

*Original Research*

# Can Environmental Improvement Promote the Development of Forest Tourism? An Empirical Study Based on Chinese National Forest Parks

Feng Yu

School of Commerce, Linyi University, Linyi 276000, China

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## Abstract

This study utilizes data spanning from 2016 to 2022 concerning Chinese national forest parks and the macro-level data of their respective cities. Employing panel data methodology and selecting forest park tourism revenue and total visitor numbers as indicators, the research aims to gauge the development of forest tourism. The investigation employs a panel model with individual and time-fixed effects to examine the impacts of four key environmental improvement indicators on forest tourism development. The findings reveal that soil quality indicators exhibit no significant influence on forest tourism revenue and attendance. Conversely, air quality and water quality indicators demonstrate a significant positive impact on both tourism revenue and attendance in forest parks. The biodiversity indicator notably influences tourist numbers positively but has no significant effect on tourism revenue. Furthermore, the study uncovers pronounced heterogeneity in the impacts of different environmental improvement indicators on forest tourism across various grades and regions of forest parks. Noteworthy variations are also identified in the impacts of these indicators on tourism revenue and attendance within national forest parks. This research contributes valuable insights into the nuanced relationships between environmental improvements and forest tourism, emphasizing the need for tailored strategies based on the heterogeneity observed among different forest park grades and regions. Furthermore, the study uncovers pronounced heterogeneity in the impacts of different environmental improvement indicators on forest tourism across various grades and regions of forest parks. Noteworthy variations are also identified in the impacts of these indicators on tourism revenue and attendance within national forest parks. This research contributes valuable insights into the nuanced relationships between environmental improvements and forest tourism, emphasizing the need for tailored strategies based on the heterogeneity observed among different forest park grades and regions.

**Keywords:** environmental improvement, forest tourism, panel model

## Introduction

With the rapid development of the global tourism industry and the improvement of people's living standards, the environmental quality of tourist destinations has become a focal point of concern [1]. Particularly in China, a country rich in natural resources and profound cultural heritage, forest tourism has emerged as a distinctive form of travel [2]. In recent years, China's National Forest Parks, as representative carriers of forest tourism, have played a crucial role in promoting sustainable development through active initiatives to enhance the environmental conditions within the scenic areas. This paper aims to conduct an in-depth investigation into the experiences of China's National Forest Parks, exploring the relationship between scenic environmental improvement and the development of forest tourism. Forest tourism, as a sustainable form of travel, not only meets the demands of individuals for natural environments but also contributes positively to local economic and social development [3]. Therefore, gaining a thorough understanding and analysis of the catalytic role of scenic environmental improvement in driving forest tourism holds significant implications for guiding the future development direction of forest tourism and enhancing the sustainability of tourist destinations. Against the backdrop of global environmental conservation and the pursuit of sustainability in the tourism industry, the research outcomes of this paper are anticipated to furnish valuable theoretical and practical support for advancing the sustainable development of forest tourism and promoting the harmonious coexistence of tourism and the natural environment.

## Literature Review

In the examination of the impact of environmental improvement on tourism development, the academic community presents three primary viewpoints that have significantly informed this dissertation. The summation of these three perspectives is elucidated below.

Firstly, some studies posit that environmental improvement can foster the growth of the tourism industry [4-7]. This perspective underscores that by enhancing the aesthetic quality of the scenic environment and improving service facilities, it becomes possible to attract a greater number of tourists, elevate visitor satisfaction, and thus establish a robust foundation for the sustainable development of the tourism sector. Scholars have observed that a favorable enhancement in the environment not only provides a more enjoyable experience for tourists but also stimulates interest in the chosen tourism destination [8]. By augmenting the aesthetic value of the area and improving the quality of natural landscapes, visitors are more inclined to select the destination as their preferred travel choice [9]. Furthermore, researchers emphasize that positive

word-of-mouth generated by improved services and enhanced visitor experiences can attract additional potential tourists, creating a virtuous cycle [10]. Therefore, through continuous environmental improvement, the tourism industry can achieve sustainable growth, fostering prosperity in regional tourism. This theoretical perspective provides a robust foundation for this study and offers valuable guidance for future strategic development in tourist destinations.

Secondly, some researchers propose an alternative viewpoint, suggesting that environmental improvement may have negative consequences for tourism development, necessitating restrictive measures to preserve sustainable environmental enhancement [11-13]. The essence of this perspective lies in accentuating the crucial balance and sustainability required between environmental conservation and tourism industry growth. In practice, certain regions have implemented a series of restrictive measures to safeguard the long-term health of natural environments [14, 15]. These measures include controlling the number of visitors to prevent ecological damage caused by excessive footfall, reducing development activities to maintain environmental health, preventing the depletion of natural resources, and disrupting ecological balance [16]. This viewpoint calls for heightened societal awareness regarding environmental conservation, emphasizing that the development of the tourism industry should occur within the parameters of not compromising the integrity of the natural environment [17]. By limiting visitor numbers and curtailing development activities, effective protection of the scenic environment can be achieved, ensuring its sustainability and ecological balance [18]. The pursuit of this equilibrium aims to realize the sustainable development of the tourism industry, allowing it to harmoniously coexist with the environment over the long term [19]. This perspective contributes essential background information for this study, shedding light on the potential negative impacts of environmental improvements on tourism development and prompting a nuanced examination of the relationship between tourism development and environmental conservation. The key challenge in practical policy formulation and management lies in striking a balance between the demands of the tourism industry and the health of the environment.

