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How can high-quality development improve the ecotourism efficiency in the region of ecological constraints of China? Empirical evidence from the Yellow River Basin

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Despite the massive impacts of ecotourism on regional development, only limited papers empirically examined the responses of the regional development factors to ecotourism in the context of an ecological constraints region. To fill this gap, the primary aim of this paper is to reveal how ecotourism efficiency is affected by quality regional development in the region of ecological constraints. The second aim is to investigate the moderating role of ecological constraints in building relationships of ecotourism efficiency and quality regional development factors. The research was conducted in the Yellow River Basin, a prime area for ecological protection and high-quality regional development in China. Data gathered from 2010 to 2019 were used to analyze ecotourism efficiency by using the super−slacks-based measurement method. Findings indicated that four quality regional development factors—innovative, green, open, and shared factors—have positive impacts on ecotourism efficiency in the Yellow River Basin. Ecological constraints moderate the relationship between ecotourism efficiency and quality regional development. The study makes a significant contribution to the literature in terms of both managing the ecological constraints and improving the sustainability of ecotourism in the region of quality development.

KEYWORDS

efficiency, quality regional development, ecotourism, ecological constraint, the Yellow River Basin

Introduction

In recent decades, the ecology has suffered unprecedented damage (Zou and Shen, 2003; Pei et al., 2023). It is also fairly well understood that, with the rapid development of the global tourism industry, the inherent environmental dependence and resource consumption of this industry aggravate the contradiction between tourism development and ecological conservation (Peng et al., 2017; Tamario et al., 2019; Wang et al., 2022). This contradiction can have serious adverse effects on the ecology of a tourism area, and the risks of the tourism destination ecosystem are continuously increasing (Ma et al., 2021). Tourism is no longer a “green” industry (Williams and Ponsford, 2009; Briassoulis, 2020); thus, its sustainable development is threatened (Qiu et al., 2017). Developing ecotourism has become some policy note issues by governments concerned for addressing the contradiction between promoting tourism and protecting the ecology (Zhang et al., 2022), and realizing the sustainable development of a regional economy is an urgent practical need.

Previous studies on this subject have concluded that ecotourism provides people with more opportunities to enjoy recreation within the acceptable range of the ecosystem, promotes the sustainable development of ecotourism destinations, and improves the quality of regional development (Shasha et al., 2020; Fuxia and Bizhe, 2022). Ecotourism has a positive effect on the protection of the ecological system and promotes high-quality economic growth (Lundholm, 2015; Chen et al., 2020). That being said, the conclusions of relevant research are relatively vague on whether the quality of regional development affects ecotourism and how it affects the efficiency of ecotourism.

The Yellow River Basin (see Figure 1), located in northern China, is a typical area as far as ecotourism in China is concerned. However, the economic aggregate of the Yellow River Basin has been in a relatively weak position. The development of continuous urbanization and industrial transformation poses a particularly significant threat to ecological and environmental protection, which further leads to ecotourism facing with serious ecological challenges (Zhao and Wu, 2018). The contradiction between the advantages of ecotourism and the disadvantages of regional economics has restricted the quality of regional development in the Yellow River Basin for a long time. The key to solving this contradiction lies in the mechanisms to the quality of regional development on ecotourism (Ma et al., 2023). Therefore, the influence mechanism of regional development quality on ecotourism was examined in this study. Although eco-efficiency is of great significance in the context of ecological protection and regional development, the existing research concerning ecotourism efficiency is insufficient, especially in terms of the relevance of its takeaway lessons to the Yellow River Basin.

Ecotourism, as a form of responsible travel that aims to minimize the negative impacts of tourism on the environment and local communities while promoting conservation and sustainable development, has received attention worldwide (Qiu et al., 2022). In the light of the previous studies, this study mainly contributes innovative suggestions as follows: First, it analyzes the characteristics underlying the efficiency in ecotourism’s temporal and spatial evolution in the Yellow River Basin, drawing on the undesirable slacks-based measurement (SBM) model based on undesirable outputs. Second, this study constructed a high-quality development evaluation system and analyzed the regional quality development index. The influence of high-quality development on ecotourism efficiency in the Yellow River Basin was found to be based on the driving factors of innovation (number of college students in school), coordination (urbanization rate), green [energy consumption per unit of Gross Domestic Product (GDP)], openness (amount of foreign capital utilized per capita), and sharing (number of beds per 1,000 people). Finally, it reveals the regional quality development of the Yellow River Basin and the effects of driving factors of high-quality development on the efficiency of ecotourism, thus revealing the much less understood link between high-quality development and ecotourism.

The rest of this paper is organized as follows: Section 2 presents the literature review and theoretical analysis of this study. Section 3

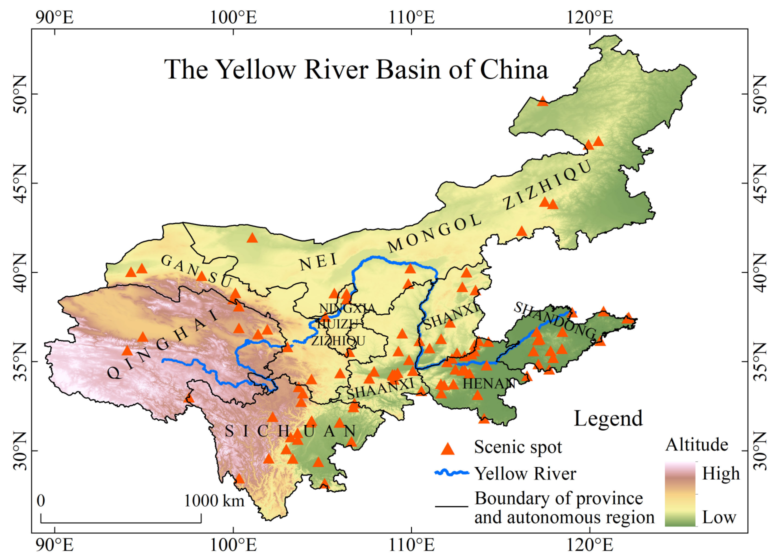

FIGURE 1
Map of the Yellow River Basin.

describes the variables and data sources, and Section 4 analyzes the empirical findings. Finally, the conclusions and recommendations are presented in Section 5.

Literature review and theoretical analysis

Ecotourism efficiency

Ecotourism is a coordinated conservation strategy to link conservation and development, a form of responsible travel that aims to minimize the negative impacts of tourism on the environment and local communities while promoting conservation and sustainable development. However, research into the effectiveness of ecotourism is mixed (Stem et al., 2003).

Eco-efficiency, first proposed by Schaltegger and Sturm (1990), is one of the most widely used indicators regarded as the ratio of economic value to environmental impact. Referring to the previous studies (Fan et al., 2017; Liu et al., 2017), the effectiveness of ecotourism can be assessed by using eco-efficiency indicators and metrics. Therefore, this study considered ecotourism efficiency, as the ratio of comprehensive ecotourism outputs obtained by tourism inputs and ecological inputs refers to the ability of the tourism industry to use resources effectively and efficiently to generate economic benefits while minimizing negative impacts on the environment and local communities.

