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Research Article

From "Harmony Between Humans and Nature" to Green Development: The Mechanism of Traditional Chinese Ecological Culture Empowering Regional Low-Carbon Economies

从"天人合一"到绿色发展：传统中国生态文化赋能区域低碳经济的作用机制

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Abstract: Amid China's "dual carbon" goals and the ecological civilization agenda, the contemporary value of traditional Chinese ecological culture—centered on "harmony between humans and nature"—is being renewed. As the digital economy and artificial intelligence integrate with the real economy, they accelerate regional low-carbon transitions while also bringing challenges such as labor-market restructuring, skill mismatches, and inadequate adaptability of the built environment. This study argues that traditional ecological culture, as a form of "cultural capital" with value guidance and practical resilience, can synergize with emerging technological and economic factors to support regional low-carbon development. Based on literature across philosophy, economics, geography, the digital economy, and sustainable development, the study constructs an analytical framework of "Cultural connotations → Modern transformation → Synergistic empowerment → Regional practice → Optimization pathways," and summarizes three conclusions: (1) traditional ecological culture can be transformed into modern low-carbon cultural capital through value ethics, institutional rules, and practical behaviors; (2) it works in synergy with digital technology, SMEs, and sustainable built environments, promoting low-carbon transition via value constraint, technological drive, subject adaptation, and spatial guarantee across firm, industry, and regional governance levels; and (3) current practices include "culture + education and communication," "culture + spatial governance," and "culture + policy integration," but still face fragmented cognition, weak regional coordination, and shallow technology–culture integration.

摘要：在"双碳"目标与生态文明建设背景下，以"天人合一"为核心的传统生态文化正被重新激活。数字经济与人工智能深度融入实体经济，一方面加速区域低碳转型，另一方面也带来劳动力结构调整、技能错配与建成环境适配不足等挑战。本文认为，传统生态文化可作为具有价值引领与实践韧性的"文化资本"，与新技术、新经济要素协同，支撑区域低碳发展。基于跨学科文献，构建"文化内涵—现代转化—协同赋能—区域实践—优化路径"框架，并提出三点结论：传统生态文化可经由价值伦理、制度规则与实践行为转化为低碳文化资本；其与数字技术、中小企业及可持续建成环境形成协同机制，通过"价值约束、技术驱动、主体适应、空间保障"推动企业、产业与区域治理层面的转型；当前实践主要包括"文化+传播教育""文化+空间治理""文化+政策整合"，但仍受文化认知碎片化、区域协同不足与技术—文化融合浅表化等制约。

Introduction

Research Background

Ecological crises triggered by global climate change have become a pressing shared challenge for humanity, making low-carbon development an inevitable choice

for countries to overcome ecological constraints and achieve sustainable growth. As the world's largest developing economy and a major carbon emitter, China has explicitly articulated its strategic goals of reaching peak carbon emissions by 2030 and achieving carbon neutrality by 2060, positioning regional low-carbon economic development as a core vehicle and key driver of ecological civilization construction.

Unlike Western low-carbon development pathways that predominantly rely on technological innovation and mandatory institutional constraints, China's low-carbon transition is inherently embedded with the genes of traditional ecological culture. From the cosmic view of "harmony between humans and nature" and the resource philosophy of "moderation in taking," to the symbiotic ideas integrating Confucianism, Taoism, and Buddhism, traditional ecological culture provides a unique value core and practical wisdom for regional low-carbon development. Its inherent characteristics—holism, inclusiveness, and sustainability—align closely with the essence of low-carbon development.

Meanwhile, the vigorous development of the digital economy and the widespread application of artificial intelligence are profoundly reshaping the production factors, industrial forms, and governance models of regional economic development. On one hand, artificial intelligence boosts production efficiency and drives green technological innovation, while the digital economy breaks geographical barriers to optimize the allocation of low-carbon resources [12]. On the other hand, technological transformation gives rise to issues such as income polarization in the labor market [11], skill mismatches in SMEs [12], and inadequate adaptability of the built environment to low-carbon industries [13], adding new complexities to regional low-carbon transitions. Against this backdrop, relying solely on technological drive or institutional constraints is insufficient to address multifaceted contradictions. There is an urgent need to tap into the empowering potential of traditional Chinese ecological culture and construct an integrated development model characterized by "cultural leadership, technological support, subject synergy, and spatial adaptation."

Research Questions and Core Logic

Existing studies have explored related themes from multiple perspectives: At the philosophical level, scholars have elaborated on the modern ecological ethical value of traditional ideas such as "harmony between humans and nature" [1, 3]; at the empirical level, research has verified the positive impact of cultural capital on corporate green innovation and regional green efficiency [5, 7]; at the practical level, studies have mapped the implementation pathways of ecological culture in regional low-carbon transitions [8]; in the field of emerging economies, scholars have focused on the impacts of artificial intelligence, the digital economy, and the built environment on enterprise operations and regional development [11, 12, 13].

However, existing research exhibits notable gaps: First, it lacks a systematic examination of the full-chain empowerment mechanism linking "ecological culture → modern transformation → regional low-carbon development," failing to clearly reveal the transmission logic of cultural capital from value concepts to practical outcomes. Second, it inadequately integrates the regulatory role of emerging technologies and economic forms in this mechanism, overlooking the synergistic relationships between culture, technology, enterprises, and space. Third, it lacks targeted analysis of the bottlenecks and breakthrough pathways of cultural empowerment in practice, resulting in insufficient connection between theory and application.

Based on these gaps, this study focuses on three core research questions: How does traditional Chinese ecological culture transform into cultural capital adapted to low-carbon development through modernization? How does this cultural capital synergize with emerging economic factors (digital technology, SMEs, built environment) to empower regional low-carbon economies? How can practical pathways be optimized to address the realistic bottlenecks of cultural empowerment? Centering on these questions, this study constructs a logical framework of "Cultural Connotations → Modern Transformation → Synergistic Empowerment → Regional Practice → Optimization Pathways," aiming to systematically uncover the complete mechanism through which traditional Chinese ecological culture empowers regional low-carbon economies and provide theoretical support and practical reference for regional low-carbon development.