Thirdly, another group of scholars underscores the uncertainty surrounding the impact of environmental improvements on the economic development of tourism [20-23]. While environmental improvement may stimulate growth in tourism in certain aspects, its overall impact on the economy may be intricate and variable [24]. This viewpoint challenges the simplified understanding of the relationship between environmental improvement and the tourism industry, emphasizing the necessity for more in-depth research to comprehensively understand the comprehensive effects of environmental improvement on tourism. Researchers supporting this viewpoint contend that

the implementation of environmental improvement may have a range of impacts on the tourism industry, both positive and negative [25]. On one hand, by enhancing the scenic environment, the tourism industry may attract more tourists, increase visitor satisfaction, and consequently propel economic growth [26]. However, on the other hand, there may be associated costs and restrictions stemming from environmental improvement, such as environmental protection investments and restrictive policies, which could impose certain burdens on the tourism industry [27]. This perspective highlights the complex relationship between environmental improvement and the tourism industry, indicating that its impact may be influenced by multiple factors, including policies, geography, and economic conditions [28]. Therefore, a profound investigation into the overall performance of the tourism industry under the backdrop of environmental improvement and the economic effects of this relationship becomes crucial. The proposition of this viewpoint serves as an inspiration for this study, guiding a comprehensive analysis of the intricate relationship between environmental improvement and the tourism industry. By considering a myriad of influencing factors, a more comprehensive understanding of the actual impact of environmental improvement on tourism economic development can be attained, offering targeted recommendations for future environmental improvement strategies and tourism industry development.

In conclusion, the aforementioned literature provides a vital theoretical foundation for this study. However, this research diverges significantly from existing studies in two crucial aspects. Firstly, by selecting China's national forest parks as the research focus, this study aims for a more typical and universally applicable perspective. Unlike previous research that primarily examined the macroscopic aspects of environmental improvement and its impact on regional tourism development at the national, regional, or city levels, this study concentrates on the microscopic viewpoint of forest parks. By delving into the impact of internal environmental improvement indicators on forest tourism and simultaneously controlling for macroscopic factors, such as city-level environmental improvement, this research differs substantially in its analytical approach. Secondly, the utilization of a unique dataset encompassing micro-level statistical data from forest parks further sets this study apart. This dataset includes diverse information from different levels of forest parks, ranging from national and provincial to county and city levels. This comprehensive data support enhances the credibility of the research and provides substantial grounds for formulating practical policies and strategies. These two distinctive characteristics will propel this study into greater depth, offering a more thorough theoretical and empirical exploration of the impact of environmental improvement on tourism development. By emphasizing a microscopic research perspective and unique data support, this study is poised to provide

distinct insights for the academic community and practical management, fostering further research and development in related fields.

## Experimental Procedures

### Explanation of Data Sources

The data utilized in this study are sourced from the Forest Park Management Office of the State Forestry and Grassland Administration of China and the "China Urban Statistical Yearbook" (from 2017 to 2023). The sample period spans from 2016 to 2022. The connection between the forest park-level data and the city-level data is established based on the city where each forest park is located. The sample includes 3,392 forest parks, comprising 828 national forest parks, 1,457 provincial forest parks, and 1,107 municipal and county-level forest parks. Due to administrative changes over different years, some provincial forest parks may have been upgraded to national status, and municipal or county-level forest parks may have been upgraded to provincial status. Additionally, newly added municipal or county-level forest parks contribute to the construction of unbalanced panel data in this study. Moreover, due to factors such as temporary closures, renovations, expansions, maintenance closures, unopened status, and environmental improvement projects, some forest parks have severe data gaps in certain years, rendering them ineligible for inclusion in the econometric model estimation. Forest parks are categorized into three levels based on their status: national forest parks, provincial forest parks, and municipal or county-level forest parks [29]. Specifically, national forest parks represent the highest tier, characterized by exceptionally beautiful forest landscapes, concentrated cultural and natural attractions, high value in terms of aesthetics, science, and culture, unique geographic locations, regional representativeness, comprehensive tourism facilities, significant recognition, and the ability to provide venues for sightseeing, leisure, as well as scientific, cultural, and educational activities [30]. The establishment of national forest parks requires administrative approval from the State Forestry Administration.

### Model Design

This study employs empirical data spanning from 2016 to 2022 at the forest park level and the corresponding city level in China to investigate the impact of environmental improvement on the tourism development of forest parks. The study aims to further explore the direction and corresponding mechanisms through which environmental improvement influences the growth of forest park tourism. To examine the impact of environmental improvement on forest tourism development, the study constructs the following baseline regression model:

$$Y_{it}^k = \alpha_0 + \sum_j \alpha_j \text{environmental improvement}_{jit} + \sum_m \beta_m \text{Control}_{mit} + \mu_i + \varphi_t + \varepsilon_{it}$$