At present, some tourism studies have examined the measurement and evaluation of ecotourism efficiency (Goessling et al., 2005; Li et al., 2008; Zhang et al., 2010; Peng et al., 2017), but the number of samples and selected indicators is relatively small and, thus, cannot fully reflect ecotourism efficiency (Liu et al., 2017). These studies mainly focus on specific cases without analyzing the factors affecting ecotourism efficiency. The above research objects of ecotourism efficiency include the tourism eco-efficiency of China's coastal cities (Liu et al., 2017), the Yangtze River Delta's ecotourism efficiency (Ma et al., 2021), and rural tourism eco-efficiency (Liang and Shi, 2020). Few scholars have discussed the ecotourism efficiency of the Yellow River Basin from the perspective of research. The research on ecotourism efficiency includes the eco-efficiency of tourism transportation (Reilly et al., 2010), forest ecotourism value (You et al., 2022), ecotourism suitability (Hz et al., 2020), eco-efficiency of tourism products (Kelly et al., 2007), eco-efficiency of tourism destinations (Minoli et al., 2015), and leisure efficiency (Lin, 2017). The research methods include data envelopment analysis (DEA) (Lin, 2017), the spatial Q method (Lee, 2019), the fuzzy analysis hierarchy (Hz et al., 2020), multi-criteria spatial decision-making technology (Feizizadeh et al., 2023), the feedback-loop dynamic system model (Yuan et al., 2018), remote sensing images and social media data (Reilly et al., 2010), and the DEA-tobit model (Liu et al., 2017). However, comprehensive research on ecotourism efficiency is lacking (Liu et al., 2017), and even less research is available on comprehensively measured ecotourism efficiency from the perspective of high-quality development.

The relationship of ecotourism and quality regional development

Quality regional development that is also defined as high-quality development is a major measure for improving total factor productivity and building a modern economic system. This may be done by changing the development mode, optimizing the economic structure, and transforming the growth momentum to achieve better quality and fairer and more efficient and sustainable development (Zeng, 2020). One view is that specific aspects of high-quality regional development include infrastructure (Wong et al., 2013; Wang et al., 2023), community engagement (Khaledi Koure et al., 2023), and policy initiatives (Gibbs et al., 2005; Potts, 2010; Khor et al., 2021). One viewpoint takes "innovation, coordination, green, openness, and sharing" as the overall concept of high-quality development and holds that high-quality development aims at solving the contradiction of unbalanced and insufficient development. It emphasizes both the promotion and realization of regional economic, political, cultural, social, and ecological high efficiency and the promotion and realization of equitable and green sustainable development under the guidance of the five major development factors in the development process (Zhang et al., 2017; Zhu et al., 2019). This research will focus on five factors of high-quality development, namely, "innovation, coordination, green, open, and shared," which are closely related to the eco-efficiency and eco-constrained management that this paper wants to examine.

The existing research studies mainly form the following issues for the relationship of quality regional development and ecotourism, discuss the different model of different area on high-quality development, and provide policy recommendations for achieving high-quality development (Yang et al., 2019). In the field of ecotourism research, there are some studies that carried out the themes of ecotourism and high-quality development, such as rural tourism, red tourism, cultural tourism integration, and large-scale festival tourism (Liu and Han, 2020; Yu et al., 2020; Song et al., 2021). Some studies have examined the response of regional development factors to ecotourism in the context of an ecological constraints region, such as the strategic role of local community participation in ecotourism development (Khaledi Koure et al., 2023), the stimulation of community ecotourism cooperation by large-scale tourism projects (Barkin and Bouchez, 2002), and the support of community tourism decision-makers for ecotourism development (Vincent and Thompson, 2020). However, these studies do not address the impact of the four high-quality regional development factors, namely, innovation, green, open, and shared on ecotourism, let alone explain the process and mechanisms by which high-quality regional development affects the efficiency of ecotourism.

Based on the above analysis, the Super-SBM model evaluation framework was established on the basis of undesirable outputs to make a systematic and complete analysis of ecotourism efficiency. In addition, the SBM model can explain the relationship between tourism and the ecology (Zhang et al., 2022) and further clarify the dynamic synergy between them, thus providing scientific management suggestions for ecological protection and high-quality development in the Yellow River Basin.

The variables, model, and data source

The variables and models of ecotourism efficiency

The variables of ecotourism efficiency

The ecotourism efficiency variables in this study consist of three components: input variables, desirable output variables, and undesirable output variables.

(1) Input variables: According to the most basic factors in classical economics, that is, capital, labor, and land, input factors variables were represented by three indicators: fixed assets investment in tourism industry, the number of employees in tourism industry, and the proportion of natural reserve area. Given that the accommodation industry and the catering industry are the main sectors allied with tourism economics, the indicators of fixed assets investment and the number of employees in tourism are only count enterprises that are above the designated size in accommodation and catering industry. The indicator of proportion of natural reserve area used the ratio of natural reserve area to the total land area. In this study, natural reserve includes national nature reserves, national geological parks, national forest parks, national scenic spots, and world natural and cultural heritage sites, and this may increase the ratio of natural reserve area, but it highlights the developing strategies, i.e., “doing a good job of great protection together,” in the Yellow River Basin. Meanwhile, some studies have considered ecotourism resources as an input factor variable to measure the efficiency of ecotourism. Accordingly, this study takes the number of tourism scenic spots as an indicator, including humanistic scenic spots and natural-type scenic spots in the Yellow River Basin.

(2) Desirable output variables: These variables were divided into the scale produces and efficient outputs, which are usually reflected in tourism industry by tourist arrivals and receipts.

(3) Undesirable output variable: This variable was reflected in CO^2 emissions that are calculated by the conversion of energy consumption per 10,000 yuan of GDP in China (Zhu et al., 2018; Zeng, 2020).

The above variables and indicators are further detailed in Table 1.

TABLE 1 Ecotourism efficiency: variables and indicators.

Variables	Indicators	Interpretation of the indicators
Input variables	Fixed asset investment in tourism	Fixed assets of accommodation enterprises + total fixed assets of catering enterprises/ million yuan
	The number of employees in tourism	Year-end number of employees in accommodation enterprises + year-end number of employees in catering enterprises above the designated size/person
	Proportion of natural reserve area	The ratio of the area of nature reserves at or above the national level, forest parks, geological parks, scenic spots, and world cultural and natural heritage sites to the total land area of the province/%
	Tourism resources	The sum of the number of 3A, 4A, and 5A tourist attractions
Desirable output variables	Tourist arrivals	International tourist arrivals + domestic tourist arrivals/million people
	Tourist receipts	International tourism revenue + domestic tourism revenue/billion yuan
Undesirable output variables	CO^2 emissions	Total tourists receipts * energy efficiency consumption per 10,000 yuan of GDP/the million tons of standard coal

The measurement model of ecotourism efficiency

The ecotourism efficiency discussed in this study aims to achieve the maximum output of tourism economic with the help of minimum inputs and ecological impact (Zhu et al., 2018). The impact of ecotourism on the ecological environment runs through the whole process of tourism activities, and tourism’s economic benefits are the typically desirable outputs of ecotourism. CO^2 emissions are often considered as the undesirable outputs of ecotourism. Based on this, a production possibility set comprising the desired and undesired outputs was constructed. Furthermore, the possibility of shrinking the desired and undesired outputs under a particular factor input was analyzed, using the directional distance function.

