensity of resource consumption. By integrating advanced green technologies into traditional production processes, industries can transition from resource-heavy operations to innovation-driven models. This shift not only mitigates the negative externalities associated with industrial expansion but also enhances the overall efficiency of ecosystem services. Consequently, the decoupling of economic growth from environmental degradation becomes feasible, allowing for a more sustainable allocation of natural assets and the promotion of long-term ecological resilience.

The proposed method adheres to objective laws and significantly enhances the robustness of the evaluation results.

Reducing physical resource consumption to achieve a green revolution in the ecotourism industry; New

1.4.2 核心解释变量：新质生产力参考现有研

New quality productive forces can facilitate the construction of a "ecological protection + cultural tourism consumption" value chain. By integrating advanced technological innovations with sustainable development practices, these forces enable a synergistic relationship where environmental preservation enhances the value of cultural and tourism offerings. This integration not only promotes the efficient use of natural resources but also fosters high-quality economic growth by transforming ecological assets into sustainable consumer experiences.

research [**?**], starting from the perspectives of new-quality laborers, new-quality objects of labor, and new-quality instruments of labor.

···foster high-value-added industries such as nature education and ecological wellness. Through large-scale···

3. Construction of the Evaluation Index System for New Quality Productive Forces

Based on the theoretical framework and the specific characteristics of industrial development, this study constructs an evaluation index system for new quality productive forces across three dimensions (Table 2).

3.1 Dimension Selection and Indicator Design

The evaluation system is designed to capture the multifaceted nature of new quality productive forces, moving beyond traditional metrics to include elements of innovation, sustainability, and digital transformation.

First, the **Innovation-Driven** dimension focuses on the core engine of new quality productive forces. This includes indicators such as R&D intensity, the number of high-tech enterprises, and the efficiency of patent conversions. These metrics reflect the capacity for original innovation and the ability to translate scientific breakthroughs into industrial applications.

Second, the **Green and Sustainable Development** dimension emphasizes the "quality" aspect of new productive forces. In alignment with national "dual carbon" goals, this dimension incorporates indicators related to energy consumption per unit of GDP, carbon emission reduction rates, and the adoption of green manufacturing processes. This ensures that the growth of productive forces does not come at the expense of environmental integrity.

Third, the **Digital and Intelligent Transformation** dimension addresses the integration of modern information technology with the real economy. Key indicators here include the penetration rate of industrial internet platforms, the degree of enterprise digitalization, and the growth of the digital economy' s core industries. This dimension captures the structural shift toward more intelligent, networked, and efficient production systems.

3.2 Methodology for Weight Assignment

To ensure the objectivity and scientific rigor of the evaluation, this study employs a hybrid approach for weight assignment. We combine the Entropy Weight Method (EWM) with the Analytic Hierarchy Process (AHP) to balance data-driven insights with expert knowledge. The EWM accounts for the information entropy of the indicators, highlighting those with greater variance, while the AHP incorporates the strategic importance of specific dimensions as determined by academic and industry experts.

By synthesizing these three dimensions, the proposed evaluation system provides a comprehensive toolkit for measuring the development level of new quality productive forces across different regions and industries. This multi-dimensional approach allows for a more nuanced understanding of how technological innovation, environmental stewardship, and digital integration converge to redefine modern productivity.

Data optimization can effectively regulate the spatio-temporal distribution of tourists, thereby reducing the ecological footprint of tourism activities. This process drives the three-dimensional transformation of the industry toward becoming more intelligent, green, and service-oriented. New quality productive forces serve as the foundation···

Measurement of New Quality Productive Forces Development Levels in 278 Prefecture-Level Cities Using Combined Weighting Methods

Introduction

The concept of "New Quality Productive Forces" represents a significant evolution in economic theory, emphasizing high technology, high efficiency, and high quality as primary drivers of modern development. To accurately assess the development level of these forces across different regions, it is essential to establish a robust evaluation index system. This study utilizes data from 278 prefecture-level cities and employs a combined weighting method to provide a comprehensive measurement of their development levels.

