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Research Article

The Impact of Integrated Development of Agriculture and Tourism on Rural Ecological Environment Quality

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The integrated development of agriculture and tourism plays an important role on the rural ecological environment, which has not absorbed attention of the academic community. From the perspective of stakeholders, the impact mechanism of the agriculture and tourism integration on rural ecological environmental quality was analyzed. Based on three dimension-agricultural production environment, rural living environment, and rural environmental governance, the evaluation index system of rural ecological environment quality was constructed, and the multi-index comprehensive evaluation method was used to measure its level. The coupled system model of physics and entropy method were used to measure the degree of the integrated development level of agriculture and tourism industry. Based on data of 19 provinces in the Yangtze River Economic Belt and Yellow River Economic Belt in China from 2007 to 2019, static and dynamic panel models were used to examine the impact of agriculture and tourism integration on the quality of rural ecological environment and its mechanism. The results show that the integrated development of agriculture and tourism has a significant positive correlation with the quality of rural ecological environment, so the integrated development of agriculture and tourism can play a positive role in improving the quality of rural ecological environment. The rural ecological environment quality of the last period has a significant impact on the rural ecological environment quality of the current period, which indicates that the rural ecological environment quality has a strong inertia. Under the background of the current ecological civilization construction in China, the research result has significant theoretical and practical value.

1. Introduction

As one of the typical forms of rural industrial integration, the practice of integrated of agriculture and tourism has made remarkable achievements in China in recent years. By 2020, 388 state-level demonstration counties for leisure agriculture and rural tourism have been established in China, while 248 “China’s Beautiful Rural Fields” and 710 “China’s Beautiful Leisure Villages” have been promoted. Data shows that in 2019, the total number of rural leisure tourism in China reaches 3.2 billion person-times, and the scale of tourism consumption exceeds 850 billion yuan. Agriculture and tourism integrations have a positive effect on rural economic and social development. And it has become an important way to promote the prosperity of rural industries and rural revitalization in China.

Scholars believe that the establishment of an effective link between agriculture and tourism industry will not only lead to new market space and consumer demand but also promote the high quality of tourism and agricultural products [1–3]. Although the agricultural products needed by tourism industry are only a part of the total agricultural products, they play an important role in guaranteeing the quality and safety of agricultural products and nutrition and promoting economic development [4, 5]. Meanwhile, the integration of agriculture and tourism is conducive to the expansion of modern agricultural functions and promotes the transformation of ordinary agriculture into an efficient agriculture [6]. Rural tourism can break through the state of agricultural internalization, promote the transfer of labor force, improve labor productivity, and drive the industrial restructuring in rural areas [7]. Rural tourism can make urban leisure products and tourism services extend to rural areas by exploring valuable agricultural resources, and the development of modern leisure agriculture can promote the optimization and upgrading of rural industrial structure [8, 9]. At the same time, the integrated development of agriculture and tourism is also helpful to solve some local problems, such as the lack of labor force in the tourism industry and the lack of market demand for agricultural products [10, 11], and to strengthen urban-rural linkages and promoting the protection of natural or cultural heritages, as well as strengthen the connection between urban and rural areas [12]. In addition to its economic and social effect, the agriculture and tourism integration also has a relatively significant ecological effect. The integration of agricultural and tourism is important to agricultural versatility, promoting the transformation of ordinary agriculture into efficient agriculture [13]. However, a review of existing literature shows that there are few empirical studies on the ecological effects of the integrated development of agriculture and tourism, and no study has focused on its effect on the overall rural ecological environment.

In view of this, this paper will try to expand from the following aspects: first, from the perspective of stakeholders, analyze the impact mechanism of agriculture and tourism integration on the quality of rural ecological environment. Then, the level of agriculture-tourism integration is measured by the coupled system model of physics. At the same time, the rural ecological environment quality is measured by the comprehensive evaluation method. Finally, static panel model and dynamic panel model were used to test the relationship between agriculture and tourism integration level and rural ecological environment quality, so as to demonstrate the impact of agriculture and tourism integration development on rural ecological environment quality and its mechanism.

2. Materials and Methods

2.1. Mechanism. Rural areas attract tourists with their beautiful ecological environment, unique agricultural landscape, and rich cultural resources. Agriculture and tourism integration forms such as ecological sightseeing agriculture and leisure agriculture have rapidly become an important industry parallel with traditional agriculture. Agriculture and tourism integrations are based on the rural ecological environment. Protecting and improving the rural ecological environment are the inevitable requirement to achieve high-quality and sustainable development of rural tourism integration. Therefore, agriculture and tourism integrations are conducive to the improvement of rural ecological environment quality.

Stakeholders are "groups or individuals who can influence the realization of organizational goals or be affected by the realization of such goals" [14]. In the process of agriculture-tourism integration development, it mainly involves stakeholders such as ordinary farmers or agriculture-tourism integration project operators, leisure consumers, tourists, and relevant administrative departments. From the perspective of stakeholders, the mechanism of agriculture and tourism integration affecting rural ecological environmental quality is as follows (Figure 1).