Considering the relaxation problem of variables and the impact of undesired outputs, the non-angle and non-oriented Super-SBM method was adopted to measure ecotourism efficiency (Yu et al., 2015), and the formula is as follows:

$$minp = \frac{\frac{1}{m}\sum_{i=1}^{m}\left(\frac{\bar{x}}{x_{ik}}\right)}{\frac{1}{r_1+r_2}\left[\frac{\sum_{s=1}^{r_1}\overline{y^d}}{y_{sk}^d}+\frac{\sum_{q=1}^{r_2}\overline{y^u}}{y_{qk}^u}\right]}$$

$$\bar{x} \geq \sum_{j=1,\neq k}^{n} x_{ij}\lambda_j; \overline{y^d} \leq \sum_{j=1,\neq k}^{n} y_{sj}^d\lambda_j; \overline{y^d} \geq \sum_{j=1,\neq k}^{n} y_{qj}^d\lambda_j$$

$$\bar{x} \geq x_k; \overline{y^d} \leq y_k^d; \overline{y^u} \geq y_k^u; \lambda_j \geq 0; i = 1, 2, \cdots, m; j = 1, 2, \cdots, n; s = 1, 2, \cdots, r_1; q = 1, 2, \cdots, r_2$$

In the formula, among n Decision Making Units (DMUs), each DMU contains input m, expected output r_1, and unexpected output r_2. x, y^d, and y^u, are the elements in the corresponding input matrix, expected output, and unexpected output matrix, respectively, and p represents the efficiency value.

The variables of high-quality regional development

The concept of high-quality regional development is based on the five development ideas: innovation, coordination, green, open, and shared. This study takes the high-quality development index of the Yellow River Basin as the explanatory variable, which was specifically designed to have five explanatory variables, namely, innovative development, coordinated development, green development, open development, and shared development. The moderating variable was designed to be an economic variable and an ecological environment variable. The explained variable is ecotourism efficiency. Based on the principles of combining the total index with the per capita index, the efficiency index with the sustainable development index, and the high-quality development index with the economic benefits index (Ren and Du, 2021), the number of college students per 10,000 people, urbanization rate, energy consumption per unit of GDP, per capita utilization of foreign capital, number of beds per 1,000 people, per capita GDP, and types of ecological functional zones were used to reflect the above variables, respectively. The variable indicators and explanations are presented in Table 2.

Data source

In this study, the data on ecotourism efficiency was obtained from the China Statistical Yearbook (2011–2020), the Statistical Yearbooks of the every provinces in the Yellow River Basin (2011–2020), and the Statistical Bulletin of National Economic and Social Development. The data on ecology and environment were obtained from the eco-functional regionalization of each province in the Yellow River Basin. Tourism-related data were acquired from the official websites of the Ministry of Culture and Tourism, People's Republic of China (PRC), and the Department of Culture and Tourism in each of the nine provinces and autonomous regions in the Yellow River Basin. The high-quality development data were sourced from the China Statistical Yearbook for 2011–2020, the Statistical Yearbooks of the nine provinces, and the Statistical Bulletin of the nine provinces in the Yellow River Basin over the years. For all of the collected data, the multiple-imputation method was used to supplement the missing data.

Empirical analysis

Empirical analysis on space-time evolution of ecotourism efficiency in the Yellow River Basin

Temporal evolution of ecotourism efficiency in the Yellow River Basin

The temporal evolution characteristics of ecotourism efficiency in the Yellow River Basin from the perspective of the whole basin are shown in Figure 2. From 2010 to 2019, the ecotourism efficiency in the Yellow River Basin increased steadily from 0.144 to 0.721, with a total growth rate of 400.69% and an average annual growth rate of 40.07%. However, on the whole, the ecotourism efficiency in the Yellow River Basin is low, and the average ecotourism efficiency value in the past 10 years was only 0.356.

From the perspective of different reaches, the ecotourism efficiency in different reaches of the Yellow River Basin showed an increasing trend, but the evolution characteristics were significantly different. (1) In the upper reaches of the Yellow River—Qinghai, Ningxia, Sichuan, Gansu, and Inner Mongolia—ecotourism efficiency showed a fluctuating trend of increase for the period 2010 to 2019. The average ecotourism efficiency increased from 0.126 to 0.542, with an average annual growth rate of 33.02%. Both the average and total growth rates were lower than the whole basin level of 0.303, indicating the lowest ecotourism efficiency. (2) In the middle reaches of the Yellow River, which includes the Shaanxi and Shanxi provinces, the growth of ecotourism efficiency was divided into two stages. From 2010 to 2014, the ecotourism efficiency rose slowly, with the average value ranging from 0.123 to 0.289, lower than the average level of the whole basin. From 2015 to 2019, the ecotourism efficiency increased rapidly from 0.379 to 1.057, with an average annual growth of 17.89%, making it the fastest-growing stretch along the Yellow River Basin in terms of

TABLE 2 High-quality regional development: variable indicators and explanations.

Variables	Variable classification	Variable symbols	Indicators	Explanation of indicators
Explanation variables	Innovative development	*Inova*	Proportion of the number of college students in school	Number of college students in school/total resident population
	Coordinated development	*Green*	Urbanization rate	Urban population/total resident population
	Green development	*Coordi*	Energy consumption per unit of GDP	Total energy consumption/per 10,000 GDP
	Open development	*Open*	Amount of foreign capital utilized per capita	Actual amount of foreign capital utilized/number of employed persons
	Shared development	*Share*	Number of beds per 1,000 people	(Number of beds in health facilities/total resident population) × 1,000
Moderating variables	Ecological constraint	*Environ*	Type of eco-functional region	According to the results of eco-functional regionalization in China, prohibited development area is 4, restricted development area is 3, key development area is 2, and the priority development area is 1
Explained variables	ecotourism	*Toureco*	Ecotourism efficiency	The ecotourism efficiency values are measured above

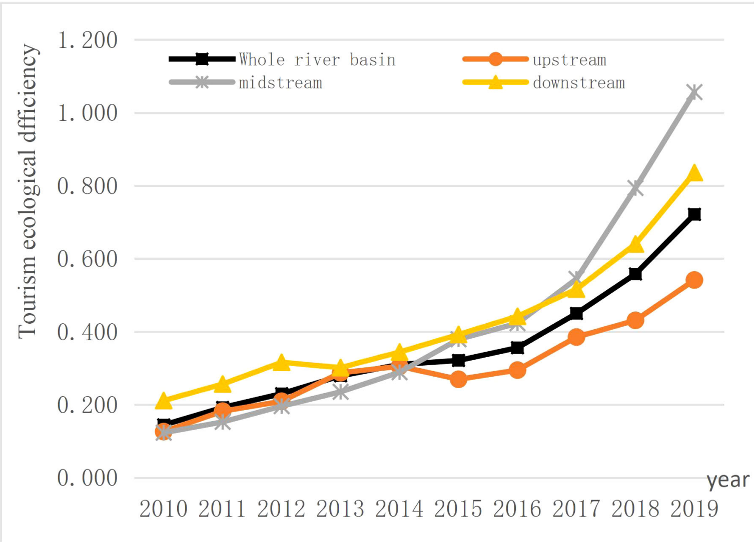

FIGURE 2
Ecotourism efficiency in the Yellow River Basin (2010–2019).

ecotourism efficiency. (3) The lower reaches of the Yellow River Basin are the Henan and Shandong provinces. In the past 10 years, ecotourism efficiency increased steadily in both provinces, with its average ranging from 0.211 to 0.836, which is the highest average rate of ecotourism efficiency in the Yellow River Basin. Notably, in the upper reaches of the Yellow River Basin, it was the lowest, whereas it was the highest in the lower reaches. Furthermore, in the middle reaches, the average growth of this efficiency was the fastest.

