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Can Integration of Agriculture and Tourism Promote Rural Green Development?—Empirical Evidence from 152 Cities in China

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Abstract: Based on theoretical analysis of the connotations of and influencing factors on rural green development, this paper systematically explains its promotion mechanisms, its heterogeneity, and transmission effects of the integration of agriculture and tourism (hereinafter referred to as IAT) on rural green development; constructs and measures development indicators of IAT based on the three dimensions factors, performance, and structure; constructs comprehensive indicators of rural green development based on the three dimensions production, life, and ecology; and takes the panel data of 152 prefecture-level cities with agricultural leisure demonstration counties from 2010 to 2019 as samples for empirical testing. Results show that (1) IAT has a significant positive effect on rural green development, and endogenous tests based on instrumental variables and robustness tests show that the above conclusion is valid; (2) heterogeneity analysis shows that IAT plays a more significant role in promoting rural green development in high-human-capital areas, central and western regions, and non-major grain-producing areas; and (3) labor structure, capital input, and technological progress can play a transmitting role in promoting rural green development through IAT. At the end, this paper puts forward some countermeasures to promote rural green development by implementation of the quality projects strategy of IAT, the "tailor-made" support policy of IAT, based on the advantages of resource endowment and improvement of transmission mechanisms based on labor structure, capital input, and technological progress.

Keywords: rural industries; sustainable development; carbon emissions reduction; rural ecological revitalization; promotion mechanism

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1. Introduction

Ecological livability is the key link in and an important content of rural ecological revitalization, which is not only a positive response to and scientific guideline for rural green and sustainable development, but also the core goal and practical destination of ecological civilization construction. Strengthening rural low-carbon development is an important way to promote the construction of a beautiful countryside and promote carbon emission reduction and rural ecological civilization [1]. In the process of promoting rural ecological civilization construction, China still faces practical problems, such as high energy consumption and agricultural pollution, weak sustainable development ability, deteriorating ecological environment quality, the weak ecological awareness of villagers, and serious rural environmental pollution [2]. The integration of agriculture and tourism (hereafter referred to as IAT) is a dynamic process where agriculture and tourism penetrate, cross, and couple with each other based on market and technological associations, with industrial boundaries gradually broken through forming a new industry, and is also a process realizing industrial cross-penetration, integration, and extension based on value creation [3]. IAT can help promote the green transformation of rural industries, promote the governance of rural resources, ecology, and the human settlement environment, and improve the quality of rural ecological livability [4]. Rural green development depends

on the governance of the rural ecological environment and the improvement of ecological efficiency. As an important way to upgrade rural industries, it is of great practical value to systematically explore IAT's mechanisms in rural green development.

The academic community has made useful explorations of the connotations of, influencing factors on, and realization methods of rural green development. Existing literature mainly conducts research from the perspectives of production, life, and ecology, and states that rural ecological civilization construction is done to advocate the green development of rural production, life, and ecology, and that its core value lies in adhering to green production, advocating green life, and pursuing green ecology, promoting the greening of the rural production, life, and ecological fields [5]. Rachel Carson was the first scholar who discussed rural ecological protection and green development. She described agricultural production and ecological environment issues in Silent Spring (1962). Agriculture is a production mode based on natural resources; extensive use of pesticides, fertilizers, and other chemical products can lead to the destruction of the rural ecological environment and even affect the survival of human society [6]. Barry Commoner (1971) pointed out that, because human beings have overemphasized the role of science and technology in the agricultural development, and ignored that science and technology itself is also a double-edged sword, fertilizers and pesticides have seriously polluted water and soil [7]. Albert Gore (1992) believed that the reason for damage to the ecological environment was that the excessive consumption of natural resources by human beings led to land degradation, the decline of biodiversity, and the sharp deterioration of rural production, living, and ecological environments, which directly threatened human survival [8]. The World Bank's measurement index system for green development mainly includes three dimensions: economy, environment, and social benefits, including the measurement of agricultural and rural green development [9]. The elements of the evaluation of rural green development in academic circles mainly include the evaluation indicators of resource carrying capacity, economic prosperity, social civilization, environmental beauty, and public security [10,11], emphasizing the livable living environment, emphasizing ecological and industrial coordinated development, and realizing the green and sustainable development of rural industries. This occurs through the integration of three industries in rural, innovation in the development modes of rural industry, integration of ecology and industry, and promotion of the ecological development of rural industry [12,13]. In terms of the factors affecting rural green development, the academic community mainly discusses industrial integration, green development, and the ecological environment, and believes that industrial integration, ecological livability, and industrial greening have a significant impact on promoting rural green development [14–16]. In the context of the profound impact of economic globalization, global climate change, and other challenging issues for rural development, future rural green development should pay special attention to economic, social, and environmental security, specifically to the rational use and management of rural land resources [17]. Although the above research has studied rural green development and its influencing factors from different angles and regions, there is still a lack of comprehensive measurement of rural green development at the levels of intensive production, good life, ecological livability, etc., which meet the requirements of rural ecological revitalization in the new era, let alone an in-depth study of rural green development from the perspective of IAT. The connotations of IAT are mainly defined on three levels: industrial linkage, industrial integration, and systems theory. Among these, the view of industrial linkage is based on the high correlation and mutual integration of agriculture and tourism, which is not only the industrial linkage between agriculture and tourism, but also the result of the extension of the industrial chain [18]. According to the views of industrial integration and system theory, the basic characteristics of IAT are "carrying tourism development with agriculture and promoting agricultural development through tourism", while the latter is "agriculture is fundamental and tourism enables agricultural development" [19,20]. IAT promoting rural green development is mainly reflected in the following three perspectives: (1) At a production level, it can promote the transformation of rural industries into pro-