First, as far as leisure consumers are concerned, "eating rural delicacies, enjoying rural beauty, purchasing rural products and enjoying rural environment" has become new forms of their tourism and leisure. Tourists are the people who have experienced and benefited from the rural ecological environment. With the arrival of the new era, people's demand for green ecological experience is increasing. Data show that 93% of Chinese tourists tend to choose environment-friendly destinations [15], and environment-friendly is an important feature of rural leisure destinations. While appreciating the beauty of nature, agri-leisure tourists are paying attention to environmental issues, which makes agri-leisure a highly socially responsible way of tourism [16]. Rural culture perception, rural landscape perception, and agricultural economy perception will all have a positive impact on tourists' environmental responsibility behavior [17], which is conducive to the protection of rural ecological environment. In addition, their leisure consumption in rural areas transforms the value of rural ecological environment into economic benefits, thus realizing the economic value of ecological environment, promoting the production and operation subject to adopt green production mode, and indirectly promoting the sustainable development of rural ecological environment.

Second, agri-leisure production operators are the decision-maker, leader, demonstrator, and beneficiary of ecological environmental protection, production, and operation subjects, whether they implement environmental behaviors that affect the quality of the ecological environment to a certain extent [18]. Here, ordinary local farmers (whether involved in agriculture or not) are also regarded as indirect main body of production, because their environmental awareness and behavior have an important impact on the local ecological environment quality, and they will also benefit from the process of regional development. When the production and operation entities are aware of the premium of ecological environment, they will also strengthen their own environmental awareness and behavior to achieve long-term sustainability of their business activities [19], for example, adopt environment-friendly production mode, reduce harmful production factors input, and improve agricultural ecological efficiency to improve agricultural production environment. Use low-carbon and energy-saving materials and equipment to classify and recycle wastes and realize resource treatment to save resources and energy.

Third, the administrative department shoulders the mission of promoting the long-term development of regional economy and is the institution of industrial development policy and the supervisor of production and operation activities. In recent years, administrative departments at all levels in China have issued a series of policy documents to guide the integrated development of agriculture and tourism, and some local administrative departments have even set up special environmental management agencies for

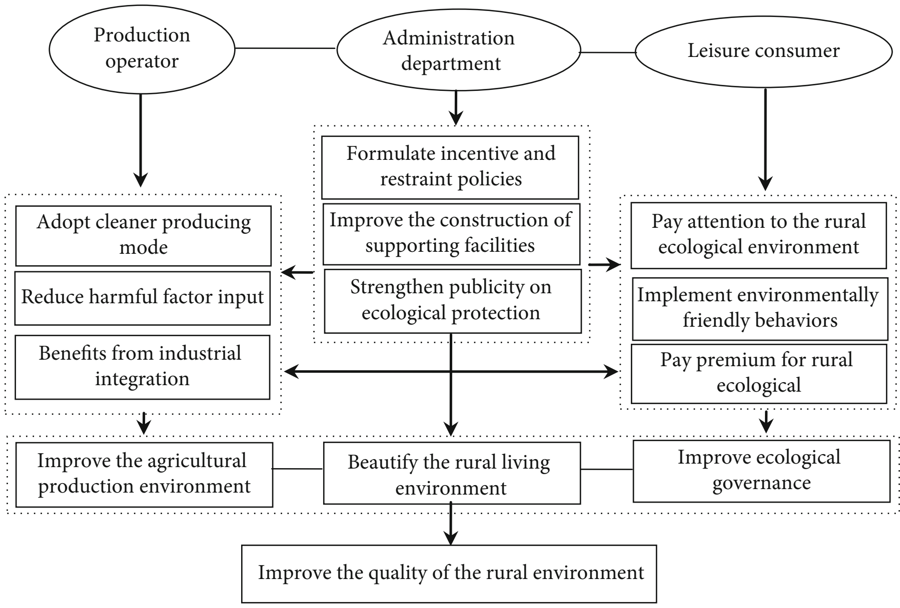

Figure 1: Mechanism analysis of the impact of agriculture and tourism integration on rural ecological environment.

leisure agriculture. At the same time, in the process of promoting the integrated development of agriculture and tourism, local governments also undertake the task of providing basic public services, such as road reconstruction, construction of water conservancy facilities, strengthening ecological environmental protection education, and providing agriculture-related technical services. All these measures have created conditions for the protection of rural ecological environment.

2.2. Methods and Data

2.2.1. Measurement of Rural Ecological Environment Quality Level. In this paper, multi-index comprehensive evaluation method is used to measure the comprehensive score of rural ecological environment quality in each province, and entropy method is used to measure the weight of each index. Entropy value method is a relatively objective weight calculation method, and its weight calculation results only rely on the original data of each index, so the index weight calculated by this method is more reliable and accurate. Entropy weight method determines the objective weight according to the index variability. The smaller the information entropy of an index is, the greater the variation degree of the index value is, the more information it provides, and the greater the role it plays in the comprehensive evaluation, and the greater its weight is. The process of using this method to calculate the quality level of rural ecological environment is as follows.

Suppose x_{ij} is the value of the j_{th} index in the i_{th} province ($i = 1, 2 \cdots, n$; $j = 1, 2 \cdots, m$). Indicators are divided into positive and negative ones, so the meanings represented by the values are also different. The higher the value of the positive indicator, the better, while the lower the value of the negative indicator, the better. For this reason, the indexes should be standardized first (to avoid meaningless data, 0.01 should be added to the initial standardized data).