Spatial evolution characteristics of ecotourism efficiency in the Yellow River Basin

Taking the average value of ecotourism in the Yellow River Basin in a certain year as the boundary, an area for which the value is higher than the average value has high ecotourism efficiency; otherwise, the area has low ecotourism efficiency (Table 3). From the perspective of the whole river basin, only the Sichuan and Henan provinces had high ecotourism efficiency in 2013. In 2019, these provinces were joined by the Shaanxi and Shanxi provinces. The regions with low ecotourism efficiency changed from seven to five provinces, namely, Qinghai, Ningxia, Gansu, Inner Mongolia, and Shandong. Thus, the spatial scope of the high ecotourism rate areas in the Yellow River Basin gradually expanded, whereas that of the low–ecotourism rate areas gradually shrunk.

TABLE 3 Spatial evolution characteristics of ecotourism efficiency in the Yellow River Basin.

Year	High–ecotourism efficiency areas	Low–ecotourism efficiency areas
2010	Sichuan, Henan, and Shandong	Qinghai, Ningxia, Gansu, Inner Mongolia, Shanxi, and Shaanxi
2013	Sichuan and Henan	Qinghai, Ningxia, Gansu, Inner Mongolia, Shanxi, Shaanxi, and Shandong
2015	Sichuan, Shanxi, Shaanxi, Henan, and Shandong	Qinghai, Ningxia, Gansu, and Inner Mongolia
2017	Sichuan, Shanxi, Shaanxi, and Henan	Qinghai, Ningxia, Gansu, Inner Mongolia, and Shandong
2019	Sichuan, Shanxi, Shaanxi, and Henan	Qinghai, Ningxia, Gansu, Inner Mongolia, and Shandong

From the perspective of the different provinces, Sichuan and Henan have always been areas with high ecotourism efficiency, whereas Qinghai, Ningxia, Gansu, and Inner Mongolia have always had low ecotourism efficiency. The spatial pattern of ecotourism efficiency in the abovementioned six provinces has not changed. The Shandong province was a high-efficiency area that later became a low-efficiency area, but it bounced back to become a high-efficiency area once again, and the spatial evolution obviously fluctuated as a result of these changes. Therefore, except in the case of Sichuan, the spatial pattern of ecotourism efficiency in the upper reaches of the Yellow River Basin hardly changed much and that of the lower reaches of Henan did not change at all. In the middle reaches, though, it changed significantly and played a key role in the spatial evolution of the ecotourism efficiency of the basin on the whole.

Linear regression analysis of high-quality development on ecotourism efficiency

Sample descriptive statistical results

The descriptive statistical results of the main variables of the high-quality development index of the Yellow River Basin are shown in Table 4. The mean value of innovation development is 0.068; the maximum value is 0.512, and the minimum value is 0.0103, indicating a strong difference in the number of college students. The standard deviation of green development was 5.92e-05, indicating significant heterogeneity in unit energy consumption data. The mean values of the coordinated development variables,

TABLE 4 Descriptive statistics of the main variables.

Variable		Observed value	Mean value	Standard deviation	Minimum value	Maximum value
Innovation development	*Inova*	88	0.0680	0.141	0.0103	0.512
Coordinated development	*Coordi*	88	0.000120	5.92e-05	4.11e-05	0.000246
Green development	*Green*	88	0.495	0.0813	0.293	0.634
Open development	*Open*	88	162.3	102.3	1.355	373.2
Shared development	*Share*	88	5.195	0.963	3.483	7.543
Ecotourism efficiency	*Toureco*	88	0.361	0.293	0.0445	1.081
Ecological environment	*Environ*	88	2.295	1.146	1	4

shared development variables, and ecological environment variables were 0.495, 5.195, and 2.295, respectively, and the standard deviations were 0.0813, 0.963, and 1.146, respectively, indicating obvious differences in the indicators. The high standard deviation of the open development variable and the economic variable indicates that the numerical difference between the unit energy consumption index and the per capita GDP index was not obvious, which may affect the reduction of the regression coefficient value in a later period but had little impact on the analysis of the study's results.

The factor analysis method was used to process the relevant data of the high-quality development index evaluation index system of the Yellow River Basin. Thus, the high-quality development index of the nine provinces was calculated for 2010–2019. The SPPS21 software was used for testing and analysis, and the results showed that the sample data passed the Bartlett sphericity test with a value above 0.05 and that the Kaiser-Meyer-Olkin (KMO) value was 0.50. According to the Kaiser metric, the sample data in this study were more suitable for factor analysis. Then, through factor analysis, the comprehensive score values of the high-quality development index were calculated, and these scores were applied to the following empirical test research.

Panel regression results of high-quality development on ecotourism efficiency

Based on the above analysis, we further analyzed the impact mechanism of innovative development, coordinated development, green development, open development, and shared development on ecotourism efficiency. First, the panel regression model was constructed with innovative development (*Inova*), coordinated development (*Coordi*), green development (*Green*), open development (*Open*), shared development (*Share*), and ecotourism efficiency (*Toureco*) as explanatory variables.

According to the characteristics of the panel data, model checking was required to find the optimal model. In this study, the F-test was used to compare the Fixed Effect (FE) and Pooled MLE (POOL) models, the BP test was used to compare the Random Effects (RE) and POOL models, and the Hausman test was used to compare the FE and RE models. As per the results, the F-test showed a significance of 5% [F (8, 74) = 7.627, p = 0.000< 0.05], indicating that the FE model is better than the POOL model. The BP test showed a significance of 5% [χ^2 (1) = 2.099, p = 0.147], indicating that the RE model is better than the POOL model. The Hausman test showed a significance of 5% [χ^2 (5) = 20.630, p = 0.001], indicating that the FE model is better than the RE model. Therefore, the FE model was used as the final regression model in this study.

To consider the role of time factors and regional factors, the fixedeffect test was conducted after the determination of the panel regression model. In general, the FE model considers only individual-fixed effects. However, considering the time dynamic characteristics of the high-quality development and ecotourism efficiency data of the Yellow River Basin, this study tested the time fixed effect as well. The Ordinary Least Squares (OLS) regression was used to include time as a virtual dummy variable in the model for analysis. The results showed that the regression coefficient value of time to ecotourism efficiency was 0.027, showing a 0.05 level significance (t = 2.381, p = 0.020< 0.05). Therefore, this study adopted the double–fixed-effect regression model, considering the individual-fixed and time-fixed effects. Table 5 shows the regression results.