duction and operation methods, reduce non-point-source pollution, water pollution, and carbon emissions by reducing the use of pesticides, fertilizers, agricultural machinery and equipment, and by controlling irrigation sowing area so as to reduce the damage to the ecological environment in the industrial production process, improve industrial ecological efficiency, and promote the green development of industries [21]. Rural ecological civilization should be based on the green development of industries, promote the green development of rural industries through IAT, reduce production pollution, strengthen ecological governance, and improve the livability of rural areas [4], and promoting the construction of beautiful villages is an effective way to achieve rural green development. (2) At a living level, IAT can promote the concentration of capital in rural areas, improve infrastructure areas such as transportation, water, electricity, and gas, and improve the level of public services such as science, education, culture, and health; it has a profound impact on promoting the construction of beautiful countryside [22]. (3) At an ecological level, IAT can realize the transformation of ecological benefits into economic benefits. The high premium of sustainable ecological value is bound to strengthen the protection and governance of ecology and create a good ecological environment [23]. Academics have conducted many studies on the connotations and impact of IAT from different perspectives, but measurement of the degree of IAT, especially the internal mechanisms of IAT promoting rural green development, needs to be systematically explained.

In summary, the existing literature has conducted beneficial research on rural green development and IAT, but mainly on the impact of IAT on rural industrial structure, agricultural ecological efficiency, and other aspects. Few systematic studies have been conducted on the internal mechanisms of IAT promoting rural green development [3,16]. Compared with urban green development, rural green development is more special and faces more severe challenges. China is a country with vast geographical space, the degree of rural green development in different regions is uneven, and there are differences between mainly grain-producing areas and mainly non-grain-producing areas in the requirements of agricultural production methods, agricultural structure, etc., especially in the rural areas, which have lacked technology, capital, and related policy support for a long time. It is not universally feasible to simply use capital investment, technology, and various related policy inputs to promote rural green development. However, from the perspective of industrial integration, IAT provides a feasible way to promote the optimization of labor structure, increase capital investment, promote technological progress and the upgrading of rural industrial structure, improve production efficiency, and shape the concept of green development so as to realize rural green development. This paper attempts to build a theoretical model to systematically analyze the internal mechanisms of the promotion of IAT for rural green development and build an indicator system for rural green development with the three dimensions of production, life, and ecology. Taking 152 prefecture-level cities including leisure agriculture and rural tourism demonstration counties as samples, this paper examined the extent of the role of IAT in rural green development and interpreted the mechanism behind it. It is expected to expand the promotion path for rural green development during the implementation of the rural revitalization strategy and enrich existing research on the IAT. This paper has two marginal contributions: (1) IAT is put into a unified analytical framework with rural green development for the first time, and the impact mechanism between them is explored from such theoretical perspectives as industrial integration and sustainable development; (2) it systematically analyzes and empirically tests the mechanisms of rural green development promoted by IAT through the direct enabling effect and the three transmission effects, including labor structure, capital investment, and technological progress. The research results are expected to provide a scientific basis for effectively promoting IAT and an important policy reference for local governments to promote rural green development.

2. Theoretical Analysis and Research Hypotheses

As a new form of interpenetration, intersection, and integrated development, IAT pays attention to the rational development of rural resources, emphasizes the guidance of rural civilization and carbon emission reduction, carries out rural ecological governance, and uses agriculture to promote tourism and tourism to rejuvenate agriculture as a means to achieve the rural green development goals of rural beauty, prosperous industry, rich life, and ecological livability, and the integrated development of agriculture and tourism essentially has the connotation of promoting rural green development. Therefore, this paper first explores the promotion mechanisms of IAT on rural green development for production, ecology, and life, then systematically analyzes its regional heterogeneity and the transmission mechanisms of labor, capital, and technology effects.