Research Significance

Theoretical Significance

This study makes three key theoretical contributions: First, it constructs a comprehensive logical framework for the empowerment of regional low-carbon economies by traditional Chinese ecological culture, filling the gap in full-chain research on "traditional ecological culture → modern low-carbon development." Second, it integrates theories from cultural economics, regional economics, digital economy, and other disciplines, proposing a "culture-technology-enterprise-space" four-dimensional synergistic empowerment model that enriches the sustainable development theory system. Third, it

expands the application boundary of cultural capital theory, extending traditional ecological culture from the philosophical realm to the practical level of regional low-carbon governance and providing a new application scenario for cultural capital theory.

Practical Significance

The practical value of this study lies in three aspects: First, it offers new insights for regional governments in formulating low-carbon development policies, promoting a shift from "technology-oriented" and "institution-oriented" policy design to a model of "cultural leadership + multi-factor synergy." Second, it provides a roadmap for enterprises—especially SMEs—in their low-carbon transition, guiding them to integrate ecological culture into their development strategies and leverage digital technology to enhance transition efficiency. Third, it offers cultural support for fostering public low-carbon behaviors, guiding the formation of low-carbon lifestyles through the dissemination of ecological culture and consolidating the social foundation for regional low-carbon development (**Figure 1**).

Theoretical Foundation: Core Connotations and Modern Transformation Logic of Traditional Chinese Ecological Culture

Traditional Chinese ecological culture is not a static historical legacy but evolves into a value system and governance resource adapted to modern regional low-carbon development through a three-stage transformation—value ethics, institutional rules, and practical behaviors. Drawing on literatures such as Tu (2001), Pan (2014), Lu (2016), and Zhang & Zhang (2023), this section clarifies its core connotations and constructs a logical framework for modern transformation.

Core Connotations: an Ecological Wisdom System Centered on "Harmony Between Humans and Nature"

Traditional Chinese ecological culture encompasses the value concepts, behavioral norms, and practical wisdom formed by the Chinese nation in long-term production and living practices, focusing on the relationship between humans and nature. Its core is the idea of "harmony between humans and nature," which is not a simplistic call for "harmonious coexistence between humans and nature" but emphasizes the holism, interconnectedness, and symbiosis of "humans-nature-society," opposing the unrestrained exploitation and conquest of nature by humans [1]. Tu Weiming [1] points out that the essence of "harmony between humans and

nature" lies in extending individual moral cultivation ("self-cultivation") to responsibility for nature, forming an ecological ethics of "caring for people and loving all things." This transcends the dichotomy between Western "anthropocentrism" and "ecocentrism," providing a holistic value guide for modern low-carbon development.

This core idea is enriched and deepened through the integration of Confucianism, Taoism, and Buddhism, forming a trinity ecological wisdom system:

1) Confucianism: Centered on "moderation," "frugality," and "caring for people and loving all things," it emphasizes the moderation and moral constraints of human economic behaviors, opposes excessive consumption and resource waste, and incorporates ecological responsibility into the moral system of "self-cultivation, family governance, state governance, and world peace" [2];
2) Taoism: Focused on "following the way of nature" and "governing by non-interference," it advocates that humans act in accordance with natural laws, reject development activities that violate ecological logic, and pursue the inherent harmony between humans and nature [3];
3) Buddhism: Based on "equality of all beings" and "karma," it strengthens reverence for life and nature, advocates a circular and symbiotic lifestyle, and forms behavioral norms of "non-harm, resource conservation, and environmental protection" [3].

Together, they constitute an ecological wisdom system of "respecting nature, following nature, and protecting nature," with core characteristics summarized as: holistic thinking (emphasizing the indivisibility of humans, nature, and society), the principle of moderation (opposing over-development and over-consumption), responsible ethics (regarding ecological protection as a moral responsibility of humans), and circular concept (advocating the sustainable use of resources). These characteristics are highly consistent with the core requirements of modern low-carbon development, laying a value foundation for regional low-carbon transitions.

Modern Transformation: a Three-Stage Logic From Philosophical Thought to Governance Resource