The impact of innovation factors on ecotourism efficiency

Table 5 shows that the index of innovation (*Inova*) is positively correlated with the value of ecotourism efficiency at the significant level of 0.1 (t = 1.684, p = 0.096 > 0.05), indicating that innovation factors have a positive impact on the ecotourism efficiency and improve the ecotourism of Yellow River Basin. Innovation is one of the main drivers for the improvement of the regional economic development level. The innovation-driven economic development, in turn, further stimulates the double growth of ecotourist arrivals and ecotourism revenues. Accordingly, it is argued that innovation factors increase the output of ecotourism, which leads to an increase in the efficiency of ecotourism in Yellow River Basin.

Next, we analyze the moderating effect of ecological constraint variables. Table 5 shows that the degree of influence of innovation factors on tourism efficiency becomes weaker under the moderating effect of ecological constraint factors. The Yellow River Basin specifies the ecological constraints of different zones, which restrict the scope of economic activities in the region and limits the number of ecotourists, and the scale of ecotourism income, which leads to the ecotourism outputs under the ecological constraint requirement that becomes less than that under the non-ecological constraint requirement, so the ecological constraint factor of the Yellow River basin weakens the degree of influence of the innovation factors on ecotourism efficiency.

The impact of coordinated factors on ecotourism efficiency

The analysis results in Table 5 show that the effect of coordination factors (*Coordi*) on ecotourism efficiency (*Tourceo*) in the Yellow River Basin was not significant (t = 0.849, p = 0.399 > 0.05). The effect of coordination factor (*Coordi*) on ecotourism efficiency (*Tourceo*) was significant and negatively correlated (t = −5.671, p = 0.000< 0.01) after adding ecological constraints as a moderating variable.

The coordination factors are the complementary resource advantages and industrial linkage between regions to enhance tourism efficiency through the level of urbanization. The provinces in the Yellow River Basin have low resource complementarity, low industrial linkage, and significant differences in urbanization levels. With different regional functional requirements, the differences in resource complementarity, linkage, and urbanization are more obvious, and the coordination factors in the Yellow River Basin did not positively influence the ecotourism efficiency in the region and did not promote ecotourism development enough.

The impact of green development on ecotourism efficiency

The green development factors (*Green*) and ecotourism efficiency (*Tourceo*) of the Yellow River Basin in Table 5 show a significant difference at the level of 0.1 (t = 1.670, p = 0.099 > 0.1), indicating that the green development factors have a significant positive impact on the ecotourism efficiency of the Yellow River Basin. Green development is an efficient development mode of low-carbon and low-energy consumption. The tourism industry belongs to the green industry and is also the core of ecotourism efficiency. Therefore, the more significant the low-carbon and low-energy consumption in the Yellow River Basin is, the more significant the positive impact on ecotourism efficiency is. At the same time, the results (Table 5) show that the positive impact of green development in the Yellow River Basin on ecotourism efficiency has been strengthened by the addition of the adjustment variables of ecological constraints, and the two have a significant positive impact relationship at a level of 0.05.

The impact of openness factors on ecotourism efficiency

In Table 5, the significant level is 0.01 (t = 2.676, p = 0.009< 0.01), and the regression coefficient value is 0.001 > 0, indicating that openness factors have a significant positive impact on ecotourism efficiency. Moreover, adding the adjustment variable of ecological constraints to the analysis, it was found that the openness factors show a strong relationship between openness factors on ecotourism efficiency.

The tourism industry is a highly open industry. With the flow of tourists between tourist sources and destinations, a strong capital flow, information flow, and material flow have formed, which can promote highly open tourism destinations. Each province in the Yellow River Basin has rich ecotourism resources and is a global and national tourist destination. Therefore, the ecotourism industry plays a strong role in promoting the growth of foreign investment and openness in the Yellow River Basin.

The impact of shared factors on ecotourism efficiency

According to the analysis results in Table 5, the shared factors showed a significant level of 0.1 (t = 1.888, p = 0.063 > 0.05), indicating that shared factors have a positive impact on ecotourism

TABLE 5 Panel regression results of high-quality development on ecotourism efficiency.

Explanatory variable		Coef	Std. Err	t	p
Intercept	(1)	−0.520	0.332	−1.569	0.121
	(2)	0.958***	0.192	5.003	0.000
Innovation-driven development (*Inova*)	(1)	3.203*	1.903	1.684	0.096
	(2)	−0.685***	0.117	−5.869	0.000
Coordinated development (*Coodi*)	(1)	0.724	0.853	0.849	0.399
	(2)	−1.534***	0.270	−5.671	0.000
Green development (*Green*)	(1)	1693.702*	1014.323	1.670	0.099
	(2)	969.061**	457.135	2.120	0.037
Development for global progress (*Open*)	(1)	0.001**	0.000	2.676	0.009
	(2)	0.001***	0.000	5.853	0.000
Development for the benefit of all (*Share*)	(1)	0.077*	0.041	1.888	0.063
	(2)	−0.002	0.023	−0.080	0.936

Remarks: (1) Adjustment variable is not added. (2) Add regulating variable; F (5, 74) = 24.543, p = 0.000; R^2 = 0.624, adjustment R^2 = 0.558; *p< 0.1, **p< 0.05, and ***p< 0.01.

efficiency. However, considering the role of the adjustment variables of ecological constraint, the impact of shared development on ecotourism efficiency was found to have weakened.

Shared factors, including the construction of regional infrastructure and public service capacity, have improved the efficiency of ecotourism in Yellow River Basin. Whereas, the number of infrastructure is lower in the areas with stringent ecological requirements than the areas with loose ecological requirements, and this weakens the impact of shared factors on ecotourism efficiency in Yellow River Basin.

Conclusions

(1) The spatiotemporal evolution characteristics of ecotourism efficiency is significant.

This study used the Super-SBM model of unexpected output to calculate the ecotourism efficiency of the Yellow River Basin in the past decade from 2010 to 2019. From the perspective of time evolution, the ecotourism efficiency value of the Yellow River Basin was generally low—only 0.721 in 2019—but showed a continuous upward trend and an annual growth rate of more than 40%. From the perspective of spatial evolution, significant differences exist in ecotourism efficiency among the upper, middle, and lower reaches of the Yellow River. The ecotourism efficiency value in the upper reaches of the Yellow River was the lowest and its growth rate kept fluctuating. In the middle reaches, the ecotourism efficiency value increased from low to high and its growth rate was the fastest. The ecotourism efficiency in the lower reaches of the Yellow River was the highest, and the development trend was stable. Moreover, significant differences in ecotourism efficiency also exist among different provinces. Sichuan and Henan have always been the areas with high ecotourism efficiency, whereas Qinghai, Ningxia, Gansu, and Inner Mongolia have always been the areas with low ecotourism efficiency. Shanxi and Shaanxi have risen from being low–ecotourism efficiency areas to high–ecotourism efficiency areas, whereas the ecotourism efficiency of Shandong fluctuated.

(2) High-quality regional development factors have a positive impact on ecotourism efficiency in Yellow River Basin.

Based on the five major quality regional development factors, namely, innovation, coordination, green, openness, and sharing, this study constructed a quality-development index system and measured the quality-development index of the Yellow River Basin of the past 10 years from 2010 to 2019. Then, linear regression and panel regression models were employed to analyze the effects of these factors on ecotourism efficiency.