2.1. The Promotion Mechanisms of IAT on Rural Green Development

The integrated development of agriculture and tourism has some characteristics of green industry. Through the development of sightseeing agriculture, family farm experiences, farm vacations, local-folk-custom tourism, agricultural research, and other forms of business, agricultural operators will be prompted to obtain sustainable green premium returns, and IAT will drive the green transformation of rural industries so as to overcome the obstacles restricting rural green development, such as resource shortages and agricultural production pollution [24]. Through IAT, we will strengthen green agricultural empowerment and promote a virtuous circle of rural low-carbon industries. (1) At a production level, IAT can change the characteristics of the single-input structure of traditional agricultural production factors, optimize the endowment structure of rural industrial factors, accelerate the trans-department and cross-regional transfer of agricultural surplus labor, and achieve carbon emission reduction and upgrading of rural industries by upgrading the structures of capital, technology, and services [25]. IAT can effectively drive the development of rural economy out of the traditional mode, provide more diversified tourism products and characteristic agricultural products, and promote the sustainable development of rural economy while meeting diversified market demand [26]. Through the introduction of new technologies, new elements, new facilities, etc., the input–output efficiency of rural industries will be improved, and green development capacity will be enhanced. In the process of IAT, new technologies, services, and products have been born, changing the traditional modes of agricultural production and services and promoting the low-carbon upgrading of product and service structures [27]. (2) At a life level, IAT can help diversify rural industries, expand the market space and sales channels of agricultural products, effectively increase local non-agricultural employment opportunities, and improve the income and living standards of rural residents [28]. With the improvement in economic benefits and income level brought by the development of IAT, the guidance and support of local governments on lifestyle and environmental awareness will continue to strengthen [29]. On this basis, IAT requires promoting the quantity and quality of infrastructure and public service supply. On the one hand, it improves ecological livability and quality of life. On the other hand, new technologies, new products, and new services can enhance the level of consumer demand. Through interaction and coordination between the supply and demand sides, IAT can promote the quality of technology, products, and services; guide and shape the concepts of green consumption and low-carbon behavior; and form a new pattern of low-carbon production and green life [30], so as to form a scientific concept of development in which man and nature coexist harmoniously and promote rural green development. (3) At an ecological level, the practice of IAT can not only enrich existing rural resources and enhance their value, but also provide a material basis for the protection of rural natural resources through economic development [31]. Land resource planning and landscape cultivation are important contents of IAT. In the process of these, it is necessary to comprehensively consider such factors as ecological beauty, comfortable life, livable tourism, and sustainable development, so as to promote rural green development [32]. The new industrial form of IAT helps to form a positive cumulative cycle of "industrial

development—capital accumulation—cognitive deepening—ecological protection" in the process of expanding the transformation of ecological benefits into social and economic benefits [33]. Under the effect of positive circular accumulation, IAT promotes carbon emission reduction and management efficiency, improves villagers' ecological awareness, and standardizes producers' ecological protection behavior [34]. At the same time, it gives full play to the enabling effect of culture and tourism by integrating the development model of "agriculture + culture + tourism" to promote the construction of low-carbon rural industries and ecological civilization. The development of IAT has strengthened the repositioning of ecological value, which can speed up the sustainable development of rural production, life, and ecology, and achieve the organic unity of economic, ecological, and social benefits while taking into account the "green water and green mountains" ecological dividend [25], promoting green development in rural areas. Based on this, this paper proposes:

Hypothesis 1. *IAT can positively promote rural green development.*

2.2. Heterogeneity Analysis of IAT Promoting Rural Green Development

Due to significant differences in resource endowment, economic development level, and production and lifestyle in different regions, there are differences in geographical characteristics, production methods, human capital, policy support, and other things among different rural regions, resulting in heterogeneity in rural ecological development and its influence mechanisms in different regions [35]. Low-input sustainable agriculture in the United States is a traditional agricultural development mode that advocates the full use of natural resources and the growth characteristics of crops. This mode focuses on tapping the biological and genetic potential of animals and plants, reducing the use of pesticides and fertilizers, and promoting the circular development of planting and aquaculture, so as to maintain the balance between ecological environmental and economic development and achieve green development in rural areas [36]. Japan's rural areas mainly achieve green and sustainable development in rural areas by developing circular economy, emphasizing resource recycling, and actively developing new energy [37]. Rural reconstruction and landscape design play a significant role in rural space ecology. Green vegetation space forms the quantitative basis of village settlements. The relationships among English villages, villagers' behavior, and the surrounding ecological environment have significant characteristics [38,39]. Green sustainable development in rural areas has complex characteristics, both ecological characteristics and social behavior mechanisms. In the process of IAT promoting rural green development, there is heterogeneity in human capital levels in various regions, and IAT is a process in which agriculture and tourism are based on economic association; penetration and integration of factors, technologies, products, markets, and other economic associations; and promotion of the gradual extension, crossover, and reorganization of the value chain to fuel a new business form. This requires a transformation from labor-intensive agriculture and tourism production to knowledge- and technology-intensive IAT; it belongs to a new type of business model, which must be supported by corresponding professional and complex talents [40]. These areas, with high levels of human capital and practitioners with high cultural quality regardless of their own learning ability, cognitive level, or ideas, are greater than those areas with low levels of human capital. Therefore, the level of human capital is a difference in which IAT promotes rural green development. In addition, grain production is the main body of agriculture, and the concentration of grain production can be used as an important indicator to measure the difference in agricultural development, so the characteristics of IAT in the major grain-producing areas are "agriculture-oriented, tourism enabling", and the characteristics of IAT in non-major grain-producing areas are "carrying tourism with agriculture, promoting agriculture with tourism". The former takes agricultural development as the main body and rural areas as the space, which "enables" agriculture through tourism, and IAT drives agricultural characteristics, services, and low-carbon emissions reduction. The latter takes rural culture and tourism resources as the starting point, trans-