Where  $Y$  represents the tourism development status of forest park  $i$  in year  $t$ ,  $k = 1$  indicates the use of annual tourism income (adjusted for inflation to 2016 constant prices), and  $k = 2$  indicates the use of tourist numbers as metrics. Environmental improvement represents the environmental improvement indicator of forest park  $i$  in year  $t$ , with the coefficient  $\alpha$  measuring the impact of environmental improvement on forest tourism, a core parameter of interest. Here,  $j$  represents different types of environmental improvement, where  $j = 1, 2, 3, 4$ , respectively, represent soil quality, air quality, water quality, and biodiversity indicators for forest parks. Control represents control variables categorized into two types: forest park-level control variables, including annual park investment (adjusted for inflation to 2015 constant prices), staff count, tour guide count, park grade, establishment time, park area, and city-level control variables, including the number of employees in the city's accommodation and catering industry, population density, per capita GRP, the proportion of secondary and tertiary industries, the ratio of local fiscal general budget revenue and expenditure, year-end savings balance of urban and rural residents, the year-end number of mobile phone users in the city, average staff salary, year-end total number of taxis, the number of public buses per ten thousand people, green area, park green area, industrial sulfur dioxide emissions, and industrial dust emissions. The coefficient  $\beta$  represents the impact of each control variable on forest tourism development. To mitigate potential biases resulting from omitted variables, this study includes an extensive set of control variables.  $i$  and  $t$ , respectively, denote individual forest parks and the time-dimension fixed effects, while  $\varepsilon$  represents the random disturbance term. Detailed data descriptions and variable statistics for the dependent variable, the core explanatory variable, and a series of control variables are provided in the table below.

The selection of environmental improvement indicators in this study is grounded in the strategic consideration of factors that are deemed pivotal in influencing the overall quality of the forest tourism environment. The chosen indicators – soil quality, air quality, water quality, and biodiversity – reflect key dimensions of the ecological and environmental context within which forest parks operate. Here is a brief justification for the selection of each indicator. Soil quality is an essential component of the overall environmental health of forest ecosystems. It directly influences vegetation, which, in turn, contributes to the aesthetic appeal and ecological vitality of forest parks. Although soil quality might not directly impact tourism revenue or attendance, its inclusion allows for a comprehensive examination of various environmental facets. Air quality is a critical factor

in enhancing the overall visitor experience and promoting the well-being of both tourists and the surrounding ecosystem. Poor air quality can deter visitors, while good air quality contributes to a pleasant and healthy environment. Therefore, assessing its impact on tourism aligns with the broader goal of sustainable and visitor-friendly forest parks. Water bodies are often significant attractions within forest parks. Assessing water quality is essential for understanding the health of aquatic ecosystems and ensuring the safety and enjoyment of visitors engaging in water-related activities. Positive impacts on tourism revenue and attendance can be expected when water quality is preserved or improved. Biodiversity is a key component of the overall ecological balance within forest ecosystems. A diverse range of flora and fauna enhances the attractiveness of forest parks to visitors interested in nature-based experiences. By studying the impact of biodiversity on tourism, we gain insights into the potential positive effects of preserving and promoting a rich and varied ecosystem. The selected indicators collectively offer a comprehensive perspective on the environmental factors influencing forest tourism. Their inclusion is grounded in the premise that a holistic understanding of the environmental context is crucial for formulating effective strategies for the sustainable development of forest tourism.

## Results and Discussion

### Baseline Regression

Tables 1 and 2 present the results of the baseline model. Table 1 reports the model results with forest park tourism income as the dependent variable, while Table 2 reports the results with forest park tourist numbers as the dependent variable. In the first column of both tables, after controlling for a range of forest park-level and city-level variables, as well as time and individual fixed effects, air quality and water quality indicators exhibit a significant positive correlation with forest tourism income and tourist numbers. The biodiversity indicator is significantly positively correlated with tourist numbers but not with tourism income, while the soil quality indicator shows no significant correlation with either tourism income or tourist numbers. Examining the coefficients and significance levels, the impact of the air quality indicator on forest tourism income and tourist numbers is significantly positive at the 1% significance level, with coefficients of 22.866 and 0.131, respectively. Similarly, the water quality indicator shows a significantly positive impact on forest tourism income and tourist numbers at the 1% significance level, with coefficients of 1.128 and 0.003.

However, considering that the establishment of Chinese forest parks requires approval from relevant administrative authorities, especially for national and provincial-level forest parks, the influence of

Table 1. Model Results with Tourism Income as the Dependent Variable.