The results showed that the quality-development factors had a significant positive effect on the ecotourism efficiency in the Yellow River Basin, indicating that quality development in the Yellow River Basin is conducive to the improvement of ecotourism efficiency. The innovation factors, green factors, open factors, and shared factors present a positive impact on ecotourism efficiency in the Yellow River Basin. Furthermore, the coordinated factors and ecotourism efficiency did not show a correlation, indicating that no influencing relationship exists between coordinated factors and ecotourism efficiency in the Yellow River Basin.

(3) The moderating effect of ecological constraint is significant.

To further examine the role of ecological constraint on the relationship between the quality development and ecotourism efficiency, this study used ecological constraint as moderating variables for analysis. The results of the study found the following: (1) ecological constraint weakened the positive impact of innovative factors and shared factors on ecotourism efficiency enhancement in the Yellow River Basin and in the context of considering different ecological constraint, the regional innovation capacity, and the public. (2) The ecological constraint strengthened the positive influence of green factors and open factor on the ecotourism efficiency of the Yellow River Basin, considering the influence of different ecological functional zones, the promotional effect of the Yellow River Basin's pursuit of low-carbon and low-energy development methods, and the increase in the amount of foreign capital utilized per capita on the ecotourism efficiency enhancement. (3) Because of the ecological constraint, coordinated factors had a negative influence on ecotourism efficiency in the Yellow River Basin, indicating that insufficient coordinated factors in the Yellow River Basin inhibits ecotourism efficiency improvement. Thus, a negative influence relationship was found between the two.

Discussion

Theoretical implications

First, this study expands the study of the influencing factors of ecotourism. Existing studies point out that ecotourism is affected by economic development level, ecological environment, and natural factors. For example, the findings of Thomas et al. (2021) suggest that universalism value is positively related to ecotourism predisposition; some scholars have explored the relationship between agro-ecotourism and agricultural regional development (Cao, 2018). This study innovatively reveals the influencing factors and mechanisms of ecotourism from the perspective of regional development quality and opens the black box between high-quality development and ecotourism.

Second, this study enriches the research objects of tourism eco-efficiency. Previous research objects on tourism eco-efficiency include the tourism eco-efficiency of China's coastal cities (Liu et al., 2017), the tourism eco-efficiency of Yangtze River Delta (Ma et al., 2021), and rural tourism eco-efficiency (Liang and Shi, 2020). Few scholars have discussed the tourism eco-efficiency of Yellow River Basin. Our study analyzes the temporal and spatial evolution characteristics of ecotourism efficiency in the Yellow River Basin of China and explores the ecotourism efficiency and its driving factors in the nine provinces in the Yellow River Basin from 2010 to 2019.

Third, this study broadens the research perspective of tourism eco-efficiency. Previous scholars have examined the eco-efficiency of tourism transportation (Reilly et al., 2010), forest ecotourism value (You et al., 2022), ecotourism suitability (Hz et al., 2020), eco-efficiency of tourism products (Kelly et al., 2007), eco-efficiency of tourism destinations (Minoli et al., 2015), and leisure efficiency (Lin, 2017). However, comprehensive research on tourism eco-efficiency is lacking (Liu et al., 2017), and even less research is available on comprehensively measured ecotourism efficiency from the perspective of high-quality development. Based on the tourism efficiency model and high-quality development index, we explore the impact of high-quality development on ecotourism development in the Yellow River Basin from five dimensions: innovation, coordination, green, openness, and sharing, which not only broadens the research perspective of tourism eco-efficiency but also serves as a useful supplement to the research on high-quality development.

Managerial implications

(1) Lead the innovation and open development of ecotourism in the Yellow River Basin with planning

According to the scientific, long-term, strategic, and systematic characteristics and requirements, the "Yellow River Basin ecotourism Special Plan" should be studied and compiled. First, the plan should scientifically analyze the foundation and conditions, advantages and disadvantages, and prospects and risks of ecotourism construction in the upper, middle, and lower reaches of Yellow River Basin. Second, it should scientifically understand the principles, goals, paths, and modes of ecotourism construction in the Yellow River Basin. Third, it should scientifically define the key areas and key regions of ecotourism construction. Fourth, it should scientifically grasp the key links and measures of ecotourism construction and define the status and role of planning

(2) Implement an ecological service–oriented compensation mechanism to promote regional coordinated development and shared development

The ecological value of tourism resources in the upper reaches of Yellow River Basin should be objectively understood, scientifically evaluated, reasonably utilized, and effectively protected. An ecological compensation system for tourism development in the middle and lower reaches of Yellow River Basin should be established and improved to build a bridge for the coordinated development of the region. Using its beautiful, natural, and ecological environment; idyllic scenery; and agricultural cultural heritage, it actively develops green industries, ecotourism, and rural tourism. Moreover, market-oriented ecological compensation brings new income and development opportunities to farmers. Tourism business activities are beneficiaries of ecological service functions and values, but they may also be detrimental to ecological service functions and ecological values. The establishment of ecological compensation mechanisms for tourism development should be explored, and ecological compensation fees (taxes) on tourism development units and individuals should be levied between the upper, middle, and lower reaches of Yellow River Basin.

(3) Create low-carbon and low-energy ecotourism product systems to improve the sustainability of ecotourism in the region of quality development

Our results show that the four high-quality regional development factors, namely, innovation, green, open, and shared, have positive impacts on ecotourism efficiency in the Yellow River Basin, which provide practical enlightenment for improving the sustainability of ecotourism in the region of quality development. Specifically, the goal of the ecotourism product system layout is to control the development intensity and to adjust the spatial structure according to the principle of balanced ecotourism resources and environment as well as unified economic, social, and ecological benefits to promote the space-intensive and efficient ecotourism product and ecological space, mountains, and water. The Shaanxi province that is located in the middle reaches of Yellow River Basin, for example, is focusing on creating a system of nine corridors with three life "blue paths," three health "green paths," and three cultural "purple paths," optimizing the ecotourism product system in the watershed. The product system of ecotourism in water should be optimized, focusing on the Han River ecological experience product; the product system of ecotourism in mountains should also be optimized, focusing on the Qinling National Park product; and, last, the product system of ecotourism in red should be optimized as well, focusing on the geological tourism product in northern Shaanxi.

(4) Take the lead in building industrial access system and optimizing ecological constraint management

The results of this paper show that ecological constraints moderate the relationship between the four quality regional development factors—innovative, green, open, and shared factors —and ecotourism efficiency, respectively, which has important practical significance for optimizing ecological constraint management and promoting regional high-quality development. This should be done according to the requirements of the main functional area planning and nature reserve system of each province in the Yellow River Basin, combined with the key tasks of zoning protection of national land space planning, based on the guiding catalog of industrial structure adjustment, the national negative market access list, the ecological environmental protection access list, the green industry guiding catalog, the negative list of national key ecological function area and county industrial access, and the development of key protected areas and general protected areas' industrial access list. The development of green recycling, energy conservation, environmental protection, organic agriculture, ecotourism, health, and pension industries should be encouraged, especially in the upper reaches of Yellow River Basin. The elimination of backward production capacity in key industries with high energy consumption and high emissions should be increased in the middle reaches of Yellow River Basin. The entry of industries with high pollution and high environmental risks should be prohibited, and the establishment of an ecological economic system with ecological industrialization and industrial ecology as the mainstay should be promoted in the lower reaches of Yellow River Basin. Following the requirements of the industrial access list, construction projects should require strict approval, ecological environmental protection responsibilities should be implemented, and the aftermath should be supervised. Finally, the implementation of the industrial list system should be dynamically monitored, the impact of various industrial development behaviors on changes in the Yellow River ecosystem should be scientifically analyzed, and the industrial access list system should be improved in a timely manner.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by The Ethics Committee of Xi'an University of Finance and Economics.