forms traditional agriculture through promoting tourism with agriculture and rejuvenating agriculture with tourism, and leads carbon emissions reduction in rural areas through IAT. Different regions have different resource endowments and industrial structures, and there are differences in the integrated development model of agriculture and tourism. In conclusion, based on differences in geographical characteristics, resource endowments, and economic development levels in different regions of China, the effect of IAT on rural green development is heterogeneous.

Hypothesis 2. *IAT promoting rural green development is characterized with heterogeneity, such as in human capital, grain-producing concentration, and regional space.*

2.3. The Transmission Mechanism of IAT Enabling Rural Green Development

IAT is also the process of promoting the continuous improvement of labor supply quality, capital input structure, technological innovation, etc., which accelerate the formation of the new business mode of IAT, thereby improving resource allocation efficiency and production efficiency and achieving energy conservation and emission reduction goals and promoting the realization of rural green development goals.

First, the quality of labor supply is an important driving factor to promote the transformation and upgrade of rural industries. IAT is also a process of adjustment and optimization of labor input mode and supply and demand structure, and the promoting effect on rural green development is mainly reflected in the following aspects: (1) IAT optimizes the structure of labor input and promotes low-carbon rural development and ecological protection. It is the process of mutual penetration and intersection of agriculture and tourism in a specific space. In the process of gradually defining industrial characteristics, improving infrastructure and public service supply, IAT has also changed the structure of the rural labor force and ecological protection awareness. Industrial added value and comparative labor income have led the rural labor force to transfer to low-carbon green industries [41,42], which has also intensified the industrial contraction of extensive production and heavy environmental pollution and promoted the expansion of ecological agriculture, leisure agriculture, and low-carbon agriculture structures and the development of rural industrial structure towards rationalization and upgrading [3]. The optimization of labor structure based on IAT has promoted the development of rural green industries, forming a positive cumulative cycle effect of energy conservation, carbon emission reduction, and pollution control. (2) The knowledge and technology spillover effect brought about by the upgrading of technology, information, management experience, and other elements in the process of agricultural and tourism integration has promoted the improvement of labor structure and quality [43]. IAT means the transformation of industrial models, production, and management innovation, which requires the standardization of producers' ecological behavior, and the knowledge and technology spillover effect in this process promotes optimization of the labor structure and quality improvement. This has a significant role in promoting resource conservation, pollution prevention, and production efficiency improvement, and has a "spillover" effect on the improvement of the green total factor productivity of adjacent agricultural production. (3) IAT has promoted the "return" of high-quality rural labor. IAT occurs in the countryside, and the integrated development of ecological agriculture, leisure agriculture, and rural tourism has high added value and a sustainable "premium" effect, which can attract a high-quality migrant labor force with the ability and vision to return to the hometown for employment and entrepreneurship under the trend of continuous improvement of comparative income and bring about the phenomenon of the "return" of labor returning to the hometown [44,45]. The "return" of high-quality labor can positively promote the high-quality development of agriculture and tourism integration, promote the development of both the economic value and ecological value of rural industries, and achieve a positive enabling effect on rural green development [28].