The modern transformation of traditional Chinese ecological culture is a prerequisite for its empowerment of regional low-carbon economies. Essentially, it involves converting traditional ecological wisdom from philosophical thought into the value ethics, institutional rules, and practical behaviors of modern society, real-
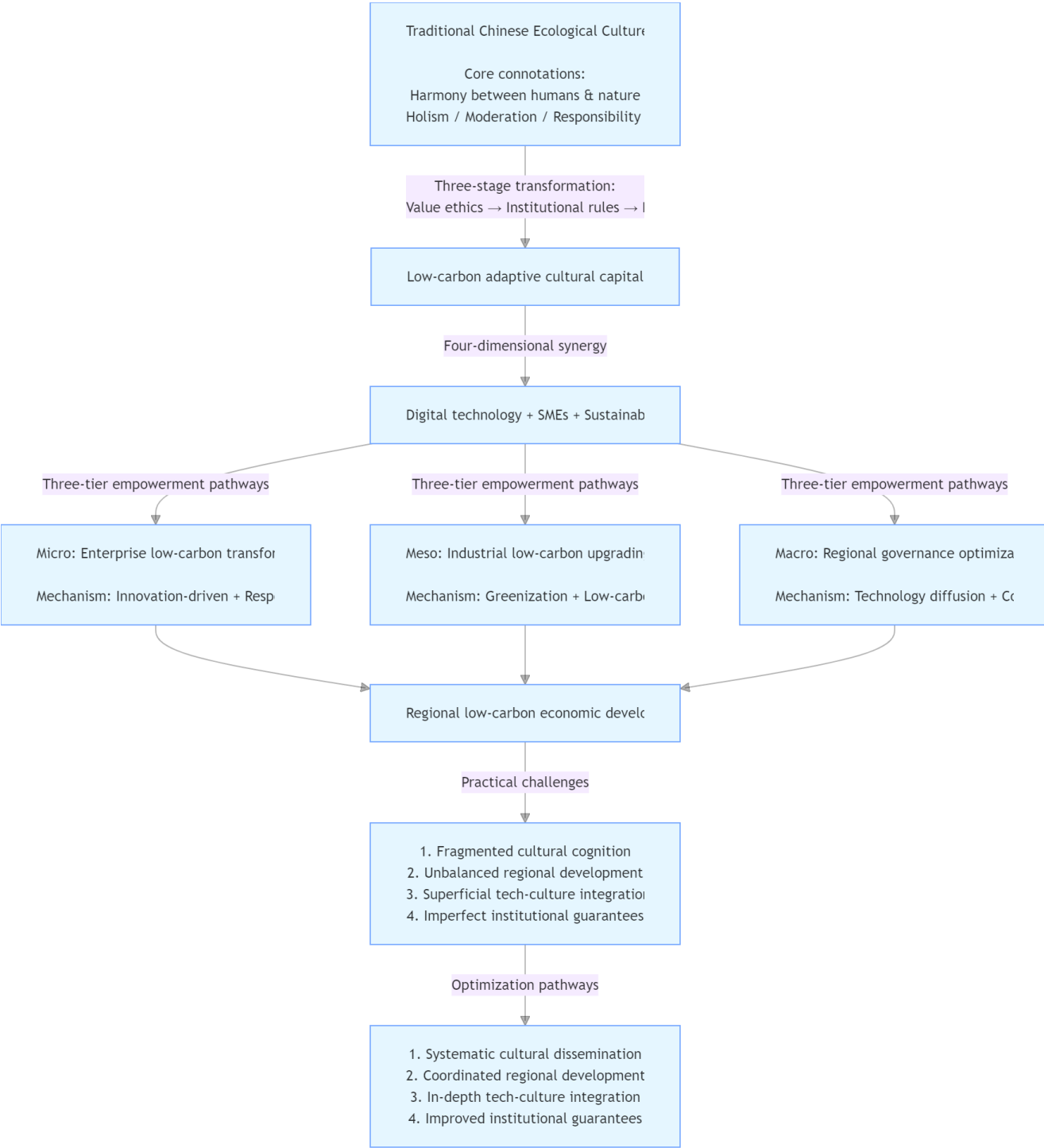
Traditional Chinese Ecological Culture

Core connotations:
Harmony between humans & nature
Holism / Moderation / Responsibility

Three-stage transformation:
Value ethics → Institutional rules → I

Low-carbon adaptive cultural capital

Four-dimensional synergy

Digital technology + SMEs + Sustainab

Three-tier empowerment pathways

Three-tier empowerment pathways

Three-tier empowerment pathways

Micro: Enterprise low-carbon transfor

Mechanism: Innovation-driven + Resp

Meso: Industrial low-carbon upgradin

Mechanism: Greenization + Low-carb

Macro: Regional governance optimiza

Mechanism: Technology diffusion + Co

Regional low-carbon economic develo

Practical challenges

1. Fragmented cultural cognition
2. Unbalanced regional development
3. Superficial tech-culture integratio
4. Imperfect institutional guarantees

Optimization pathways

1. Systematic cultural dissemination
2. Coordinated regional development
3. In-depth tech-culture integration
4. Improved institutional guarantees

Figure 1 | Conceptual framework of traditional Chinese ecological culture empowering regional low-carbon economies

Figure 2 | Three-stage modern transformation of traditional Chinese ecological culture

Note: Traditional Chinese ecological culture achieves the leap from philosophical thought to governance resource through three-stage transformation, laying a foundation for regional low-carbon development.

ized through a three-stage logic (**Figure 2**):

Stage 1: Value-Ethical Transformation—From Traditional Ecological Concepts to Modern Low-Carbon Values

The core of this transformation is integrating traditional ecological concepts such as "harmony between humans and nature" and "frugality and caring for others" with modern sustainable development concepts and low-carbon development goals, forming time-specific low-carbon values. Neo-Confucianism transforms "harmony between humans and nature" into modern ecological humanism [1], emphasizing that humans must assume responsibility for nature while pursuing economic development, incorporating ecological protection into the core dimension of human civilization progress. Scholars such as Lu Feng [3] interpret Confucian, Taoist, and Buddhist wisdom to propose low-carbon lifestyle solutions for addressing the crises of industrial civilization, converting traditional concepts such as "frugality" and "simplicity" into modern low-carbon consumption values. In the context of the digital economy, this transformation further extends to a value orientation of "technology for good," guiding emerging factors such as artificial intelligence and digital technology to tilt toward green and low-carbon fields, avoiding the disconnection between technological development and ecological protection.

Stage 2: Institutional-Rule Transformation—From Traditional Behavioral Norms to Modern Governance Tools

The behavioral norms in traditional ecological culture are transformed into institutional rules and policy tools for modern environmental governance through policy

construction. Pan Yue [2] systematically sorts out the empowering role of traditional Chinese culture in ecological civilization systems, pointing out that ecological norms in Confucian "ritual system" (such as "worship of mountains and rivers" and "hunting seasons") can be converted into modern environmental regulatory systems, Taoist "circular concept" into resource recycling policies, and Mohist "frugality" thought into energy conservation and emission reduction policies. Zhang Kai and Zhang Ying [4] propose a "three-dimensional transformation framework," integrating traditional ecological wisdom into the development concept of "lucid waters and lush mountains are invaluable assets," ecological clauses in village regulations and people's conventions, and ecological protection red line systems, realizing in-depth integration with the contemporary governance system. Meanwhile, the policy construction process fully considers the impact of the digital economy on employment and income distribution [11], as well as the role of SMEs in low-carbon transitions [12], making the institutional rules transformed from ecological culture more practically adaptable.