Positive indicators:

$$x_{ij} = \frac{x_{ij} - \min\left(x_{1j}, \cdots, x_{nj}\right)}{\max\left(x_{ij}, \cdots, x_{nj}\right) - \min\left(x_{1j}, \cdots, x_{nj}\right)}. \quad (1)$$

Negative indicators:

$$x_{ij} = \frac{\max\left(x_{1j}, \cdots, x_{nj}\right) - x_{ij}}{\max\left(x_{ij}, \cdots, x_{nj}\right) - \min\left(x_{1j}, \cdots, x_{nj}\right)}. \quad (2)$$

The proportion of the ith province in the j_{th} index is

$$p_{ij} = \frac{x_{ij}}{\sum_{i=1}^{n} x_{ij}}. \quad (3)$$

The entropy value of the j_{th} index and the redundancy of information entropy was calculated:

$$e_j = -\frac{1}{\mathrm{In}(n)} \sum_{i=1}^{n} p_{ij} \mathrm{In}\left(p_{ij}\right), d_j = 1 - e_j. \quad (4)$$

The weight of each index can be expressed as

$$\omega_j = \frac{d_j}{\sum_{j=1}^{m} d_j}. \quad (5)$$

Finally, the comprehensive score of rural ecological environment quality (EQ_i) in each province was calculated according to the linear weighting method:

$$EQ_i = \sum_{j=1}^{m} \omega_j p_{ij}. \quad (6)$$

The larger the EQ_i value is, the better the rural ecological environment quality is, while the smaller the EQ_i value is, the worse the rural ecological environment quality is.

2.2.2. Data for Rural Ecological Environment Quality Level. Rural ecological environment construction is an important part of the national ecological civilization construction system in China, but also an important content of rural revitalization. At present, there are two main lines in the study of rural ecological environment evaluation in the academic circle. First, based on the main subjects such as the rural ecological civilization, the construction of beautiful countryside, and the rural human settlement environment, the rural economy, society, culture, and environment are comprehensively evaluated. The second is to focus on the rural ecological environment; the quality of the rural ecological environment, rural environmental governance, and environmental construction is evaluated; this paper also follows this research line. Rural ecological environment quality evaluation index system is an objective evaluation and response to agricultural production environment, rural living environment, and ecological environment protection and governance. On the basis of other scholars' researches, the rural ecological environment quality evaluation system was constructed from dimensions of the agricultural production environment, rural living environment, and rural environmental governance; specific indicators and their weight were showed in Table 1.

2.2.3. Measurement of Agriculture and Tourism Integration Level. In terms of measuring the degree of integration of agricultural and tourism industries, scholars have constructed corresponding calculation models based on theories of different disciplines. Some scholars have calculated the industrial integration degree of the two industries based on the input-output model, and some have constructed the industrial integration process model based on the interaction relationship model between populations in ecology. "Sticky" physics theory is introduced based on the model of optimal entropy value method to measure the viscosity of agriculture and tourism industry integration. There are also scholars that draw lessons from the physics coupling concept and coupling coefficient model to build the agriculture tourism integration level measure model. In this paper, the integration degree model of agriculture and tourism industry (CI) is established by using the coupled system model of physics. The details are as equation (7).

$$CI(u_1, u_2) = \left[\frac{\sqrt{u_1 u_2}}{u_1 + u_2}(\alpha u_1 + \beta u_2)\right]^{1/2}, \quad (7)$$

$$u_{(1,2)} = \sum_{j=1}^{m} w_j x_{tj} \quad (t = 1, 2 \cdots, k; j = 1, 2 \cdots m). \quad (8)$$

In formula (7), u_1 and u_2, respectively, represent the development level index of agriculture and tourism industry in a certain province in a certain year, which is calculated by multi-index comprehensive evaluation method and entropy method as above α is the weight of agriculture and β is the weight of tourism industry. Since the two systems are intersecting and infiltrating each other during the integration and development of agriculture and tourism, the roles of agriculture and tourism industry in the whole system are not separated from each other, so both α and β are set as 0.5. In equation (8), w_j is the weight of the j_{th} index, which is determined by the entropy value method above. x_{jt} represents the standardized data of the j_{th} index in the t_{th} year of a province.

On the basis of existing research, this paper selects evaluation index of the development level of agriculture and tourism industry. Agricultural development level is measured from two aspects: agricultural industry performance and agricultural industry elements. Similarly, the development level of the tourism industry is measured from two aspects: industry performance and elements of the tourism industry. Specific indicators and their weight were showed in Table 2.

2.3. Construction of Panel Regression Models

2.3.1. Model Construction. The fixed effect model can control the individual nonobservable factors that do not change with time, so it can effectively solve the error problem caused by the missing variables in the model. Based on this, the individual fixed-effect panel model is used to test the linear relationship between the level of agriculture and tourism integration and the quality of rural ecological environment. The model is set as the following equation:

$$EQ_{it} = \alpha_0 + \beta CI_{it} + \lambda_1 RP_{it} + \lambda_2 ID_{it} + \lambda_3 PE_{it} + \lambda_4 HC_{it} + \mu_i + \xi_{it}. \quad (9)$$

In the above formula, μ_i is the individual effect, and ξ_{it} represents the random error term which follows the normal distribution.