Methodology: Combined Weighting Approach

To ensure the objectivity and scientific rigor of the evaluation, this study adopts a combined weighting method that integrates the Entropy Weight Method (an objective weighting approach) with the Analytic Hierarchy Process (AHP, a subjective weighting approach). This integration mitigates the limitations of using a single method, such as the potential for extreme values in objective weighting or the subjectivity inherent in expert assessments.

1. Objective Weighting: The Entropy Method The entropy method determines weights based on the information provided by the variance of each indicator. For a given indicator, a higher degree of dispersion results in a lower information entropy and a higher weight, indicating that the indicator plays a more significant role in the comprehensive evaluation.

2. Subjective Weighting: Analytic Hierarchy Process (AHP) The AHP method decomposes the complex goal of "New Quality Productive Forces" into a hierarchical structure of dimensions and specific indicators. By conducting pairwise comparisons, we can incorporate theoretical insights and policy priorities into the weighting scheme, ensuring that the index system aligns with the strategic definition of new quality productive forces.

3. Combination of Weights The final weights are calculated by synthesizing the results from both the entropy method and AHP. This combined approach ensures that the measurement reflects both the underlying data characteristics

and the theoretical importance of various dimensions, such as technological innovation, industrial transformation, and green development.

Indicator System Construction

The evaluation index system for new quality productive forces is constructed across several key dimensions:

- **Technological Innovation:** Measured by R&D investment intensity, the number of patent applications per capita, and the proportion of high-tech industry output.
- **Digital Transformation:** Assessed through indicators such as internet penetration rates, the scale of the digital economy, and the application of industrial automation.
- **Green Development:** Evaluated based on energy consumption per unit of GDP, carbon emission intensity,

Dynamic Regulation of Development Intensity via Ecological Monitoring Technology: Constructing a Blockchain-Enabled Framework

The rapid advancement of ecological monitoring technology provides a critical foundation for the dynamic regulation of regional development intensity. By integrating real-reaching environmental data with spatial planning, it is possible to achieve a more responsive and sustainable approach to land use and resource management. This paper explores the development of a governance framework that leverages these monitoring capabilities to ensure that human activities remain within the carrying capacity of the local ecosystem.

1. Dynamic Regulation of Development Intensity

Traditional static planning models often fail to account for the fluid nature of ecological health and environmental degradation. By utilizing remote sensing, IoT-based sensor networks, and high-resolution satellite imagery, we can establish a continuous feedback loop between environmental status and development permissions. This dynamic regulation allows for the adjustment of development quotas and intensity based on the immediate ecological response, effectively mitigating the risks of over-exploitation.

[Figure 1: see original paper]

2. Blockchain-Enabled Ecological Governance

To ensure the transparency, traceability, and integrity of ecological data, we propose a blockchain-based architecture for environmental management. Blockchain technology provides a decentralized ledger that records monitoring data and regulatory actions in an immutable format. This system addresses

the challenges of data silos and potential manipulation, fostering trust among stakeholders including government agencies, private developers, and the public.

The integration of smart contracts allows for the automation of regulatory responses. For instance, if ecological monitoring indicators exceed a predefined threshold—represented by $\mathcal{E}_{threshold}$—the system can automatically trigger a suspension of development permits or initiate environmental remediation protocols.

3. Mathematical Modeling of Ecological Constraints

The relationship between development intensity and ecological stability can be modeled to provide a quantitative basis for regulation. Let D_t represent the development intensity at time t, and S_t represent the ecological stability index. The dynamic adjustment can be expressed as:

$$\Delta D_t = f(S_t, \bar{S}, \alpha)$$

where $\bar{S}$ is the target stability level and α is a sensitivity coefficient. By applying machine learning algorithms to historical monitoring data, we can optimize the function f to minimize the variance between actual and target ecological states.