Variable Name	(1)	(2)	(3)	(4)
	Core Explanatory Variable: Environmental Improvement		Core Explanatory Variable: Lagged Environmental Improvement	
Soil Quality Indicator	0.457(1.719)	-0.438(2.413)	1.519(1.029)	5.429**(2.66)
Air Quality Indicator	22.866***(4.244)	27.898***(5.053)	29.854***(4.143)	30.96***(5.177)
Water Quality Indicator	1.128***(0.178)	1.110***(0.209)	1.388***(0.196)	1.134***(0.238)
Biodiversity Indicator	0.090(0.060)	0.251***(0.071)	0.178***(0.066)	0.171**(0.086)
Annual Investment Amount	-0.017**(0.007)	-0.083***(0.015)	-0.042***(0.007)	-0.191***(0.02)
Number of Employees	18.408***(1.091)	15.771***(1.357)	27.003***(1.45)	36.968***(2.057)
Number of Guides	214.982***(7.379)	246.12***(8.465)	230.29***(7.67)	229.39***(9.35)
Provincial Park	1055.71(1486.44)	1907.56(1742.13)	1388.95(1582.6)	1504.7(2001.1)
Municipal Park	970.65(2518.09)	1612.17(13013)	767.77(2809.89)	0
Establishment Time		-97.897(329.62)		-256.06(624.30)
Park Area		0.035(1.210)		2.66(4.56)
Accommodation and Catering Industry Employees	59.901***(21.17)	118.701***(31.63)	48.72**(23.10)	103.93***(36.28)
Population Density	-0.513(0.921)	-0.790(1.23)	-0.208(0.913)	-0.77(1.27)
Per Capita GRP	0.021*(0.011)	0.025*(0.014)	0.021*(0.012)	0.029*(0.016)
Secondary Industry Share	38.546(54.695)	54.035(68.398)	19.58(67.15)	41.96(90.63)
Tertiary Industry Share	17.748(55.325)	37.745(68.95)	15.92(67.03)	44.73(89.12)
Local Fiscal Budget Balance Ratio	98.425(164.69)	126.19(213.15)	68.537(204.54)	138.41(291.63)
Urban-Rural Resident Savings at Year-End	-0.00004***(0.00001)	-0.0001***(0.00002)	-0.00003(0.00003)	-0.00004(0.00004)
Year-End Mobile Phone Users (Per 10,000 People)	0.864*(0.472)	1.119*(0.642)	0.688(0.487)	1.05(0.698)
Average Employee Salary	0.008(0.010)	0.010(0.013)	0.012(0.01)	0.013(0.013)
Year-End Taxi Total	0.061(0.065)	0.064(0.096)	0.039(0.069)	0.011(0.104)
Public Bus Quantity per 10,000 People	-26.843(22.807)	-22.12(25.88)	-25.38(25.15)	-25.40(30.76)
Green Area	0.184***(0.047)	0.18***(0.058)	0.196***(0.055)	0.239***(0.073)
Park Green Area	-0.473***(0.162)	-0.499**(0.216)	-0.499**(0.224)	-0.626**(0.313)
Industrial Sulfur Dioxide Emissions	-0.002(0.001)	-0.002(0.002)	-0.002(0.001)	-0.001(0.002)
Industrial Particulate Matter Emissions	0.0004(0.0007)	0.0007(0.001)	0.0004(0.001)	0.0007(0.001)
Constant Term	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Park Fixed Effects	Yes	Yes	Yes	Yes
Observations	11670	6756	8222	5369
Grouped Observations	2110	1213	1916	1148
Adjusted R <sup>2</sup>	0.3567	0.3344	0.3984	0.0753

Note: \*\*\*, \*, \* denote significance levels of 1%, 5%, and 10%, respectively.



the approval duration on forest parks cannot be ignored. Forest parks established earlier not only possess superior natural and cultural endowments compared to parks established later but also receive more policy and financial support. Therefore, the establishment of forest parks may affect various environmental improvements and their tourism development. Additionally, the size of the forest park area may also influence its tourism development; larger parks have more development potential but are constrained by financial limitations, potentially weakening the environmental improvements and services they can provide. In the second column, establishment time and park area variables are included. Due to limitations in publicly available information, data for these variables was only found for national forest parks, resulting in varying degrees of missing data for other parks. Including these variables in the estimation would lead to sample selection bias, focusing mainly on national forest parks, and a reduction in sample size, excluding nearly 50% of the samples. Furthermore, the significance and coefficients of the key independent variables did not fundamentally change; only the biodiversity indicator variable shifted from insignificant to significant, with an increased coefficient. Therefore, to balance forest park structure and sample richness, the baseline model results in Tables 1 and 2, the first column, are considered the reference for subsequent heterogeneity analysis, robustness tests, etc.

Furthermore, considering the potential lag in the impact of environmental improvements within parks on forest tourism and to alleviate possible reverse causation biases, columns 3 and 4 in Tables 1 and 2 lag the four types of environmental improvement variables by one period. The regression results indicate that the impact of soil quality in the previous period on the current forest park tourism income and tourist numbers remains insignificant. In contrast, the impact of air quality and water quality indicators in the previous period on the current forest park tourism income and tourist numbers is significantly positive at the 1% significance level, with positive coefficients. This to some extent reflects that, after entering the forest park, forest tourists do not highly depend on modern soil quality indicators but prefer improvements in air quality and water quality indicators. The impact of the previous period's biodiversity indicator variable on the current forest tourism income and tourist numbers is significantly positive at the 1% level. These results indicate a certain lag in the impact of environmental improvements within the park on tourism income and tourist numbers. However, the coefficients and significance levels of the four key environmental improvement variables have not fundamentally changed, suggesting a relatively reliable baseline estimate and minimal risk of reverse causation bias.

The fixed effects results of the baseline model indicate that, overall, the soil quality indicator has no significant impact on tourism income or the number of visitors to forest parks. In contrast, the air quality

and water quality indicators exhibit significant effects on both tourism income and visitor numbers in forest parks. Additionally, the biodiversity indicator shows a significant positive impact only on the number of visitors. Why, then, is the soil quality indicator not significantly influencing forest tourism? The impact of forest tourism is a complex process influenced by various factors, and soil quality represents just one element in this multifaceted equation. Its impact may be relatively minor, making it difficult to stand out significantly in the overall effects. Other environmental factors could play more crucial roles in shaping the tourist experience and attractiveness of the tourism site, diminishing the significance of soil quality. Visitor behavior and management measures are also critical factors influencing forest tourism. For instance, visitors may concentrate their activities within a certain range, making them less directly affected by the soil quality.