2.3.2. Dynamic Panel Regression Model. The ecological environmental quality is greatly affected by the previous period. Therefore, in order to reveal the dynamic change process of ecological environmental quality more objectively, EQ_{it-1} of rural ecological environmental quality is introduced on the basis of equation (10), and the dynamic panel econometric model is constructed as the following equation:

$$EQ_{it} = \alpha_0 + \rho EQ_{it-1} + \beta CI_{it} + \lambda_1 RP_{it} + \lambda_2 ID_{it} + \lambda_3 PE_{it} + \lambda_4 HC_{it} + \mu_i + \xi_{it}. \quad (10)$$

Because provincial heterogeneity characteristics μ_i may be related to other explanatory variables, OLS estimation can cause the problem of missing variable bias. As equation (10) above introduces the lagged term of the explained variable as the explanatory variable, which may be related to the random disturbance term, even if the fixed effect model is

Table 1: Rural ecological environment quality evaluation index system.

Dimension	Criteria layer	Unit	Attributes	Weight
Agricultural production environment (0.3537)	Cultivated land area per person	Hectares/ person	Positive	0.0601
	Irrigation water consumption	m^3/hectare	Positive	0.0598
	Fertilizer application amount	10,000 tons	Negative	0.0586
	Pesticide application amount	10,000 tons	Negative	0.0538
	Plastic film usage amount for agriculture	10,000 tons	Negative	0.0611
	Livestock and poultry breeding scale	10,000	Negative	0.0603
Rural living environment (0.3429)	Forest coverage rate	%	Positive	0.0597
	Wetland area	10,000 hectares	Positive	0.0573
	The proportion of days with air quality reaching grade II or above	%	Positive	0.0584
	The penetration rate of sanitary toilets	%	Positive	0.0576
	The penetration rate of tap water supply	%	Positive	0.0518
	The accessibility rate of roads in administrative village	%	Positive	0.0581
Rural environment governance (0.3034)	Afforestation area	10,000 hectares	Positive	0.0599
	Water-saving irrigation area	10,000 hectares	Positive	0.0621
	Soil erosion control area	10,000 hectares	Positive	0.0590
	Investment in environmental pollution control	100 million yuan	Positive	0.0623
	Harmless disposal rate of household garbage	%	Positive	0.0601

used to estimate and eliminate the individual effect μ_i, the parameter estimation error caused by endogeneity cannot be eliminated. Scholars believed that when the endogenous variables in the model would cause errors in the ordinary panel regression results, the dynamic panel estimation could eliminate such errors. Differential generalized moment estimation (DIF-GMM) and system generalized estimation (SYS-GMM) are usually used for parameter estimation in dynamic panel models. Monte Carlo test shows that SYS-GMM is more effective than DIF-GMM. SYS-GMM can use the information of level equation and difference equation at the same time, and it is more effective for the estimation of finite samples, which is a feasible method to solve simultaneous endogeneity bias at present. In order to ensure that equation (10) can obtain reliable unbiased estimator, the system generalized moment estimation (SYS-GMM) is used to estimate the dynamic panel model.

2.3.3. Data for Panel Regression Models. This paper focuses on the impact of agriculture tourism integration level (CIit) on rural ecological environmental quality (EQit), with CIit as the explanatory variable and EQit as the explanatory variable. Referred to existing literature, the main factors influencing the quality of rural ecological environment were selected as control variables: natural growth rate of rural population (RPit), human capital level (HCit), industrialization level (IDit), and agricultural economic development level (PEit) (Table 3). The human capital level is represented by the proportion of the population with a college degree or above in the total rural population, the industrialization level is represented by the proportion of the industrial added value in the GDP, and the agricultural economic development level is represented by the per capita agricultural added value. The subscript i and t represent the province and year, respectively.

2.3.4. Data Sources. Agriculture depends on the support of water, and the regions on both sides of rivers are generally developed agricultural regions. Therefore, the Yangtze River Economic Zone and the Yellow River Economic Zone, the two largest economic regions linked by rivers in China, are selected as the analysis regions. It covers 19 provinces. The research data in this paper are mainly from China Tourism Yearbook, China Rural Yearbook, China Statistical Yearbook, China Environment Yearbook, China Regional Economic Statistical Yearbook, China Land and Resources Bulletin, provincial statistical yearbook, and Statistical Bulletin of National Economy and Social Development (2007-2019). In addition, the official websites of relevant ministries and commissions and provincial statistics bureaus are also important supplementary data sources. All data measured in monetary units have been adjusted for inflation to 2007 constant price levels. The data analysis process was completed by SPSS software and R language.

Table 2: Evaluation index system of development level of agriculture and tourism industry.