Author contributions

JH: Conceptualization, Formal Analysis, Funding acquisition, Writing – original draft. YG: Formal Analysis, Investigation, Writing – original draft, Writing – review & editing. MW: Investigation, Methodology, Writing – original draft. ZL: Investigation, Software, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

Barkin, D., and Bouchez, C. P. (2002). NGO-community collaboration for ecotourism: A strategy for sustainable regional development. *Curr. Issues Tourism* 5 (3-4), 245–253. doi: 10.1080/13683500208667921

Briassoulis, H. (2000). Tourism and the environment. *Springer Netherlands Dordrecht*, 6, 21–37. doi: 10.1007/978-94-015-9584-1

Cao, X. H. (2018). Study on the coordinated development of agricultural eco-tourism and agricultural economy in ethnic regions based on coupling model* — taking Ganzi Tibetan autonomous prefecture in Sichuan province as an example. *Chinese Journal of Agric. Resour. and Reg. Plan.* 39 (8), 205–210. doi: 10.7621/cjarrp.1005-9121.20180828

Chen, H., Dong, K., Wang, F., and Emmanuel, C. A. (2020). The spatial effect of tourism economic development on regional ecological efficiency. *Environ. Sci. pollut. Res.* 27, 38241–38258. doi: 10.1007/s11356-020-09004-8

Fan, Y., Bai, B., Qiao, Q., Kang, P., Zhang, Y., and Guo, J. (2017). Study on eco-efficiency of industrial parks in China based on data envelopment analysis. *J. Environ. Manage.* 192, 107–115. doi: 10.1016/j.jenvman.2017.01.048

Feizizadeh, B., Omrazadeh, D., Ghasemi, M., Bageri, S., Lakes, T., Kitzmann, R., et al. (2023). Urban restaurants and online food delivery during the COVID-19 pandemic: a spatial and socio-demographic analysis. *Int. J. Digit. Earth* 16(1), 1725–1751. doi: 10.1080/17538947.2023.2210313

Fuxia, Z., and Bizhe, W. (2022). Research on allocation efficiency of ecological tourism resources in Hunan Province. *Environment Dev. Sustainability* 1 (24), 12813–12832. doi: 10.1007/s10668-021-01965-1

Gibbs, D., Deutz, P., and Proctor, A. (2005). Industrial ecology and eco-industrial development: A potential paradigm for local and regional development? *Regional Stud.* 39 (2), 171–183. doi: 10.1080/003434005200059959

Goessling, S., Peeters, P., Ceron, J. P., Dubois, G., Patterson, T., and Richardson, R. B. (2005). The eco-efficiency of tourism. *Ecol. Economics* 54 (4), 417–434. doi: 10.1016/j.ecolecon.2004.10.006

Hz, A., Ma, A., Idwb, C., Mk, D., Aa, A., and Hs, A. (2020). A gis-based fuzzy-analytic hierarchy process (f-ahp) for ecotourism suitability decision making: a case study of babol in Iran. *Tourism Manage. Perspect.* 36. doi: 10.1016/j.tmp.2020.100726

Kelly, J., Haider, W., Williams, P. W., and Englund, K. (2007). Stated preferences of tourists for eco-efficient destination planning options. *Tourism Manage.* 28 (2), 377–390. doi: 10.1016/j.tourman.2006.04.015

Khaledi Koure, F., Hajjarian, M., Hossein Zadeh, O., Alijanpour, A., and Mosadeghi, R. (2023). Ecotourism development strategies and the importance of local community engagement. *Environment Dev. Sustainability* 25 (7), 6849–6877. doi: 10.1007/s10668-022-02338-y

Khor, H. E., Poonpatpibul, C., and Yong Foo, S. U. A. N. (2021). Belt and road initiative: A framework to address challenges and unlock potential for high-quality and inclusive growth. *Singapore Economic Rev.* 66 (01), 21–58. doi: 10.1142/S0217590819410029

Lee, J. H. (2019). Conflict mapping toward ecotourism facility foundation using spatial q methodology. *Tourism Manage.* 72 (6), 69–77. doi: 10.1016/j.tourman.2018.11.012

Li, P., Yang, G. H., Zheng, B., and Zhang, Y. Q. (2008). GHG emission-based eco-efficiency study on tourism itinerary products in Shangri-La, Yunnan Province, China. *Acta Ecologica Sin.* 27 (7), 2954–2963. doi: 10.108013683500802475943

Liang, Y., and Shi, C. (2020). Efficiency evaluation and optimization of rural ecotourism space based on dea model. *Int. J. Low-Carbon Technologies.* 15 (3), 356–360. doi: 10.1093/ijlct/ctz084

Lin, T. Y. (2017). Evaluating the leisure benefits of ecotourism with data envelopment analysis. *Appl. Ecol. Environ. Res.* 15 (2), 33–41. doi: 10.15666/aeer/1502_033041

Liu, Y. J., and Han, Y. J. (2020). Factor structure, institutional environment and high-quality development of the tourism economy in China. *J. Tourism* 35 (3), 28–38. doi: 10.19765/j.cnki.1002-5006.2020.03.008

Liu, J., Zhang, J., and Fu, Z. (2017). Tourism eco-efficiency of chinese coastal cities – analysis based on the dea-tobit model. *Ocean Coast. Manage.* 148 (11), 164–170. doi: 10.1016/j.ocecoaman.2017.08.003

Lundholm, J. T. (2015). The ecology and evolution of constructed ecosystems as green infrastructure. *Front. Ecol. Evol.* 3 (106). doi: 10.3389/fevo.2015.00106

Ma, S., Qiu, H., Zhu, Y., Yang, D., Tang, B., Wang, D., et al. (2023). Topographic changes, surface deformation and movement process before, during and after a rotational landslide. *Remote Sens.* 15 (3), 662. doi: 10.3390/rs15030662

Ma, X., Sun, B., and Hou, G. L. (2021). Evaluation and spatial effects of tourism ecological security in the Yangtze River Delta. *Ecol. Indic.* 131, 108190. doi: 10.1016/j.ecolind.2021.108190

Minoli, D. M., Goode, M., and Smith, M. T. (2015). Are eco labels profitably employed in sustainable tourism? a case study on audubon certified golf resorts. *Tourism Manage. Perspect.* 16, 207–216. doi: 10.1016/j.tmp.2015.07.011

Pei, Y., Qiu, H., Yang, D., Liu, Z., Ma, S., Li, J., et al. (2023). Increasing landslide activity in the Taxkorgan River Basin (eastern Pamirs Plateau, China) driven by climate change. *Catena* 223, 106911. doi: 10.1016/j.catena.2023.106911

Peng, H., Zhang, J., Lu, L., Tang, G., Yan, B., and Xiao, X. (2017). Eco-efficiency and its determinants at a tourism destination: a case study of huangshan national park, China. *Tourism Manage.* 60 (6), 201–211. doi: 10.1016/j.tourman.2016.12.005