Moreover, effective management measures could mitigate the potential negative impact of soil quality on visitor activities. Forest soils may possess some adaptability to certain types of visitor activities, thereby alleviating the adverse effects of soil quality on tourism. Certain soil types might better withstand the pressures exerted by visitor activities, making the impact of soil quality less pronounced in the overall picture. In summary, for forest tourism, air quality emerges as the most pivotal factor influencing tourism income and visitor numbers, followed by water quality and biodiversity indicators. The soil quality indicator, however, does not exhibit a significant impact on tourism income and visitor numbers in forest parks.

### Heterogeneity Analysis

From the perspectives of the natural, cultural, and historical dimensions of the facilities provided by forest parks and the tourism resources and services offered, national forest parks demonstrate a significant superiority over provincial-level parks, while provincial parks are notably superior to city/county-level parks. Hence, different levels of forest parks exhibit evident heterogeneity. Theoretically, such heterogeneity may result in varying impacts of environmental improvement on tourism revenue and visitor numbers across different levels of forest parks. Moreover, due to the vast geographical diversity in China, regional disparities between different forest parks may also be pronounced. Furthermore, within the same level of forest parks, variations across different regions may be substantial. Given the significance and representativeness of national forest parks, this section focuses only on the differences among national forest parks in different regions. Based on the results of the baseline model mentioned earlier, this section explores the heterogeneity effects of environmental improvement on forest tourism across different levels of parks and regions.

The regression results in Table 3 report the impact of the quantity of environmental improvement on forest

Table 2. Model Results with Tourist Numbers as the Dependent Variable.

Variable Name	(1)	(2)	(3)	(4)
	Core Explanatory Variable: Environmental Improvement		Core Explanatory Variable: Lagged Environmental Improvement	
Soil Quality Indicator	-0.005(0.006)	-0.005(0.007)	-0.006(0.007)	0.011(0.008)
Air Quality Indicator	0.131***(0.014)	0.098***(0.016)	0.070***(0.015)	0.031**(0.016)
Water Quality Indicator	0.003***(0.0006)	0.002***(0.001)	0.005***(0.001)	0.001**(0.001)
Biodiversity Indicator	0.001***(0.0002)	0.002***(0.0002)	0.0005**(0.0002)	0.001***(0.0003)
Annual Investment Amount	0.00002(0.00002)	-0.0001***(0.00005)	-0.0001**(0.00003)	-0.0003***(0.0001)
Number of Employees	0.054***(0.004)	0.052***(0.004)	0.100***(0.005)	0.127***(0.006)
Number of Guides	0.144***(0.024)	0.153***(0.026)	0.122***(0.028)	0.072**(0.028)
Provincial Park	-32.30***(4.90)	-14.62***(5.35)	-29.32***(5.70)	-14.82**(6.05)
Municipal Park	-29.42***(8.30)	27.98(39.96)	-25.996**(10.12)	0
Establishment Time		-0.858(1.012)		-2.19(1.89)
Park Area		-0.001(0.004)		0.008(0.014)
Accommodation and Catering Industry Employees	-0.031(0.070)	0.432***(0.097)	-0.007(0.083)	0.37***(0.11)
Population Density	-0.003(0.003)	-0.006(0.004)	-0.004(0.003)	-0.005(0.004)
Per Capita GRP	0.00002(0.00004)	0.00004(0.00004)	0.00002(0.00004)	0.00003(0.00005)
Secondary Industry Share	-0.054(0.180)	-0.013(0.210)	-0.129(0.242)	-0.133(0.274)
Tertiary Industry Share	-0.100(0.182)	0.021(0.212)	-0.212(0.241)	-0.077(0.271)
Local Fiscal Budget Balance Ratio	-0.688(0.542)	-1.063(0.655)	-0.276(0.736)	-0.185(0.88)
Urban-Rural Resident Savings at Year-End	4.4e-08(4.8e-08)	1.2e-07**(5.63-08)	-9.6e-08(1.1e-07)	1.7e-07(1.3e-07)
Year-End Mobile Phone Users (Per 10,000 People)	0.0004(0.002)	0.002(0.002)	-0.00002(0.002)	0.002(0.002)
Average Employee Salary	0.00004(0.00003)	0.0001(0.00004)	0.0001*(0.00004)	0.0001*(0.00004)
Year-End Taxi Total	-0.0003(0.0002)	0.0006**(0.0003)	-0.0002(0.0002)	0.0004(0.0003)
Public Bus Quantity per 10,000 People	0.027(0.075)	0.041(0.079)	0.028(0.091)	0.059(0.093)
Green Area	0.0001(0.0002)	0.0001(0.0002)	0.0001(0.0002)	0.0002(0.0002)
Park Green Area	-0.0005(0.0005)	-0.0005(0.0007)	0.0004(0.001)	-0.001(0.001)
Industrial Sulfur Dioxide Emissions	-0.00001***(4.4e-06)	-0.00002***(5.9e-06)	-9.99e-06**(4.8e-06)	-0.00002**(6.0e-06)
Industrial Particulate Matter Emissions	2.2e-06(2.2e-06)	3.5e-06(3.2e-06)	2.2e-06(2.4e-06)	3.8e-06(3.3e-06)
Constant Term	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Park Fixed Effects	Yes	Yes	Yes	Yes
Observations	11670	6756	8222	5369
Grouped Observations	2110	1213	1916	1148
Adjusted R <sup>2</sup>	0.2496	0.2007	0.2909	0.0157