Dimension	Criteria layer	Quantitative indicators	Unit	Weight
Agricultural development level	Agricultural industry performance (0.5491)	Primary industry output value	100 million yuan	0.0907
		Output of agriculture, forestry, and fishing	100 million yuan	0.0911
		Rural residents' consumption level	Yuan/person	0.0923
		The per capita net income of rural households	Yuan	0.0921
		Per capita output of agricultural products	Kg/person	0.0916
		Agricultural modernization level	%	0.0913
	Agricultural industry elements (0.4509)	Crop planting area	1000 hectares	0.0854
		Total power of agricultural machinery	Million kW	0.0964
		Afforestation and orchard area	1000 hectares	0.0858
		Investment in agriculture, forestry, animal husbandry, and fishery	100 million yuan	0.0880
		Primary industry employment	10,000 people	0.0953
Tourism development level	Tourism industry performance (0.5762)	Number of domestic tourism	100 million yuan	0.0982
		Domestic tourism income	100 million yuan	0.0850
		Number of inbound tourists	10,000 people	0.1036
		Tourist foreign exchange	10,000 people	0.1006
		Operating income of travel agencies	10,000 yuan	0.0824
		Operating income of star-rated hotels	10,000 yuan	0.1064
	Tourism industry elements (0.4238)	Number of the travel agency		0.0890
		Number of scenic spots below 4A		0.0868
		Number of 4A or above scenic spots		0.0902
		Number of staff workers in travel agency	10,000 people	0.0742
		Number of staff workers in star-rated hotel	10,000 people	0.0836

Table 3: Variable descriptions for panel regressions.

Symbol	Variable	Definition	Unit
CIit	Explanatory variable	Level of agriculture tourism integration	——
EQit	Explained variable	Rural ecological environmental quality	——
RPit	Control variable	Natural growth rate of rural population	%
HCit	Control variable	Human capital level (the proportion of the population with a college degree or above in the total rural population)	Ratio
IDit	Control variable	Industrialization level (the proportion of the industrial added value in the GDP)	Ratio
PEit	Control variable	Agricultural economic development level (the per capita agricultural added value)	Yuan

3. Results

3.1. Results of Rural Ecological Environment Quality Level. Combined with the above measurement model and the evaluation index system of rural ecological and environmental quality, the rural ecological and environmental quality is calculated based on the collection of relevant data of all provinces in the study area from 2007 to 2019. The mean value

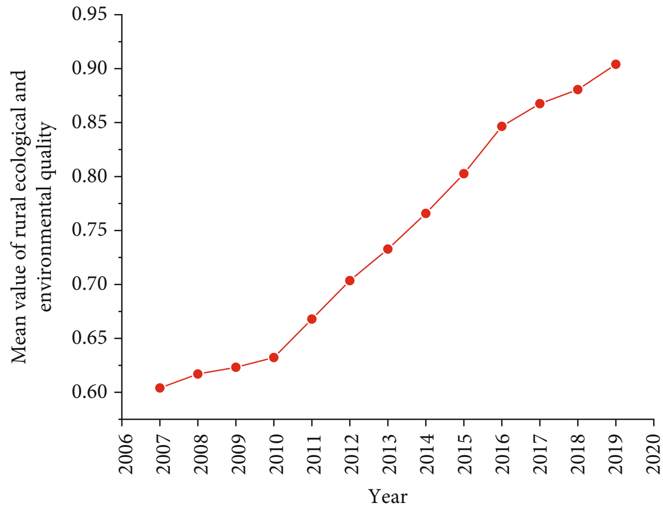

Figure 2: The mean change of the rural ecological environmental quality level in the whole study area over years.

Table 4: Summary table of integrated level of agriculture and tourism in each province over years.

Province	Integrated level of agriculture and tourism												
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Shanghai	0.691	0.683	0.645	0.686	0.707	0.673	0.722	0.682	0.712	0.706	0.702	0.725	0.714
Jiangsu	0.545	0.597	0.633	0.616	0.617	0.615	0.675	0.698	0.717	0.769	0.748	0.781	0.803
Zhejiang	0.567	0.687	0.720	0.693	0.735	0.757	0.715	0.718	0.751	0.784	0.812	0.836	0.858
Anhui	0.533	0.514	0.602	0.595	0.685	0.730	0.758	0.733	0.727	0.747	0.723	0.773	0.797
Jiangxi	0.446	0.576	0.725	0.738	0.731	0.741	0.754	0.790	0.751	0.759	0.771	0.783	0.778
Hubei	0.621	0.687	0.711	0.691	0.690	0.724	0.631	0.620	0.641	0.676	0.692	0.713	0.684
Hunan	0.583	0.566	0.596	0.595	0.727	0.759	0.741	0.822	0.789	0.799	0.739	0.740	0.749
Chongqing	0.331	0.463	0.629	0.531	0.615	0.668	0.658	0.683	0.682	0.713	0.708	0.688	0.678
Sichuan	0.633	0.677	0.725	0.722	0.683	0.716	0.677	0.719	0.770	0.753	0.676	0.731	0.789
Yunnan	0.597	0.666	0.733	0.744	0.705	0.690	0.659	0.669	0.734	0.675	0.735	0.696	0.684
Guizhou	0.334	0.505	0.688	0.597	0.495	0.554	0.570	0.569	0.665	0.652	0.722	0.773	0.790
Shanxi	0.387	0.431	0.554	0.571	0.586	0.613	0.618	0.714	0.756	0.834	0.705	0.696	0.682
Shandong	0.530	0.524	0.656	0.696	0.604	0.676	0.673	0.711	0.790	0.851	0.861	0.873	0.899
Henan	0.570	0.609	0.686	0.672	0.661	0.696	0.702	0.692	0.660	0.685	0.636	0.658	0.775
Shaanxi	0.411	0.442	0.609	0.612	0.659	0.655	0.670	0.691	0.665	0.698	0.709	0.823	0.754
Inner Mongolia	0.387	0.414	0.432	0.559	0.584	0.617	0.639	0.654	0.720	0.758	0.809	0.883	0.823
Gansu	0.594	0.673	0.699	0.696	0.637	0.683	0.686	0.727	0.706	0.732	0.704	0.713	0.717
Ningxia	0.462	0.454	0.475	0.553	0.640	0.686	0.619	0.703	0.703	0.711	0.714	0.709	0.718
Qinghai	0.393	0.424	0.539	0.564	0.526	0.555	0.650	0.641	0.655	0.657	0.771	0.824	0.791
Average	0.480	0.560	0.641	0.643	0.656	0.678	0.672	0.700	0.723	0.738	0.737	0.751	0.742