Stage 3: Practical-Behavioral Transformation—From Traditional Lifestyles to Modern Low-Carbon Behaviors

Through educational dissemination and social guidance, the transformed low-carbon values and institutional rules are internalized into conscious low-carbon behaviors of the public and enterprises. At the public level, traditional concepts of "frugality" and "simplicity" are converted into daily behaviors such as low-carbon consumption and green travel; at the enterprise level, the moral norm of "caring for people and loving all things" is transformed into operational behaviors such

as green production, pollution reduction, and green innovation; at the government level, the governance concept of "harmony between humans and nature" is converted into administrative behaviors such as low-carbon policy formulation, green spatial planning, and ecological protection [8]. This transformation process is consistent with the requirements of sustainable built environments [13], promoting the formation of a collaborative low-carbon behavior system involving "government-enterprises-public."

Synergistic Empowerment Mechanism: Core Pathways of Traditional Chinese Ecological Culture Driving Regional Low-Carbon Economies

Through modern transformation, traditional Chinese ecological culture forms "cultural capital," which constitutes a "four-dimensional synergistic" empowerment system with digital technology, SMEs, and sustainable built environments. It constructs a multi-dimensional and multi-level empowerment mechanism across three tiers: micro-level enterprise transformation, meso-level industrial upgrading, and macro-level regional governance. Drawing on empirical literatures such as Du et al. (2022), Xu et al. (2021), and Li et al. (2023), combined with emerging economic research by Gu et al. (2025), this section reveals its core functional pathways.

Composition of the Four-Dimensional Synergistic Empowerment System (Figure 3)

Core Leadership: Traditional Chinese Ecological Cultural Capital

As the core of the empowerment system, traditional Chinese ecological cultural capital provides value leadership and moral constraints, specifically reflected in: at the value level, guiding the transformation of regional development concepts from "economic priority" to "ecological priority and green development"; at the moral level, strengthening the ecological responsibility awareness of enterprises and the public; at the behavioral level, regulating low-carbon production, consumption, and governance behaviors.

Technological Support: Digital Economy and Artificial Intelligence

The digital economy and artificial intelligence provide technological empowerment for low-carbon transitions, specifically manifested as: efficiency improvement—optimizing resource allocation through big data and the Internet of Things to reduce emission reduction costs; technological innovation—promoting the R&D and promotion of green technologies; information dissemination—facilitating the rapid diffusion of low-carbon concepts and technologies [12].

Subject Adaptation: Small and Medium-Sized Enterprises (SMEs)

As an important component of the regional economy, SMEs play a "bridge" role in low-carbon transitions, specifically reflected in: bridging skill mismatches—addressing talent gaps in low-carbon industries through flexible skill training and talent adaptation [12]; filling industrial chain gaps—providing products and services in segmented areas of the low-carbon industrial chain; promoting regional balance—driving low-carbon economic development in central and western regions and county areas.

Spatial Guarantee: Sustainable Built Environments

Sustainable built environments provide spatial support for low-carbon transitions, specifically manifested as: optimizing spatial layout—realizing the rational allocation of production, living, and ecological spaces; improving building energy efficiency—reducing carbon emissions from urban operations; improving green transportation systems—reducing carbon emissions in the transportation sector [13].

Three-Tier Empowerment Pathways

Micro-Level: the "Dual-Drive + Dual-Support" Mechanism for Promoting Corporate Low-Carbon Transformation

As the core subject of regional low-carbon economies, enterprises' green transformation relies on the synergistic effect of "cultural leadership + technological support + subject adaptation + spatial guarantee," forming a "dual-drive" of "innovation-driven and responsibility-constrained," coupled with a "dual-support" of "technological empowerment and spatial adaptation":

1) Innovation-Driven Effect: Confucian thought of "caring for people and loving all things" enhances managers' ecological moral responsibility, reduces short-term profit-seeking behaviors, and encourages enterprises to incorporate green innovation into their development strategies; the concept of "frugality" promotes enterprises to optimize production processes, reducing resource consumption and carbon emissions [5]. Digital technology provides technical support for corporate green innovation, such as artificial intelligence optimizing production processes and big data accurately matching green resources; SMEs accelerate the application and diffusion of green technologies within enterprises by bridging skill mismatches [12]. Empirical research shows that in regions with a strong Confucian cultural at-
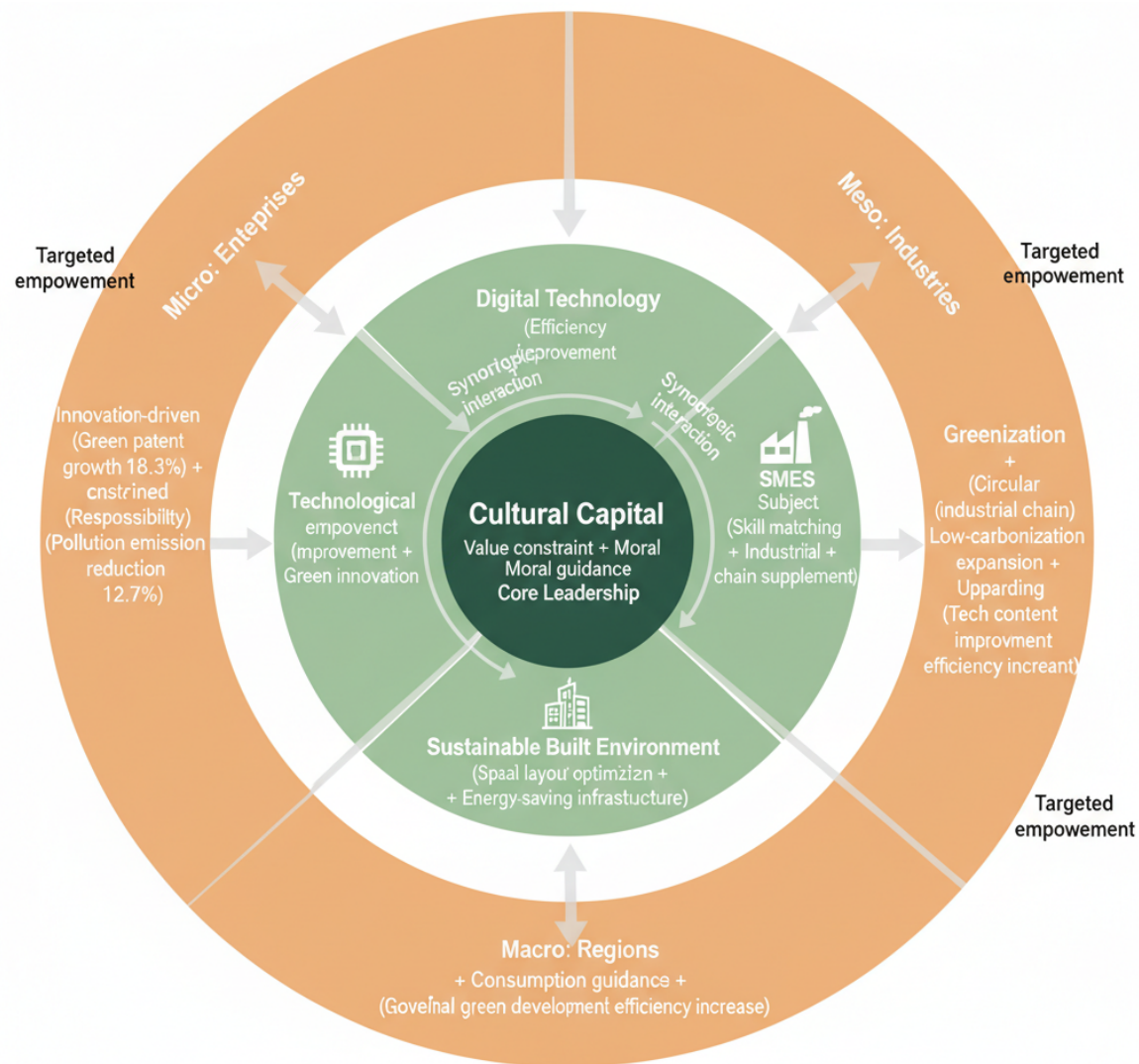
Figure 3 | Four-dimensional synergistic empowerment mechanism