Therefore, Hypothesis 3 is proposed:

Hypothesis 3. *IAT can promote rural green development through adjusting the labor supply structure.*

Second, IAT can attract high-quality capital to invest in low-carbon industry and achieve rural green development. The "high added value" and low-carbon characteristics of industrial integration can effectively attract government financial support and social capital to support rural industrial development and ecological construction. On the one hand, IAT can attract more government investment support in the process of driving the development of characteristic agriculture and leisure agriculture. IAT is an effective way to promote rural prosperity, agricultural prosperity, and farmers' happiness, and governments at all levels need to provide public investment into rural industrial development through infrastructure support, public service supply, and other inputs. IAT puts forward higher requirements for public infrastructure investment, such as water, electricity, gas, heating, roads, and public transportation, and promotes an optimized energy structure and low-carbon industrial development through local government investment improvement. A sound public infrastructure and transportation system will help improve rural production efficiency and support cleaner life; reduce logistics costs and energy consumption; promote rural ecological environmental protection; improve rural investment in the environment; attract better capital to the countryside; and accelerate the agglomeration of rural capital and green industries [46], which has a promoting effect on rural green development. On the other hand, IAT is a complex of horizontal industrial integration and vertical extension of the industrial chain, which helps to attract more social capital investment in agricultural research, ecological health care, pastoral parent–child tours, ecological farmhouses, green catering, and other fields, which plays an important role in changing the concepts and lifestyle of local residents and advocating low-carbon environmental protection actions. IAT, expanding the industrial chain, can attract capital investment in new industrial forms such as low-carbon tourism and health care; optimize the rural industrial structure and product structure; guide low-carbon consumption; and realize the optimization of consumption structures so as to promote rural green development.

Therefore, Hypothesis 4 is proposed:

Hypothesis 4. *IAT can promote rural green development through attracting capital investment.*

Third, IAT can stimulate technological progress to promote rural green development. IAT is an important way to build a modern rural industrial system and promote the upgrading of rural industries, and its ecological and economic benefits have stimulated the enthusiasm of local governments and industrial operators for technological innovation. Green technology innovation and application capabilities promote carbon emission reduction and the development of rural green and low-carbon industries. On the one hand, IAT can produce technological spillover effects, and, after the penetration, integration, and reorganization of tourism and agriculture with knowledge, technology, and culture-intensive characteristics, it will have knowledge and technology spillover effects on agriculture and related industries and promote green innovation and the development of various rural industries. The development of new business forms such as smart tourism in the process of IAT has a "reverse pushing" effect on business entities, promoting the innovation and application of green technology and achieving green development through a positive circular cumulative effect [47]. On the other hand, the market competition mechanism promotes technological innovation and the application of new industrial entities integrating agriculture and tourism to promote carbon emission reduction. Whether IAT can achieve sustainable development depends on the degree of its meeting the needs of tourists, and on technological innovation to promote innovation in processes, products, and services, which is the fundamental way to enhance the competitive advantage of the market. Technological innovation is not only the power source of IAT [48], which can reduce industrial barriers and cross the entry threshold, but also an important content of IAT. In order to

ensure that the quality of products and services can meet the needs of consumers, and then achieve product structure, service efficiency, and sustainable development of the industry, it is necessary to actively promote the progress of green technology and reduce marginal costs. IAT has spawned new business forms in technological innovation; innovated low-carbon technologies in raw material supply, product deep processing, and other areas; and promoted low-carbon industrial development so as to realize rural green development.

Therefore, Hypothesis 5 is proposed:

Hypothesis 5. *IAT can promote rural green development through strengthening technological progress.*

3. Research Design

3.1. Model Settings

Combined with existing relevant studies, some scholars have adopted fixed-effect models to explore the promotion of agro-ecological efficiency and agricultural labor productivity based on IAT [21,49]. Considering the impact of agro-ecological efficiency and labor productivity on rural green development, based on the above literature reviews, theoretical analysis, and research assumptions, this paper constructs the following panel model for empirical testing with reference to the existing research results.

$$Index_{it} = \alpha_0 + \alpha_1 A\&T_{it} + \beta Control_{it} + \delta_t + \lambda_i + \varepsilon_{it} \quad (1)$$

In the above formula, $A\&T_{it}$ represents the level of IAT, $Index_{it}$ represents rural green development, and $Control_{it}$ represents control variables, including government financial support (GFS), regional economic capital stock (ECS), environmental pollution control intensity (EPCI), regional industrial pollution degree (IPD), and environmental carrying capacity (ECC); the last three variables are closely related to carbon emission reduction, i and t represent the region and year, and δ and λ represent time and individual fixed effects, respectively; ε represents an error item.

3.2. Variable Selection and Calculation Method

3.2.1. Variable Selection

(1) Dependent variable. The connotations of rural green development are multidimensional, and there are literature studies on rural green development focusing on the degree of rural ecological livability. This mainly focuses on the perspective of "production, life and ecology", and the evaluation factors include the degree of rural production development, livability level, ecological environment status, etc. Based on existing research, this paper evaluates rural ecological livability from the perspective of "production, life and ecology" [50], and constructs a comprehensive index system for rural green development from three dimensions: production development, livability of life, and ecological beauty (Table 1). Considering dimensional differences in the original data, to ensure the comparability of the indicators and the accuracy of the analysis results, the extreme value method is used to standardize the original data, and the entropy method is used to determine the weight of each index.