of rural ecological and environmental quality in each year during the study period is shown in Figure 2. The average level of rural ecological environmental quality in the study area showed a gradual upward trend from 2007 to 2019, and most of them were stable between 0.604 and 0.902. In addition, there is little difference in the quality of rural ecological environment in different provinces in the same year. In short, from the time point of view, the quality of rural ecological environment in 19 provinces has been continuously improved, which better reflects the direction and achievements of China's new rural construction and ecological civilization construction.

3.2. Results of Integrated Development Level of Agriculture and Tourism. With above evaluation index system and the corresponding measurement method, on the basis of data collection and sorting, this paper measures the integrated development level of agriculture and tourism in each province in research area from 2007 to 2019. The results are shown in Table 4. From the perspective of time dimension,

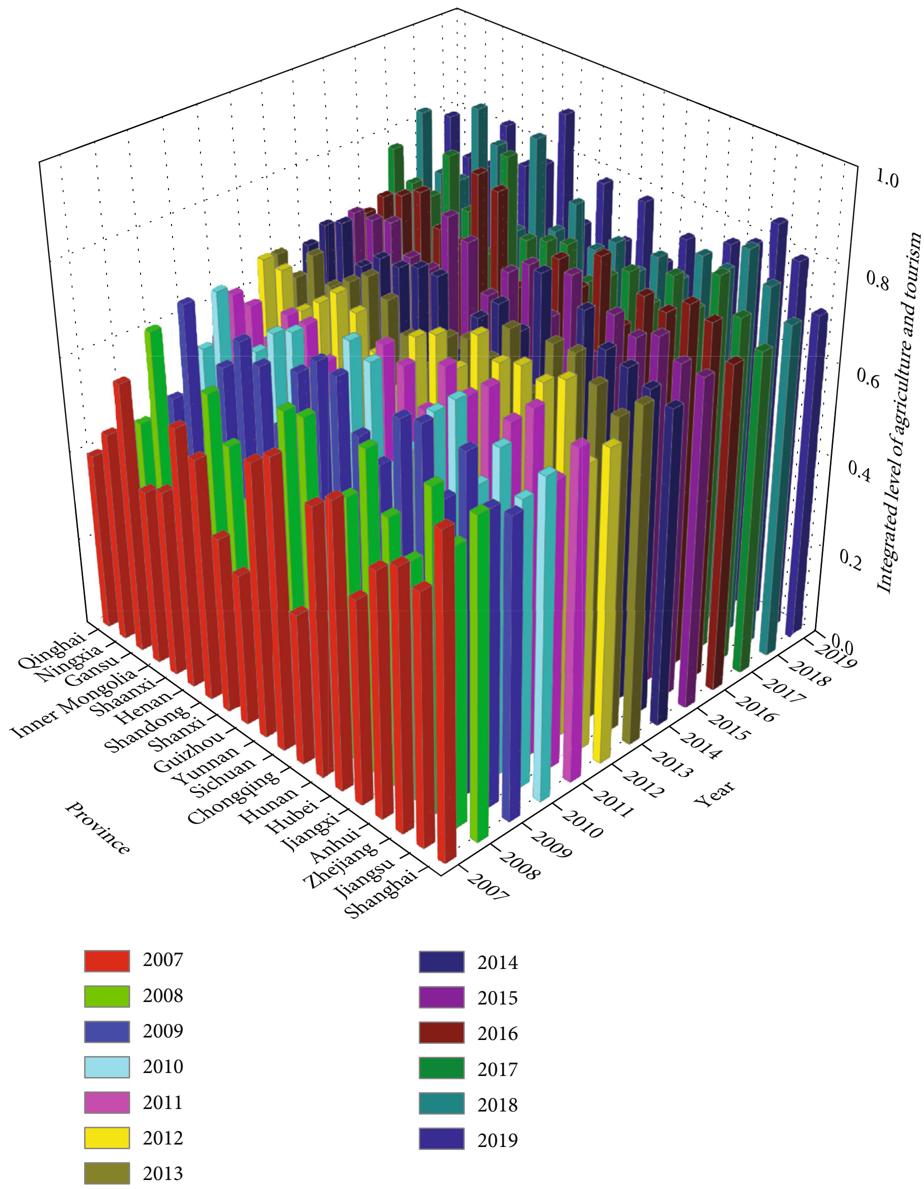

Figure 3: Histogram of agricultural tourism comprehensive level of each province over the years.

the average value of agriculture-tourism integration in the whole study period was stable between 0.48 and 0.751, and the level of agriculture-tourism integration in all provinces showed a gradual upward trend during this period, which better reflected the direction of the integrated development of agriculture and tourism industry in China. Horizontally, there is little difference in the level of Agriculture and tourism integration in different provinces in the same year. Among them, Zhejiang, Shandong, Jiangxi, and Sichuan have a relatively high integration level of agriculture and tourism (Figure 3).