mosphere, the number of green patent applications by enterprises increases by an average of 18.3% [5], and the application of digital technology can further amplify this effect.

2) Responsibility-Constrained Effect: Traditional culture restricts corporate pollution behaviors through a "social reputation mechanism"—in regions with a strong cultural atmosphere, corporate pollution behaviors are prone to condemnation by community public opinion, increasing reputation costs and forcing enterprises to reduce emission intensity [6]. Confucian "integrity" and Taoist "reverence for nature" form dual moral constraints, while sustainable built environments regulate enterprise location selection and production layout from the spatial level [13], forming a dual guarantee of "moral constraints + spatial constraints." Research by Xu et al. [6] shows that for

each one-standard-deviation increase in the traditional culture index, the intensity of corporate pollution emissions decreases by 12.7%.

Meso-Level: the "Three-Oriented + Three-Synergistic" Mechanism for Promoting Industrial Low-Carbon Upgrading

Industrial low-carbon upgrading is a core link in regional low-carbon economic development. Traditional Chinese ecological cultural capital guides the "greenization, low-carbonization, and upgrading" of industries, forming a "three-synergistic" mechanism with digital technology, SMEs, and built environments:

1) Industrial Greenization: The holistic thinking of "harmony between humans and nature" guides the adaptation of regional industrial layout to the natural environment, avoiding the excessive agglomeration of high-pollution and high-energy-consuming industries;

the concept of "circular symbiosis" promotes the circular development of industries, forming a circular industrial chain of "resources-products-waste-recycled resources." Digital technology provides technical support for industrial circularization, such as the Internet of Things enabling precise management and control of resource recycling; SMEs promote the implementation of circular economic models by participating in segmented links of the circular industrial chain.

2) Industrial Low-Carbonization: The concept of "frugality" guides industries to reduce energy consumption and carbon emissions, promoting the transformation and upgrading of high-energy-consuming industries; low-carbon consumption culture drives demand for low-carbon industries, guiding market resources to tilt toward low-carbon industries such as new energy and energy conservation and environmental protection. The digital economy promotes cross-border integration of low-carbon industries, such as the integration of low-carbon agriculture with rural tourism and the integration of green manufacturing with modern service industries; sustainable built environments provide spatial carriers for low-carbon industries, such as the construction of low-carbon industrial parks and green industrial parks [13].

3) Industrial Upgrading: Traditional concepts of "innovation" and "progress" (such as Confucianism's "If one can improve oneself in one day, do so each day, and keep doing so") drive enterprises to increase investment in green technology R&D, promoting the upgrading and intelligent transformation of low-carbon industries. Digital technologies such as artificial intelligence and big data enhance the technological content and added value of low-carbon industries; through technological innovation and model innovation, SMEs inject vitality into the upgrading of low-carbon industries [12].

Macro-Level: the "Three-Dimensional + Three-Guarantee" Mechanism for Improving Regional Green Development Efficiency

At the regional level, traditional Chinese ecological cultural capital provides three-dimensional support for green development efficiency through technology diffusion, consumption guidance, and governance optimization, while forming three guarantees with digital technology, SMEs, and built environments:

1) Technology Diffusion Support: In regions with a strong ecological cultural atmosphere, enterprises' green innovation achievements are more likely to diffuse across subjects and industries, forming "innovation clusters" and reducing the overall regional emission reduction costs. Digital technology breaks geographical restrictions, promoting the sharing and adaptation of green technologies on a larger scale; as important carriers of technology diffusion, SMEs accelerate the extension of green technologies to county and rural areas [12].

2) Consumption Guidance Support: Traditional ecological concepts of "frugality" and "simplicity" are transformed into public low-carbon consumption behaviors through educational dissemination, driving demand for regional low-carbon industries and guiding market resources to tilt toward green industries. The digital economy facilitates the dissemination of low-carbon consumption information, making it easier for consumers to supervise enterprises' low-carbon behaviors and further strengthening the guiding role of low-carbon consumption in industrial structure; sustainable built environments promote the formation of low-carbon consumption behaviors by optimizing consumption scenarios (such as green shopping malls and low-carbon communities) [13].