4. Conclusion

The convergence of advanced ecological monitoring and blockchain technology offers a robust pathway for the sustainable management of natural resources. By shifting from static oversight to a dynamic, data-

1.4.3 机制变量机制变量包括绿色技术创新、旅

Ecological Label Certification System and Green Finance Integration for Ecological Restoration

The development of a robust ecological label certification system serves as a critical bridge for integrating green finance into ecological restoration efforts. By establishing standardized metrics and transparent verification processes, this system enables financial institutions to accurately assess the environmental impact and sustainability of restoration projects. This alignment ensures that capital is directed toward initiatives that yield verifiable ecological benefits, thereby reducing investment risks associated with "greenwashing."

Furthermore, the synergy between ecological labeling and green finance instruments—such as green bonds, sustainability-linked loans, and ecological credit systems—provides a scalable framework for funding long-term environmental recovery. When restoration projects are backed by recognized ecological labels, they gain enhanced credibility in international markets, facilitating the mobilization of private sector investment alongside public funding. This integrated approach not only incentivizes high-quality restoration practices but also fosters

a market-driven mechanism for biodiversity conservation and ecosystem service enhancement.

Industrial Structure and Institutional Innovation

Drawing upon existing research [**?**], this study adopts green···

Conclusion

The system establishes a sophisticated multi-layered closed-loop mechanism. Ultimately, this framework facilitates a transformative process where industrial innovation serves as the primary driver for unlocking ecological value. By optimizing the underlying structural components, the system ensures that economic development and environmental sustainability are no longer mutually exclusive, but rather mutually reinforcing through continuous technological advancement and strategic resource integration.

Abstract

This study examines the relationship between the number of granted green invention patents and the number of granted green utility model patents. As critical indicators of environmental innovation, these two categories of intellectual property reflect different levels of technological advancement and practical application in the field of sustainable development. By analyzing the distribution and growth trends of these patent types, we aim to elucidate the evolving landscape of green technology and the strategic priorities of innovators in balancing breakthrough research with incremental improvements.

Introduction

In the context of global climate change and the transition toward a circular economy, green technological innovation has become a primary driver of industrial transformation. Intellectual property rights, particularly patents, serve as a fundamental metric for measuring the output and quality of such innovations. Within the Chinese patent system, green patents are generally categorized into green invention patents and green utility model patents. While invention patents represent a higher degree of technical novelty and undergo a rigorous substantive examination process, utility model patents focus on practical improvements to the shape or structure of products, offering a faster route to legal protection for incremental innovations.

Analysis of Patent Categories

Green Invention Patents

Green invention patents are characterized by their high technical threshold and long-term strategic value. These patents typically involve fundamental break-

throughs in areas such as renewable energy storage, carbon capture and storage (CCS), and advanced waste treatment processes. The granting of a green invention patent signifies a significant contribution to the existing state of the art, providing the patent holder with robust legal protection for a duration of 20 years. The volume of these patents serves as a proxy for a region' s or organization' s core competitiveness in high-end green manufacturing.

Green Utility Model Patents

In contrast, green utility model patents are often referred to as "small patents" due to their focus on practical utility and shorter protection period (10 years). These patents are essential for the rapid commercialization of green technologies, as they protect improvements in product design that enhance energy efficiency or reduce environmental impact without necessarily requiring a fundamental scientific discovery. The high volume of green utility model patents indicates a vibrant market where existing technologies are being continuously refined and adapted for specific industrial applications.

Comparative Trends and Implications

The ratio between granted green invention patents and green utility model patents provides insight into the "quality-to-quantity" balance of a nation' s innovation ecosystem. A rising proportion of invention patents suggests a shift toward high-quality, original innovation, whereas a dominance of utility model patents may indicate a focus on rapid imitation or minor modifications. Understanding the synergy between these

The core objectives of this initiative are the transformation and reshaping of industrial efficiency, alongside the chain-

Note: Figure translations are in progress. See original paper for figures.