3.3. Effect of Agriculture and Tourism Integration on Rural Ecological Environment Quality. In order to test whether there is a difference in the effect of agriculture and tourism integration level on improving rural ecological environmental quality in different regions, models (1) ~ (3) were built for all provinces in the study area, the Yangtze River Economic Belt and the Yellow River Economic Belt. Based on the data of each province, the fixed effect model of common panel is estimated. First, the F test showed that the individual fixed effect was significant. In addition, the Hausman test rejects the null hypothesis that there is no systematic difference between random effect (RE) and fixed effect (FE) coefficients. Therefore, individual fixed-effect models can be given priority. According to the estimation results of the general panel individual fixed effect model (Table 5), the regression coefficient of the integrated development level of agriculture and tourism on the rural ecological environment quality in the whole study area is 0.0764 ($P < 0.05$), indicating that when other factors remain unchanged, each 1% increase in the integrated development level of agriculture and tourism will promote the corresponding increase in the quality of rural ecological environment by 7.64%. The integration level

Table 5: Results of the impact of agriculture and tourism integration on rural ecological environment quality.

Coefficient	Model (1)-the whole research area		Model (2)-Yangtze River Economic Belt		Model (3)-Yellow River Economic Belt	
	FE	SYS-GMM	FE	SYS-GMM	FE	SYS-GMM
β	0.0764** (0.002)	0.0479** (0.008)	0.0803** (0.001)	0.0557** (0.001)	0.0628* (0.002)	0.0379* (0.005)
$\lambda 1$	-0.0807** (0.012)	-0.1021** (0.041)	-0.0655* (0.004)	-0.0985* (0.002)	-0.0815* (0.006)	-0.0832* (0.002)
$\lambda 2$	-0.0284* (0.021)	0.0198* (0.094)	-0.0132** (0.017)	-0.118 (0.003)	-0.0232* (0.002)	-0.0320 (0.015)
$\lambda 3$	0.0524* (0.043)	0.0861* (0.007)	0.0617** (0.021)	0.0986** (0.014)	0.0387* (0.011)	0.0281* (0.161)
$\lambda 4$	0.0021* (0.031)	0.0151* (0.001)	0.0017** (0.002)	0.0264* (0.001)	0.0035* (0.012)	0.0061* (0.002)
L.EQit		0.321*** (0.011)		0.223*** (0.031)		0.398*** (0.027)
F_test	26.831***		28.754***		16.983**	
Hausman_test	28.983***		32.831***		24.398***	
$R2$	0.7865		0.7011		0.6865	
AR(1)_test		-3.925*** [0.000]		-2.525*** [0.000]		-4.084*** [0.000]
AR(2)_test		1.154 [0.298]		0.896 [0.174]		1.376 [0.486]
Hansen_test		21.877 [0.094]		32.021 [0.143]		17.907 [0.286]

Note: ***, **, and * indicate rejection of the null hypothesis at the confidence level of 1%, 5%, and 10%, respectively. In brackets are the test statistic P value, and in brackets are the standard deviation.

of agriculture and tourism in all provinces has a positive effect on the quality of rural ecological environment. However, the effect of Yangtze river economic belt was more significantly than the entire study area and the Yellow River economic belt, and this may be due to its superior natural geographical environment, economic development level, and the tourism market demand conditions.

In order to capture the "inertia" of rural ecological environmental quality, the lagging first-term term of rural ecological environmental quality level was included in the estimation model. This lagging first-term term may be related to the random error term, leading to endogeneity problems in the model, thus causing deviation in the regression results. In order to overcome endogeneity and considering the feature of "big N and small T" in the panel data structure used in this paper, it is more appropriate to use SYS-GMM to estimate the dynamic panel model. For this reason, Hansen test and Arollano-Bond test are used to judge the stability of the model. The former tests the problem of excessive identification of instrumental variables, and the latter tests the autocorrelation problem of residual errors.

In the Hansen test of above three models, P values are all greater than the critical value of 0.05, indicating that the dynamic panel model does not have the problem of overrecognition. As can be seen from the P values in column Ar(1) and Ar(2), there is first-order autocorrelation in the difference of the disturbance term of the three estimation models, but there is no second-order autocorrelation. So far, the model has passed the test of all aspects. In model (1), the estimation results of dynamic panel model show that the lagging term of rural ecological environment quality in the first period is positively correlated with the level of rural ecological environment quality in the current period ($P < 0.01$), and the level of rural ecological environment quality will increase by 0.321 for every 1% increase in the previous period, which indicates that the level of rural ecological environment quality has a certain dynamic inertia. In addition, the regression coefficient of agriculture-tourism integration was 0.0479 ($P < 0.05$), and this coefficient is slightly lower than that of the ordinary panel fixed effect model.

The regression coefficients of the integrated level of agriculture and tourism in the Yangtze river basin on rural ecological environment quality are the biggest in the two methods of estimation, reflecting the region's integrated level of agriculture and tourism development has a more prominent impact on rural ecological environment quality improvement, which may benefit from the region's economic development level and the tourism market space, as well as regional ecological resources; at the same time, the dynamic panel model estimates that the impact of the level of rural ecological environment quality of the lagging term on the previous term in this region is the least. In terms of control variables, the agricultural economic development level and rural human capital have significant effects on the improvement of rural ecological environment quality, while the rural population and industrialization level have significant negative effects on rural ecological environment.