Note: \*\*\*, \*, \* denote significance levels of 1%, 5%, and 10%, respectively.

park tourism revenue and visitor numbers. It is evident that the effects of different environmental improvements on tourism revenue and visitor numbers at various levels of forest parks exhibit substantial heterogeneity. From the perspective of tourism revenue, the impact of the four environmental improvement indicators on forest park tourism revenue varies significantly across different levels of parks, indicating a significant heterogeneity in the effects of environmental improvement on forest park tourism revenue. The soil quality indicator has no impact on the tourism revenue of national forest parks, significantly negatively affects provincial forest parks, and has a significantly positive impact on city/county-level forest parks. Air quality, water quality, and biodiversity indicators all have a significant positive impact on the tourism revenue of national forest parks, while they have no impact on provincial and city/county-level forest parks. Therefore, the heterogeneity of environmental improvement on forest park tourism revenue is apparent. To enhance tourism revenue for different levels of forest parks, this heterogeneity needs to be considered. For national forest parks, substantial improvement in air quality should be the primary focus, followed by water quality and biodiversity indicators. Provincial and city/county-level forest parks, however, did not show a significant promotion in tourism revenue growth concerning air quality, water quality, and biodiversity indicators.

From the perspective of tourist numbers, the heterogeneity in the impact of environmental improvement mainly lies in the soil quality indicator and biodiversity indicator. The former has no significant impact on national forest parks but has a significantly negative impact on provincial and city/county-level forest parks. The latter has a significant positive impact on national forest parks, no impact on provincial forest parks, and a significantly negative impact on city/county-level forest parks. The impact of air quality and water quality indicators on tourist numbers shows no significant differences across different levels of forest parks.

The regression results in Table 4 below report the impact of environmental improvements in different regions on the revenue and number of forest park tourists. It is evident that the heterogeneity of the impact of different environmental improvements on forest tourism income and the number of people is also evident at the regional level. From the perspective of tourism income, the impact of environmental improvement on tourism income has obvious heterogeneity among regions. For the eastern region, the influence of the water quality index was significantly positive, the biodiversity index was significantly negative, and the soil quality index and air quality index had no significant influence. In the central region, the air quality index and water quality index had significant positive effects, the biodiversity index had significant negative effects, and the soil quality index had no effect. In western China, the effects of the air quality index and biodiversity index

were significantly positive, while the effects of the soil quality index and water quality index were significantly negative. From the perspective of tourist numbers, only the soil quality index has a significant negative effect on tourist numbers in the eastern region, and the rest have a significant positive effect. In the central region, soil quality indexes had no effect, air quality indexes and water quality indexes had significant positive effects, and biodiversity indexes had significant negative effects. For the western region, the effects of the air quality index and biodiversity index were significantly positive, while the others had no effect.

The regression results in Table 5 below report the impact of environmental improvements in different regions on tourism revenue and the number of people in national forest parks. For the same national forest park, the impact of environmental improvement in different areas on tourism income and tourism numbers shows obvious heterogeneity. From the perspective of tourism income, the impact of environmental improvement on tourism income has obvious heterogeneity among regions. For the eastern region, the effects of the air quality index and water quality index were significantly positive, the biodiversity index was significantly negative, and the soil quality index had no significant effect. For the central region, the effects of the air quality index and water quality index were significantly positive, the effects of the biodiversity index were significantly negative, and the effects of the soil quality index were not significant. In western China, the air quality index and biodiversity index had significant positive effects, the water quality index had significant negative effects, and the soil quality index had no effect. From the perspective of the number of tourists, only the soil quality index had no significant effect on the number of tourists in the eastern region, and the rest had significant positive effects. The soil quality index and biodiversity index had no effect on the central region, while the air quality index and water quality index had a significant positive effect. For the western region, the soil quality index and air quality index had significant positive effects, while the rest had no effect.

### Robustness Tests

To ensure the reliability of our research findings, we conducted a series of robustness tests using the regression results reported in the first column of Table 1 and Table 2 as the baseline. The corresponding outcomes are presented in Table 6.

Firstly, to enhance the comparability of the research sample, we excluded samples from county-level forest parks and retained samples from provincial-level and above forest parks. The rationale behind this decision is that national and provincial-level forest parks represent all parks included in the statistical scope. While a few parks may not be included in the sample due to closures for maintenance or expansion, the majority of forest parks are part of our analytical sample. In contrast,



Table 3. Regression Results for Different Levels of Forest Parks.