(2) Independent variables. IAT is the core explanatory variable of this paper. It is the process of mutual penetration, intersection, and coupling of agriculture and tourism and the realization of reorganization and combination to form a new business format. Drawing on existing research, the selection can not only reflect the respective development levels of agriculture and tourism, but also reflect the coordination of mutual penetration, alternate fertilization, and coupling reorganization in agriculture and tourism [51–53]. Therefore, the comprehensive index system of IAT is constructed from the dimensions of elements, structure, and performance (Table 2). Based on industrial factors and performance, the total planting area of crops, the total power of agricultural machinery, the number of domestic tourists, the number of inbound tourists, the added value of the primary industry, the added value of agriculture, forestry, animal husbandry, and fishery, and the per capita disposable income of farmers are selected to measure the development level of agriculture

and tourism. At the level of industrial structure, the industrial rationalization index and the level of industrial advancement are used as proxy variables of the correlation and coordination of IAT to construct a comprehensive index system for IAT. According to the list of demonstration counties for IAT selected from 2010 to 2017, in view of the availability of data, 152 prefecture-level cities containing demonstration counties were selected as research samples, the original data of each index were dimensionless, and the entropy method was used to determine the weight of each index to calculate the comprehensive score of each index to measure the level of IAT.

Table 1. Comprehensive indicator evaluation system for rural green development.

Overall Objectives	System Layer	Feature Layer	Specific Indicators
rural green development	Rural production development (0.2528%)	Total industrial output value per capita above designated size	Added value of secondary industry (0.0863%)
		Regional economic development level	Per capita GDP (0.0583%)
		Proportion of characteristic industries	Proportion of non-agricultural industry in GDP (0.0361%)
		Food Self-sufficiency ratio	Total grain output (0.0721%)
	Rural life is livable (0.4662%)	Medical and health security level	Number of beds in medical and health institutions (0.0692%)
		Wage level	Average salary of in-service employees (0.0511%)
		Pollution of human settlements	Emission of industrial sulfur dioxide (0.1043%)
			Industrial wastewater discharge (0.0995%)
			CO_2 emissions (0.1421%)
	Beautiful rural ecology (0.281%)	Improvement of human settlement environment	Domestic garbage harmless treatment rate (0.0241%)
		Air pollution degree	PM 2.5 (0.0421%)
		Input of harmful production factors	Amount of agricultural chemical fertilizer (converted into pure fertilizer) (0.0721%)
		Resource loss degree	Total energy consumption (0.1427%)

Table 2. Comprehensive index system of IAT.

Overall Goal	System Layer	Subsystem Layer	Specific Indicators
IAT	Agriculture (0.1954%)	Industry factors	Total power of agricultural machinery (0.0482%)
			Total area sown with crops (0.0399%)
		Industry performance	Gross output value of the primary industry (0.0355%)
			The total output value of agriculture, forestry, animal husbandry and fishery (0.0365%)
			Per capita disposable income of farmers (0.0353%)
	Tourism (0.495%)	Industry performance	Number of domestic tourists (0.0548%)
			Number of inbound tourists (0.1679%)
			Domestic tourism revenue (0.0807%)
			Foreign exchange tourism income (0.1916%)
	Industrial structure (0.3096%)	Industrial rationalization	Industrial rationalization index (0.273%)
		Advanced industry	Level of industrial sophistication (0.0366%)

(3) Control variables. In addition to the impact of IAT, local financial support, economic development level, regional industrial pollution degree, and environmental governance intensity are also important influencing factors. To this end, this paper selects the following

control variables: (1) the degree of local financial support, using the per capita fiscal revenue of each city as the proxy variable; (2) regional economic capital stock, using the fixed capital stock of various local-level cities as the proxy variable; (3) the intensity of environmental pollution control, using measured data on the environmental pollution control intensity of various cities as the proxy variable; (4) the degree of regional industrial pollution, using industrial soot emissions as the proxy variable; (5) environmental carrying capacity, using the total population at the end of the year as the proxy variable.

3.2.2. Variable Measure

Following the principles of scientificity and preciseness, the entropy method was used to empower the determination of index weights, aiming to eliminate human subjective factors in determining the weight of indicators. In order to make the index weight results more reasonable and scientific, time variables were added, and the improved entropy method was used to evaluate the level of IAT and the degree of rural green development [54].

(1) Dimensionless processing. Due to differences in the dimensions, orders of magnitude, and positive and negative orientations of each index, it is necessary to use the extreme value method to standardize the original data, and the positive index calculation method is used if a larger index is more beneficial to the development of the system, $X'_{\partial ij} = \frac{X_{\partial ij} - \min X_j}{\max X_j - \min X_j} + 0.0001$. If a smaller index is more beneficial to the development of the system, the negative index calculation method is adopted, $X'_{\partial ij} = \frac{\max X_j - X_{\partial ij}}{\max X_j - \min X_j} + 0.0001$. To avoid zero, add 0.0001, $X_{\partial ij}$ as the Jth indicator value of prefecture-level city i in the ∂ year.