3.4. Influence Mechanism of Agriculture and Tourism Integration on Rural Ecological Environment. In order to further analyze the mechanism of the impact of agriculture and tourism integration on rural ecological environment, this paper analyzes the dimensions of rural ecological environment and establishes a panel regression analysis model of the impact of agriculture and tourism integration level on agricultural production environment, rural living environment, and rural ecological governance. Among them, the explained variables of model (4), (5), and (6) are agricultural production environment (AEit), rural living environment (REit), and rural ecological management level (EGit), respectively, and the control variables are the same as above. The values of the above explained variables were calculated

Table 6: Test results of the influence mechanism of agriculture-tourism integration on rural ecological environment.

Coefficient	Model (4)		Model (5)		Model (6)	
	FE	SYS-GMM	FE	SYS-GMM	FE	SYS-GMM
β	0.0486* (0.010)	0.0316* (0.001)	0.0593* (0.009)	0.0317* (0.002)	0.0768* (0.009)	0.0452* (0.002)
$\lambda 1$	-0.0697 (0.004)	-0.1021 (0.044)	-0.0915* (0.208)	-0.0054* (0.143)	0.0315 (0.021)	0.008 (0.304)
$\lambda 2$	-0.1184* (0.114)	0.0064 (0.494)	-0.0832* (0.243)	-0.0465* (0.097)	0.0032* (0.109)	0.0104* (0.004)
$\lambda 3$	0.0021* (0.206)	0.0861* (0.004)	0.0417* (0.021)	0.0387* (0.164)	0.0017 (0.319)	0.0054 (0.295)
$\lambda 4$	0.0036* (0.103)	0.0055* (0.001)	0.0019 (0.307)	0.0321 (0.119)	0.0017* (0.028)	0.0043* (0.170)
L.AEit		0.1874*** (0.001)				
L.REit				0.1397*** (0.003)		
L.EGit						0.0687* (0.017)
F_test	29.981***		23.814***		13.964**	
Hausman_test	38.983***		26.837***		29.394***	
$R2$	0.6809		0.8032		0.7104	
AR(1)_test		-3.214*** [0.000]		-2.877*** [0.000]		-2.752*** [0.000]
AR(2)_test		1.0182 [0.427]		0.895 [0.624]		0.918 [0.781]
Hansen_test		22.980 [0.073]		26.096 [0.044]		35.753 [0.004]

Note: ***, **, and * indicate rejection of the null hypothesis at the confidence level of 1%, 5%, and 10%, respectively. In brackets are the test statistic P value, and in brackets are the standard deviation.

by the entropy value method mentioned above and were still estimated by the ordinary panel fixed effect model and the dynamic panel SYS-GMM method, respectively.

Table 6 shows that integration levels of agriculture and tourism have significant impact on different dimensions of rural ecological environment. The environment of agricultural production and rural living environment and rural ecological management levels are rising along with the deepening of the integration, verifying the above influence mechanism of agriculture-tourism integration on rural ecological environment quality. There is a significant positive relationship between the lagging term and current term of each dependent variable. Among them, the rural living environment lagging one period has the biggest impact on the current period. However, the lag of the level of rural ecological governance has relatively little influence on the current period. This may be because the level of rural ecological governance is closely related to ecological and environmental protection policies, and the factors such as policy measures may not have long-term sustainability.

Both the ordinary panel model and the dynamic panel model show that the integrated development of rural tourism has a significant positive impact on the agricultural production environment, rural living environment, and rural ecological governance level from the perspective of the influence mechanism test.

4. Conclusions

(1) The analysis of both ordinary panel (static) and dynamic panel model shows that the integrated development of agriculture and tourism has a significant positive relationship with the quality of rural ecological environment, indicating that the integrated development of agriculture and tourism can play a positive role in improving the quality of rural ecological environment

(2) The dynamic panel model shows that the rural ecological environment quality of the last period has a significant impact on the rural ecological environment quality of the current period, indicating that the rural ecological environment quality has a strong inertia. The analysis of different regions shows that the integration level of agriculture and tourism in the Yangtze River Economic Belt has the most significant promoting effect on the quality of rural ecological environment

(3) The regression coefficient of the comprehensive development level of agriculture and tourism to the rural eco-environmental quality of the whole study area is 0.0764 ($P < 0.05$), indicating that under the condition that other factors remain unchanged, every 1% increase in the comprehensive development level of agriculture and tourism will promote the corresponding increase in the rural eco-environmental quality by 7.64%. The regression coefficient of the comprehensive level of agriculture and tourism in the Yangtze River Basin on the quality of rural ecological environment is the largest, reflecting that the comprehensive level of agricultural and tourism development in the region has a more prominent impact on the improvement of rural ecological environment quality

(4) Both the ordinary panel model and the dynamic panel model show that the integrated development of rural tourism has a significant positive impact

on the agricultural production environment, rural living environment, and rural ecological governance level from the perspective of the influence mechanism test

Data Availability

The figures and tables used to support the findings of this study are included in the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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