Variable Name	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent Variable: Tourism Revenue			Dependent Variable: Tourist Numbers		
	National Level	Provincial Level	City/County Level	National Level	Provincial Level	City/County Level
Soil Quality Indicator	1.35 (2.94)	-3.96** (1.72)	19.10** (8.07)	-0.00004 (0.009)	-0.014** (0.007)	-0.307** (0.133)
Air Quality Indicator	29.61*** (6,20)	-0.353 (6.37)	-3.44 (9.88)	0.099*** (0.019)	0.156*** (0.026)	0.328** (0.163)
Water Quality Indicator	0.996*** (0.25)	0.262 (0.381)	-0.39 (0.67)	0.002*** (0.001)	0.009*** (0.002)	0.024** (0.011)
Biodiversity Indicator	0.213*** (0.081)	0.034 (0.207)	0.074 (0.167)	0.0013*** (0.0002)	0.0006 (0.001)	-0.008*** (0.003)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Constant Term	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Park Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observation Count	4567	5692	411	4567	5692	411
Group Count	752	1296	120	752	1296	120
Adjusted R <sup>2</sup>	0.3361	0.5578	0.1198	0.2514	0.0757	0.0236

Note: Standard errors are reported in parentheses. \*\*\*p<0.01, \*\*p<0.05, \*p<0.1.

Table 4. Regression Results for Forest Parks in Different Regions.

Variable Name	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent Variable: Tourism Revenue			Dependent Variable: Tourist Numbers		
	East Region	Central Region	West Region	East Region	Central Region	West Region
Soil Quality Indicator	-1.826 (2.147)	-5.117 (4.18)	-16.537* (9.327)	-0.0089** (0.004)	0.009 (0.015)	0.0095 (0.056)
Air Quality Indicator	-0.611 (12.52)	21.68*** (3.71)	25.033** (12.69)	0.193*** (0.024)	0.078*** (0.013)	0.369*** (0.076)
Water Quality Indicator	7.15*** (0.422)	1.695*** (0.275)	-0.965*** (0.295)	0.009*** (0.0008)	0.005*** (0.001)	-0.001 (0.002)
Biodiversity Indicator	-0.437*** (0.086)	-0.76*** (0.118)	1.174*** (0.201)	0.0008*** (0.0002)	-0.001** (0.0004)	0.005*** (0.001)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Constant Term	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Park Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observation Count	4055	4118	2497	4055	4118	2497
Group Count	822	764	524	822	764	524
Adjusted R <sup>2</sup>	0.4295	0.2872	0.4704	0.3192	0.2855	0.1119

Note: Standard errors are reported in parentheses. \*\*\*p<0.01, \*\*p<0.05, \*p<0.1.

Table 5. Regression Results for National Forest Parks in Different Regions.

Variable Name	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent Variable: Tourism Revenue			Dependent Variable: Tourist Numbers		
	East Region	Central Region	West Region	East Region	Central Region	West Region
Soil Quality Indicator	-1.689 (3.369)	-7.876 (6.122)	-46.182 (28.366)	-0.009 (0.007)	-0.005 (0.020)	0.501*** (0.129)
Air Quality Indicator	203.02*** (32.5)	20.52*** (5.512)	47.084** (21.11)	0.509*** (0.064)	0.060*** (0.018)	0.180* (0.096)
Water Quality Indicator	9.15*** (0.639)	1.374*** (0.412)	-1.061** (0.443)	0.012*** (0.001)	0.004*** (0.001)	-0.0015 (0.002)
Biodiversity Indicator	-0.409*** (0.107)	-0.624*** (0.185)	1.342*** (0.318)	0.0005** (0.0002)	-0.0005 (0.0006)	0.0015 (0.0014)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Constant Term	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Park Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observation Count	1511	1918	1138	1511	1918	1138
Group Count	242	310	200	242	310	200
Adjusted R <sup>2</sup>	0.3886	0.2746	0.4557	0.1434	0.2482	0.1572

Note: Standard errors are reported in parentheses. \*\*\*p<0.01, \*\*p<0.05, \*p<0.1.

Table 6. Robustness Check Results.

Variable Name	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent Variable: Tourism Revenue			Dependent Variable: Tourist Numbers		
	Exclusion of County-Level Samples	Removal of Top and Bottom 0.5% of Environmental Improvement Samples	Lagging All Control Variables by One Period – Iteration 1	Exclusion of County-Level Samples	Removal of Top and Bottom 0.5% of Environmental Improvement Samples	Lagging All Control Variables by One Period – Iteration 1
Soil Quality Indicator	0.3052 (1.750)	-7.461 (4.760)	-4.457 (5.455)	-0.0043 (0.0057)	-0.019 (0.016)	0.002 (0.018)
Air Quality Indicator	22.794*** (4.327)	38.880*** (6.595)	31.329*** (7.476)	0.130*** (0.014)	0.237*** (0.022)	0.219*** (0.025)
Water Quality Indicator	1.117*** (0.181)	0.334 (0.269)	1.013*** (0.314)	0.0034*** (0.0006)	0.003*** (0.001)	0.0033*** (0.001)
Biodiversity Indicator	0.089 (0.061)	-0.189 (0.158)	-0.101 (0.182)	0.0013*** (0.0002)	0.003*** (0.0005)	0.0037*** (0.0006)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Constant Term	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Park Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observation Count	10259	10670	8214	10259	10670	8214
Group Count	2014	2110	1917	2014	2110	1917
Adjusted R <sup>2</sup>	0.3578	0.3365	0.2899	0.2518	0.2441	0.2495

Note: Standard errors are reported in parentheses. \*\*\*p<0.01, \*\*p<0.05, \*p<0.1.

county-level forest parks are only statistically reported in a few provinces, with most provinces lacking statistical data for these parks. Additionally, county-level forest parks are relatively undeveloped compared to provincial-level parks in terms of area, landscape quality, cultural and historical resources, forest resources, and environmental improvement. These county-level forest park samples only constitute 3.75% of the entire sample. The regression results, reported in Table 6, align closely with the baseline scenario.