3) Governance Optimization Support: The traditional governance concepts of "harmony in diversity" and "collaborative governance" guide regions to construct a multi-stakeholder collaborative low-carbon governance system involving "government-enterprises-public-social organizations." Digital technology improves governance efficiency, such as big data enabling precise monitoring of carbon emissions and blockchain ensuring the transparency of carbon trading; the extensive participation of SMEs and the public enhances the relevance and effectiveness of low-carbon governance; sustainable built environments provide spatial platforms for multi-stakeholder collaborative governance, such as the construction of community deliberation spaces and ecological protection collaboration platforms.

Empirical research by Li Wei et al. [7] shows that there is a significant positive correlation between cultural capital and regional green development efficiency, presenting a "marginal effect increasing" characteristic. Meanwhile, the level of digital technology, SME development, and built environment quality all have a positive regulatory effect on this correlation.

Regional Practice: Models, Challenges, and Optimization Pathways of Ecological Culture Empowering Low-Carbon Transitions

The value of theories and mechanisms is ultimately reflected through regional practice. Drawing on literatures such as Zuo et al. (2021), Wang et al. (2018), and Chen & Pan (2017), combined with emerging economic
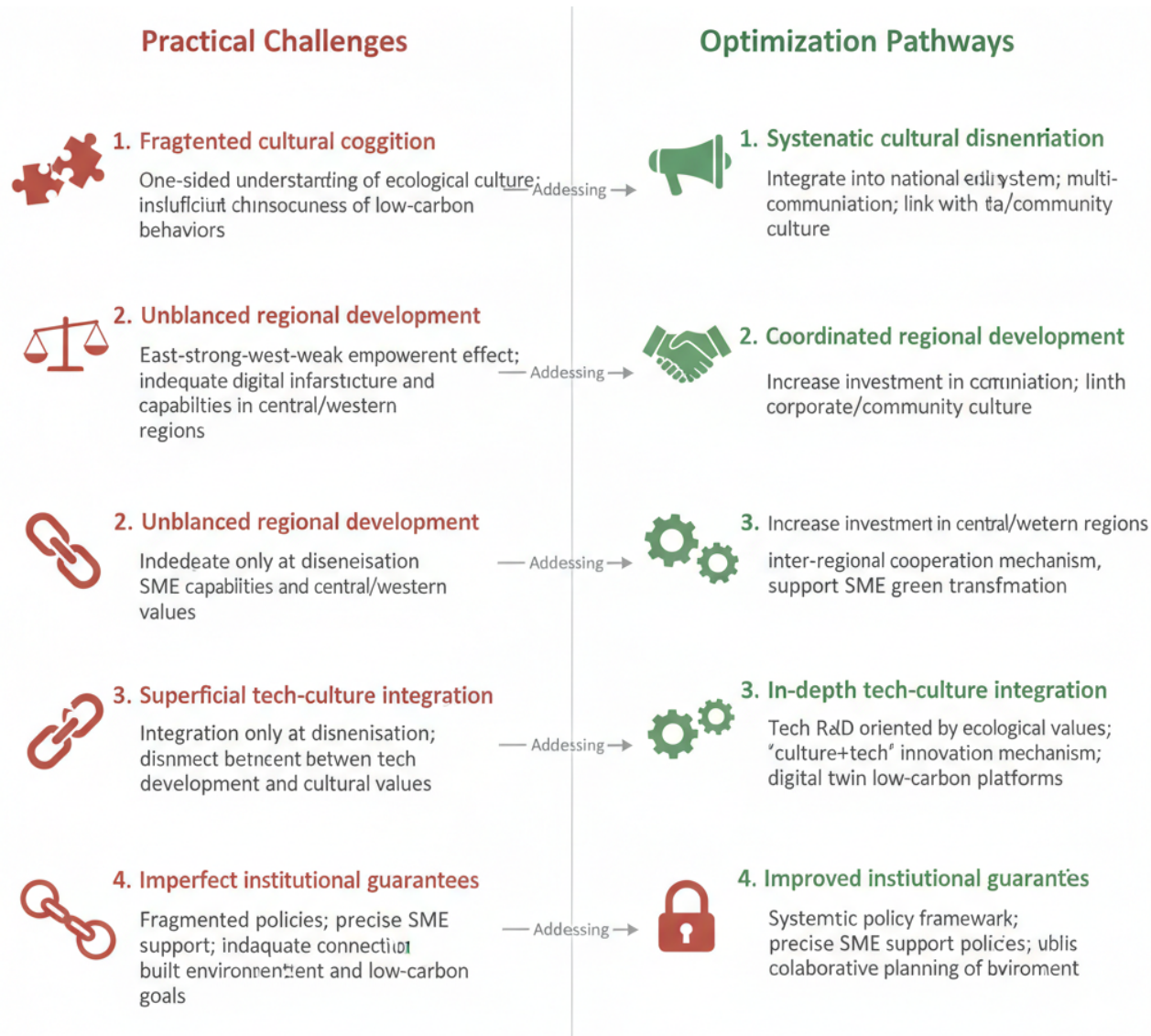
Figure 4 | Practical challenges and corresponding optimization pathways

research by Gu et al. (2025), this section sorts out the typical practice models, realistic challenges, and targeted optimization pathways of ecological culture empowering regional low-carbon transitions (**Figure 4**).

Typical Practice Models

"Culture + Education and Communication" Model: Cultivating the Social Foundation for Low-Carbon Development

This model integrates traditional Chinese ecological culture into public cognition through a three-dimensional system of basic education, higher education, and social education, transforming it into low-carbon behaviors. At the basic education stage, primary and secondary schools incorporate ecological knowledge from the "Twenty-Four Solar Terms" and ancient environmental protection stories (such as "Mencius opposing over-hunting") into courses such as "Morality and Rule of Law" and "Science," fostering low-carbon awareness among young people [8]; at the higher education stage, universities offer interdisciplinary courses such as "Traditional Ecological Wisdom and Low-Carbon Development," cultivating "ecology + technology" compound talents to meet the skill demands brought about by the digital economy [12]; at the social education stage, ecological concepts such as "harmony between humans and nature" and "frugality and caring for others" are disseminated through community cultural walls, village regulations and people's conventions, and digital media, guiding the public to form low-carbon lifestyles. For example, Anji in Zhejiang Province combines "bamboo

culture" with low-carbon industries, guides residents to participate in green production and living through community education and digital platforms, and collaborates with SMEs to carry out skill training, bridging skill mismatches in low-carbon industries.