Potts, T. (2010). The natural advantage of regions: linking sustainability, innovation, and regional development in Australia. *J. cleaner production* 18 (8), 713–725. doi: 10.1016/j.jclepro.2010.01.008

Qiu, X., Fang, Y., and Yang, X. (2017). Tourism eco-efficiency measurement, characteristics, and its influence factors in China. *Sustainability* 9 (9), 1634. doi: 10.3390/su9091634

Qiu, H., Zhu, Y., Zhou, W., Sun, H., He, J., and Liu, Z. (2022). Influence of DEM resolution on landslide simulation performance based on the Scoops3D model. *Geomatics Natural Hazards Risk* 13 (1), 1663–1681. doi: 10.1080/19475705.2022.2097451

Reilly, J., Williams, P., and Haider, W. (2010). Moving towards more eco-efficient tourist transportation to a resort destination: the case of whistler, british columbia. *Res. Transportation Economics* 26 (1), 66–73. doi: 10.1016/j.retrec.2009.10.009

Ren, B. P., and Du, Y. X. (2021). Coupling coordination of economic growth, industrial development and ecology in the Yellow River Basin. *China Population. Resource Environ.* 31 (02), 119–129. doi: 10.3390/ijerph182010664

Schaltegger, S., and Sturm, A. (1990). Ökologische rationalität: ansatzpunkte zur ausgestaltung von ökologieorientierten managementinstrumenten. *Die Unternehm* 44 (4), 273–290.

Shasha, Z. T., Geng, Y., Sun, H. P., Musakwa, W., and Sun, L. (2020). Past, current, and future perspectives on eco-tourism: a bibliometric review between 2001 and 2018. *Environ. Sci. pollut. Res. Int.* 27 (19), 23514–23528. doi: 10.1007/s11356-020-08584-9

Song, C. Y., Li, X. J., and Zhang, Q. (2021). High-quality development of red tourism. *J. Tourism* 36 (6), 3–5. doi: 10.19765/j.cnki.1002-5006.2021.06.002

Stem, C. J., Lassoie, J. P., Lee, D. R., Deshler, D. D., and Schelhas, J. W. (2003). Community participation in ecotourism benefits: the link to conservation practices and perspectives. *Soc. Natural Resour.* 5), 16. doi: 10.1080/08941920309177

Tamario, C., Sunde, J., Petersson, E., and Forsman, A. (2019). Ecological and evolutionary consequences of environmental change and management actions for migrating fish. *Front. Ecol. Evol.* doi: 10.3389/fevo.2019.00271

Thomas, S. K., Mark, T. S., Azilah, K., Dewa, G. S., and Lexi, P. B. (2021). Millennials' predisposition toward ecotourism: the influence of universalism value, horizontal collectivism and user generated content. *J. Ecotourism* 20 (2), 145–164. doi: 10.1080/14724049,2020.1795183

Vincent, V. C., and Thompson, W. (2020). Assessing community support and sustainability for ecotourism development. *J. Travel Res.* 41 (2), 153–160. doi: 10.1177/004728702237415

Wang, L., Qiu, H., Zhou, W., Zhu, Y., Liu, Z., Ma, S., et al. (2022). The post-failure spatiotemporal deformation of certain translational landslides may follow the pre-failure pattern. *Remote Sens.* 14 (10), 2333. doi: 10.3390/rs14102333

Wang, S., Sun, X., Cong, X., and Gao, Y. (2023). Input efficiency measurement and improvement strategies of new infrastructure under high-quality development. *Systems* 11 (5), 243. doi: 10.3390/systems11050243

Williams, P. W., and Ponsford, I. F. (2009). Confronting tourism's environmental paradox: Transitioning for sustainable tourism. *Futures* 41 (6), 396–404. doi: 10.1016/j.futures.2008.11.019

Wong, H. L., Luo, R., Zhang, L., and Rozelle, S. (2013). Providing quality infrastructure in rural villages: The case of rural roads in China. *J. Dev. Economics* 103, 262–274. doi: 10.1016/j.jdeveco.2013.03.002

Yang, X. Z., Zhang, Z. F., Luo, W., Tang, Z., Gao, X., Wan, Z. C., et al. (2019). The impact of government role on high-quality innovation development in mainland China. *Sustainability* 11 (20). doi: 10.3390/su11205780

You, S., Zheng, Q., Chen, B., Xu, Z., Lin, Y., Gan, M., et al. (2022). Identifying the spatiotemporal dynamics of forest ecotourism values with remotely sensed images and social media data: a perspective of public preferences. *J. Cleaner Production* 341 (3), 130715. doi: 10.1016/j.jclepro.2022.130715

Yu, F. W., Huang, X., and Yue, H. (2020). The high-quality development of rural tourism: Connotative features, key issues and countermeasures. *China's Rural Economy* 428 (08), 27–39.

Yu, H., Lu, L., and Li, Y. J. (2015). Tourism efficiency evaluation, classification and ascension path of lake-type chinese national scenic area. *Scientia Geographica* 35 (10), 1247–1255. doi: 10.1631/jzus.B1000185

Yuan, H., Ping, H., and Hong, X. (2018). Simulation of a dynamical ecotourism system with low carbon activity: A case from western China. *J. Environ. Manage.* 206, 1243–1252. doi: 10.1016/j.jenvman.2017.09.008

Zeng, B. (2020). Spacial structure and spillover effect of China's provincial tourism economic efficiency under environmental constraints. *Techno-economic* 39 (06), 141–146, 174. doi: 1002980X(2020)6/014107

Zhang, H., Duan, Y., and Wang, H. (2022). An empirical analysis of tourism eco-efficiency in ecological protection priority areas based on the DPSIR-SBM model: A case study of the Yellow River Basin, China. *Ecol. Inf.* 70, 101720. doi: 10.1016/j.ecoinf.2022.101720

Zhang, L., Gao, X., Cai, W. M., Chen, X. Q., Wang, L. J., and Huang, Q. (2017). Eco-efficiency evaluation of tourism lands in Qilihai Wetlands, Tianjin. *Wetland Sci.* 15 (04), 489–496.

Zhang, Y. H., Zhang, P. Y., and Zhang, Z. X. (2010). Disquisition of touristic ecological footprint and sustainable development of LHASA. *China Population. Resource Environ.* 20 (7), 154–159. doi: 10.1007/978-90-481-3779-4_12

Zhao, L., and Wu, Y. (2018). Tourism and rural poverty alleviation in China: facts and interpretations. *Nankai Manage. Rev.* 21 (06), 142–155.

Zhu, S. S., Zhang, J. H., Hu, H., and Chen, C. H. (2019). Study on the value-added effect of ecosystem serive values in tourism development. *Resour. Environ. Yangtze River Basin* 28 (03), 603–613. doi: 10.11870/cjlyzyyhj201903011

Zhu, Y., Zhang, B., Ni, H. W., and Lv, J. H. (2018). Study on output efficiency of forest ecological products based on supply theory of public goods. *Economic Problems Forestry* 38 (02), 25–32. doi: 10.16832/j.cnki.1005-9709.2018.02.005

Zou, C. X., and Shen, W. S. (2003). Advances in ecological security. *J. Ecol. Rural Environ.* 19 (1), 56–59. doi: 10.3969/j.issn.1673-4831.2003.01.014