Furthermore, to mitigate the impact of outliers in the environmental improvement variables on regression results, we excluded the top and bottom 0.5% of samples for each environmental improvement variable. The regression results, also presented in Table 6, indicate that the research findings remain largely unchanged.

Finally, considering concerns about potential endogeneity issues arising from reverse causality in control variables, all control variables were lagged by one period. The regression results, reported in Table 6, show no substantial differences from the baseline scenario. The robustness test results affirm the reliability of the research findings.

### Conclusion

Forest tourism has emerged as a vital sector in China's forestry, embodying a sunrise industry, green enterprise, wealth generator, and a beloved contributor to public health and happiness. As the primary entities driving forest tourism, the effective promotion of stable and rapid development in forest tourism parks is an urgent and essential concern.

Utilizing data from forest parks spanning 2016 to 2022, coupled with macro-level data from their respective cities, we constructed a unified integrated panel dataset. The study employed forest park tourism revenue and the number of tourists received as key indicators to assess forest tourism development, investigating the impact of four types of environmental improvements on forest tourism. The main conclusions of this study are as follows: Soil quality indicators exhibit no significant influence on forest tourism revenue and attendance; air quality and water quality indicators demonstrate a significant positive impact on both tourism revenue and attendance; biodiversity indicators significantly positively affect the number of tourists but have no impact on tourism revenue. The influence of different environmental improvements on forest tourism revenue and attendance manifests distinct heterogeneity across parks of different grades and regions, emphasizing the need for differentiated strategies.

The policy implications derived from our research are as follows:

**Prioritize improvements in air and water quality:** The results underscore the significant positive impact of air and water quality on forest tourism revenue and

attendance. Therefore, government and management authorities can intensify efforts to enhance and protect the air and water quality surrounding forest parks. Measures may include reducing sources of pollution, strengthening environmental monitoring, and advancing ecological protection and restoration projects.

**Focus on biodiversity conservation:** Given the significant positive impact of biodiversity indicators on the number of tourists, policies encouraging and supporting ecological conservation projects can be implemented to facilitate the recovery and maintenance of biodiversity within forest parks.

**Consider heterogeneity factors:** The results highlight the influence of disparities among parks of different grades and regions on the relationship between environmental improvement and forest tourism. Policymakers should factor in these heterogeneity elements when formulating policies, adopting differentiated strategies to more effectively drive the development of forest tourism.

**Strengthen attention on national forest parks:** Considering the significant differences in the impact of different environmental improvements on tourism revenue and attendance at national forest parks, targeted attention from the government can be intensified. Through policy support and investment guidance, further development of the tourism industry in national-level forest parks can be encouraged.

These policy implications provide valuable guidance for decision-makers, facilitating the optimization of forest tourism development strategies, enhancing the attractiveness and competitiveness of forest parks, and promoting the sustainable development of the tourism industry.

### Comprehensive Reflection on Results and Future Directions

The findings from this research shed light on the intricate interplay between environmental improvements and forest tourism. Going beyond the immediate policy implications, they prompt a more profound reflection on the sustainable development of forest tourism and future research trajectories.

#### Implications of the Results

The observed disparities in the impacts of environmental improvements emphasize the need for policies tailored to the specific characteristics of different forest parks. While air and water quality improvements emerge as paramount, the positive influence of biodiversity on tourist numbers signals an opportunity for ecological conservation initiatives.

#### Potential Future Research Directions

**Temporal Dynamics:** Investigate how the influence of environmental improvements on forest tourism

evolves over time. Assessing temporal dynamics can provide insights into the lagged effects and the sustainability of the observed impacts.

**Visitor Experience and Preferences:** Explore the qualitative aspects of tourist experiences and preferences within forest parks. Understanding what aspects of environmental quality contribute most to visitor satisfaction can inform targeted park management strategies.

**Climate Change Resilience:** Assess the resilience of forest tourism to climate change. Given the global focus on climate issues, understanding how forest tourism can adapt to changing environmental conditions becomes crucial for long-term planning.

**Policy Impact Assessment:** Evaluate the effectiveness of existing policies aimed at environmental improvement in forest parks. Assessing the actual impact of implemented policies can guide future policymaking.

In conclusion, this study not only provides actionable policy insights but also prompts deeper contemplation on the intricacies of forest tourism development. Future research should delve into the temporal dynamics and qualitative dimensions of these relationships, ensuring that policies align with the evolving needs of diverse forest parks and their visitors.

### Author Contributions

All the work related to the paper is done independently by the Y.F.

### Data Availability Statement

The data presented in this study are available upon request from the author.

### Conflicts of Interest

The authors declare no conflict of interest.

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