(2) Calculate the index weight.

$$y_{\partial ij} = X'_{\partial ij} / \sum_{\partial} \sum_{i} x'_{\partial ij} \tag{2}$$

Calculate the entropy of indicator j.

$$e_j = -k \sum_{\partial} \sum_{i} y_{ij} \ln y_{\partial ij} \tag{3}$$

Among these, $k > 0$, $k = \ln(fs)$, f is the number of years, and s is the number of sample prefecture-level cities.

Calculate the coefficient of difference for indicator j.

$$g_j = 1 - e_j \tag{4}$$

The formula for calculating the weight of each metric.

$$w_j = g_j / \sum_{j} g_j \tag{5}$$

(3) Calculate the comprehensive score for IAT and rural green development in various local-level cities.

$$h_{\partial i} = \sum_{j} (w_j x'_{\partial ij}) \tag{6}$$

3.2.3. Research Object, Sample Selection, and Data Source

First of all, in order to explore the internal mechanisms of IAT promoting rural green development, this paper takes China's leisure agriculture and rural tourism demonstration counties as the analysis samples. Second, we selected samples according to the following realities. (1) The time span of the selection of the demonstration county is from 2010 to 2017. Since 2018, national selection has stopped and local selection has been carried out independently; in view of the scientific and rigorous nature of the empirical testing and considering the impact of COVID-19 on the tourism industry, the samples were selected from 2010 to 2019. (2) From 2010 to 2019, a total of 389 demonstration counties were selected

(including local independent selections). Since the demonstration counties involved in Hainan Province are directly under the provincial government, the sample selection did not include Hainan Province. These IAT demonstration counties are respectively subordinate to 202 prefecture-level cities (autonomous prefectures), which are very representative of the development of IAT in China. (3) Based on the principles of data availability and continuity, 152 data samples on the agriculture, tourism, production development, livability, and ecological beauty of prefecture-level cities (autonomous prefectures), including agricultural and tourism integration demonstration counties, were finally selected as samples, which are well representative. Thirdly, the number of demonstration counties involved in the calculation of IAT and the lists for past years were derived from the official websites of various local-level cities, and from the Ministry of Agriculture and Rural Affairs, with data mainly derived from the "China Urban Statistical Yearbook", "Provincial Statistical Yearbook", "Statistical Yearbook of Local-level Cities", "China Regional Economic Statistical Yearbook", China Economic Information NET Database (CEI Database), and the statistical bulletins of various local-level cities.

4. Empirical Results

4.1. Empirical Test on IAT Promoting Rural Green Development

First, benchmark regression analysis. Based on the results of the Hausman test, a fixed-effect model was adopted to analyze the degree of rural green development promoted by IAT with analysis software Stata 15.1. Regression results are shown in Table 3. According to column (1), IAT has a positive impact on rural green development alone, and column (2) is the result of adding control variables. The regression coefficients are significantly positive at the level of 1%, which has a positive effect on rural green development. This verifies that IAT can effectively promote rural green development and is a powerful engine and action resource. At the production level, IAT optimizes the structure of factors through resource integration, transforms traditional production and operation methods, innovates in agricultural development models, improves output levels, effectively reduces resource waste and consumption, and promotes the green development of rural industries. At the life level, IAT can develop new industrial forms, promote product and service innovation, and create a good ecologically livable environment. At the ecological level, IAT accelerates capital accumulation, realizes both ecological and economic benefits, improves the ecological awareness and ecological protection of local governments and villagers, and forms a positive cycle of accumulation effects, "IAT—capital accumulation—strengthening cognition—protecting ecology", which verifies the research hypothesis that IAT has a positive promoting effect on rural green development.

Second, an endogeneity test based on instrumental variables. The endogeneity problem cannot be ignored in regression analysis since the measurement error of variables and the omission of important variables may cause endogenous errors in estimation results [55]. In order to avoid the possible endogeneity problems of the above regression, the instrumental variable method was selected. Taking the added value of the tertiary industry as the instrumental variable (IV) of IAT, the results of Table 3 show that the first stage in column (3) is significantly positive at the level of 1%, so there is no problem of weak instrumental variables. The coefficient of IAT in the second stage is consistent with the benchmark regression results, which indicates that IAT still has a significant role in promoting rural green development after considering endogenous issues. This shows that the above conclusion is still valid.