"Culture + Spatial Governance" Model: Building Spatial Carriers for Low-Carbon Development

This model combines the "spatial harmony" concept in traditional ecological wisdom with the requirements of sustainable built environments, optimizes regional spatial layout, and builds spatial carriers for low-carbon development. At the urban level, it preserves "mountains and rivers patterns" (such as Suzhou's water towns and Beijing's central axis greening), constructs green transportation systems and low-carbon building clusters, and reduces carbon emissions from urban operations [9]; at the county level, it develops low-carbon tourism and ecological agriculture relying on ecological and cultural resources, achieving a win-win situation of "ecological protection + economic development"; at the industrial park level, it builds circular economic parks to realize resource sharing and waste recycling, in line with the traditional concept of "circular symbiosis" [13]. For example, Huangshan in Anhui Province integrates "Taoist ecological wisdom" into scenic area planning and management, constructs green transportation systems, implements garbage classification and resource recycling, and builds a low-carbon scenic area integrating "ecology-tourism-culture."

"Culture + Policy Integration" Model: Constructing Institutional Guarantees for Low-Carbon Development

This model integrates traditional Chinese ecological culture into the regional low-carbon policy framework, promoting the transformation of cultural capital into low-carbon development momentum through policy guidance and institutional constraints. At the national level, the concept of "harmony between humans and nature" is transformed into the development goal of "harmonious coexistence between humans and nature," and the idea of "frugality" is converted into policies such as total energy consumption control and energy conservation and emission reduction [10]; at the local level, the inheritance of ecological culture and the effectiveness of low-carbon development are included in the assessment indicators of local governments, and policies supporting SMEs' participation in low-carbon transitions are introduced (such as financial subsidies and tax incentives) to encourage enterprises to apply green technologies and carry out skill training [12]; at the community level, traditional village regulations and people's conventions are combined with modern low-carbon

norms to formulate community low-carbon conventions, strengthening the constraints on public low-carbon behaviors. For example, Suzhou in Jiangsu Province integrates "Confucian integrity culture" into the enterprise environmental credit evaluation system, providing policy inclinations for enterprises with good environmental credit and forcing enterprises to fulfill their low-carbon responsibilities.

Realistic Challenges

Despite certain achievements in ecological culture empowering regional low-carbon transitions in China, four major realistic challenges persist:

Fragmented Cultural Cognition and Inadequate Value Transformation

Some regions have a one-sided understanding of the core connotations of traditional Chinese ecological culture, simply equating it with "ecological tourism promotion" or "traditional cultural performances," while neglecting its modern transformation at the levels of value ethics and institutional rules; the public has insufficient understanding of the inherent connection between ecological culture and low-carbon development, and low-carbon behaviors lack cultural consciousness, mostly relying on external constraints, making it difficult to form a long-term mechanism.

Unbalanced Regional Development and Gaps in Synergistic Empowerment

Eastern regions are leading central and western regions in terms of cultural capital transformation, digital infrastructure, SME development level, and built environment quality, resulting in an "east-strong-west-weak" pattern in the empowering effect of ecological culture [7]; central and western regions have weak digital infrastructure, insufficient green transformation capabilities of SMEs, and poor adaptability of built environments, which restrict the synergistic empowerment of cultural capital and emerging factors.

Superficial Integration Between Technology and Culture and Low Empowerment Efficiency

The current integration of digital technology and ecological culture mostly remains at the dissemination level (such as digital media disseminating ecological culture), with insufficient integration in core areas such as green technology innovation, low-carbon industrial upgrading, and regional governance optimization; there is a certain disconnect between technological development and cultural values, and some digital technology applications still prioritize "efficiency," neglecting the cultural connotation of ecological protection.

Imperfect Institutional Guarantees and Obstacles to Practical Implementation

The institutional design for ecological culture empowerment lacks systematicness, with fragmented and inconsistent policies; support policies for SMEs' participation in low-carbon transitions are not precise enough, and the support for skill training and technological R&D is insufficient [12]; the connection between built environment planning and low-carbon policies, as well as cultural inheritance, is not close enough, making it difficult to balance the ecological rationality and economic sustainability of spatial layout [13].

Optimization Pathways

In response to the above challenges, combined with the theoretical and mechanism analysis above, the following optimization pathways are proposed:

Strengthen Systematic Cultural Dissemination and Deepen Value Transformation

Construct an ecological culture dissemination system led by the government, supported by academic circles, linked with the media, and participated by the public. Systematically disseminate the core connotations of traditional Chinese ecological culture through compiling popular readers, producing special programs, and organizing cultural activities; incorporate ecological culture into the national education system, forming a complete curriculum chain from basic education to higher education, and cultivating "culture + low-carbon" compound talents; promote the in-depth integration of ecological culture with corporate culture and community culture, transforming concepts such as "harmony between humans and nature" and "frugality and caring for others" into corporate business philosophy and public behavioral norms.

Coordinate Regional Development and Narrow the Gap in Empowerment

Increase policy inclination and resource investment in central and western regions, improve digital infrastructure construction, and enhance the accessibility of green technologies; support the development of SMEs in central and western regions, strengthen their green transformation capabilities and skill adaptation capabilities through skill training, technology incubation, and financial support [12]; develop characteristic industries such as low-carbon tourism and ecological agriculture based on the unique ecological and cultural resources in central and western regions, realizing a virtuous cycle of "cultural resources - economic development - ecological protection"; establish a coordination mechanism between eastern and central-western regions to promote the cross-regional flow of cultural capital, digital technology, and green industries.

Promote in-Depth Integration Between Culture and Technology and Improve Empowerment Efficiency

Guided by ecological cultural values, promote the focus of digital technology on green and low-carbon fields, such as using artificial intelligence to optimize green technology R&D, big data to achieve precise carbon emission control, and blockchain to improve the carbon trading system; develop innovative "culture + technology" products and services, such as low-carbon lifestyle APPs based on traditional ecological wisdom and digital twin low-carbon community platforms; establish a "culture-technology-industry" integrated innovation mechanism, encouraging cooperation between enterprises, universities, and research institutions to develop low-carbon technologies and products with both cultural connotations and technological content.

Improve the Institutional Guarantee System and Strengthen Practical Implementation

Construct a systematic institutional framework for ecological culture empowerment, incorporating ecological culture inheritance, digital technology application, SME support, and built environment optimization into regional low-carbon development plans; introduce precise policies to support SMEs' participation in low-carbon transitions, focusing on skill training, green technology R&D and application, and low-carbon industrial chain integration [12]; establish a collaborative planning mechanism between built environments, low-carbon development, and cultural inheritance, integrating ecological cultural connotations into urban spatial layout, architectural design, and transportation system construction to improve spatial adaptability [13]; improve the assessment and evaluation system, incorporating indicators such as cultural empowerment effectiveness, regional coordinated development, and technology-culture integration into local government assessments, and strengthening policy implementation supervision.

Conclusions

By integrating core literatures from multiple disciplines, this study constructs a comprehensive analytical framework of "Cultural Connotations → Modern Transformation → Synergistic Empowerment → Regional Practice → Optimization Pathways," systematically revealing the intrinsic logic and core mechanisms of traditional Chinese ecological culture empowering regional low-carbon economies. The key conclusions are as follows:

1) Centered on "harmony between humans and nature," traditional Chinese ecological culture forms an ecological wisdom system with holism, moderation, responsibility, and circularity. Through a three-stage transformation of "value ethics - institutional rules - practical behaviors," it becomes a cultural capital adapted to modern low-carbon development;

2) Ecological cultural capital forms a "four-dimensional synergistic" empowerment system with digital technology, SMEs, and sustainable built environments. It achieves all-round empowerment of regional low-carbon economies through four pathways—"value constraint, technological drive, subject adaptation, and spatial guarantee"—across three tiers: micro-level enterprise transformation, meso-level industrial upgrading, and macro-level regional governance;

3) Three typical practice models have been formed in China: "culture + education and communication," "culture + spatial governance," and "culture + policy integration." However, challenges such as fragmented cultural cognition, unbalanced regional development, superficial integration between technology and culture, and imperfect institutional guarantees persist;

4) By strengthening systematic cultural dissemination, coordinating regional development, promoting in-depth integration between culture and technology, and improving the institutional guarantee system, the realistic bottlenecks can be effectively addressed, and the efficiency and sustainability of ecological culture empowering regional low-carbon economies can be enhanced.

Future research can be further deepened in three directions: First, conduct quantitative research to construct an evaluation index system for ecological cultural capital, digital technology, SME development, and built environment quality, and empirically test the effectiveness and boundary conditions of the four-dimensional synergistic empowerment mechanism; second, focus on specific regions or industries to carry out case studies, in-depth analyzing the differences and adaptability of ecological culture empowerment models in different regions and industries; third, expand the international comparative perspective, exploring the uniqueness and universality of traditional Chinese ecological culture empowering low-carbon development, and providing a more referenceable "Chinese solution" for global sustainable development.

References

1. Tu, W. (2001). The ecological turn in New Confucian humanism: Implications for China and the world. Daedalus, 130(4), 243–264.

2. Pan, Y. (2014). The Chinese cultural origins of ecological civilization. Social Sciences in China, 35(4), 138–158.

3. Lu, F. (2016). Traditional wisdom and ecological civilization. Frontiers of Philosophy in China, 11(1), 1–13.

4. Zhang, K., & Zhang, Y. (2023). The modern transformation of traditional ecological wisdom: A study based on ecological civilization construction in China. Economic and Political Studies, 11(3), 335–354.

5. Du, X., Weng, J., Zeng, Q., Chang, Y., & Pei, H. (2022). Does Confucianism promote corporate green innovation? Evidence from China. Journal of Cleaner Production, 359, 131114.

6. Xu, S., Liu, D., & Huang, J. (2021). Traditional culture and corporate environmental responsibility: Evidence from China. Journal of Business Ethics, 173(1), 181–195.

7. Li, W., Xu, J., & Li, G. (2023). Influence of cultural capital on regional green development efficiency. Environmental Science and Pollution Research, 30(6), 14815–14830.

8. Zuo, J., Pullen, S., Rameezdeen, R., Bennetts, H., Wang, Y., Mao, G., et al. (2021). Ecological civilisation education in China: From ancient wisdom to modern practice. Sustainability, 13(9), 4854.

9. Wang, X., Wang, Z., & Wu, J. (2018). Spatial-temporal evolution of low-carbon development in Chinese cities. Journal of Geographical Sciences, 28(9), 1317–1334.

10. Chen, S., & Pan, J. (2017). China's low-carbon transition: Progress and challenges. In Y. Qi (Ed.), The Routledge Handbook of Environmental Policy in China (pp. 165–182).

11. Gu, Y., & Wang, Y. (2025). The Impact of Artificial Intelligence on Labor Market Income Inequality. International Journal of Advanced Science, 1(2), 8-13.

12. Gu, Y., & Lukin, S. (2025). Employment Effects of Digital Economy: The Role of SMEs in Bridging Skill Mismatch. International Journal of Multidisciplinary Research, 1(2), 112-118.

13. Gu, Y., & Kharytonova, V. A. (2025). The Built Environment and Economic Context: Impacts on Enterprise Operations, Mechanisms, and Adaptive Strategies. Journal of Sustainable Built Environment, 2(6).