Third, a robustness test. In order to ensure the reliability of the above empirical results, a robustness test was carried out by adding control variables. Transportation convenience and tertiary industry development level can play an important role in IAT in rural green development, so the two variables of transportation convenience and tertiary industry development level are added to the control variables for robustness testing. Among these, the number of taxis is used as a proxy variable for the degree of transportation convenience (EOT), and the proportion of employees in the tertiary industry is used as a proxy variable

to measure the development level of the tertiary industry (TLOTID). Column (5) of the estimated results shows that the regression results are still significant, and the regression coefficient of IAT on rural green development is still significantly positive, which indicates that the empirical results in this paper are robust.

Table 3. Benchmark regression, endogeneity test, and robustness test results.

	(1)	(2)	(3)	(4)	(5)
Variables	**Index**	**Index**	**A&T**	**Index**	**Index**
A&T	0.339 ***	0.261 ***		0.662 ***	0.263 ***
	(3.06)	(2.73)		(7.96)	(2.72)
IV			0.001 ***		
			(8.77)		
GFS		0.012 ***	−0.006 **	0.009 ***	0.012 ***
		(3.92)	(−2.87)	(4.08)	(3.94)
ECS		0.012 **	0.009 *	0.010 **	0.009 *
		(2.35)	(2.44)	(2.64)	(1.77)
EPCI		0.013 ***	0.001	0.014 ***	0.013 ***
		(4.62)	(0.02)	(8.17)	(4.54)
IPD		−0.003 **	0.001	−0.004 ***	−0.003 **
		(−2.38)	(0.29)	(−4.05)	(−2.18)
ECC		0.054 ***	0.055 ***	0.011	0.058 ***
		(2.99)	(4.20)	(0.94)	(3.18)
EOT					0.004 *
					(1.80)
TLOTID					−0.018 ***
					(−3.38)
Control	0.137 ***	−0.316 **			−0.255 *
	(20.32)	(−2.31)			(−1.83)
Observations	1520	1520	1520	1520	1520
Individual effects	control	control	control	control	control
Time effect	control	control	control	control	control
R2	0.518	0.588			0.597
First stage F value			77.001		
Cragg-Donald				375.909	
Wald F statistic value				[16.38]	

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.2. Heterogeneity Test

In order to systematically explore the role and heterogeneity characteristics of IAT in rural green development, this paper selects three levels of human capital level, geographical region, and grain production concentration.

4.2.1. Human Capital Level Heterogeneity Analysis

Based on the level of human capital in prefecture-level cities with recreational agriculture demonstration counties, the samples were divided into high-level and low-level human capital areas. The regression results in Table 4 show that the regression coefficient of IAT on rural green development in areas with high human capital is significantly positive at the level of 1%, while the regression coefficient of IAT in low-human-capital areas is not significant, which indicates that IAT in areas with high human capital can significantly promote rural green development, but not in areas with low human capital. According to endogenous growth theory, human capital and technological innovation interact to drive economic growth. Technological innovation requires high-skilled human capital, and high-level human capital can efficiently improve technological innovation and application capabilities [56]. In areas with low human capital levels, there are only weak technological innovation and application capabilities.The endogenous power of industrial development

is insufficient, which restricts IAT and affects the green transformation of industries. In addition, high-level human capital has a "spillover effect", which can bring advanced technology; scientific management experience and concepts; low-carbon and environmentally friendly lifestyles; green consumption concepts; etc. This affects people's production activities, environmental awareness, and lifestyle.

Table 4. Heterogeneity test.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	**Low Human Capital**	**High Human Capital**	**Eastern Region**	**Central Region**	**Western Region**	**Major Grain-Producing Areas**	**Non-Major Grain-Producing Areas**
A&T	0.037	0.392 ***	0.167	0.425 ***	0.377 ***	0.244 *	0.326 ***
	(0.74)	(5.55)	(1.54)	(4.27)	(7.17)	(1.82)	(3.82)
GFS	0.007	0.012 ***	0.013 ***	0.007 *	0.012 ***	0.007	0.016 ***
	(1.46)	(3.50)	(2.88)	(1.83)	(4.86)	(1.51)	(5.53)
ECS	0.014 **	0.008	0.012	0.020 ***	−0.004	0.013 **	0.010
	(2.30)	(1.01)	(1.22)	(2.83)	(−0.40)	(2.26)	(1.11)
EPCI	0.012 ***	0.017 **	0.024 ***	0.017 ***	0.002	0.015 ***	0.011 **
	(4.72)	(2.61)	(3.44)	(5.31)	(0.82)	(4.10)	(2.54)
IPD	−0.001	−0.007 **	−0.006 **	−0.007 ***	0.001	−0.004 **	−0.002
	(−0.97)	(−2.48)	(−2.18)	(−3.29)	(0.87)	(−2.30)	(−0.99)
ECC	0.039	0.042 **	0.094	0.031 *	0.018	0.051 **	0.039 *
	(1.61)	(2.43)	(1.29)	(1.93)	(1.07)	(2.01)	(1.67)
Control	−0.294 **	−0.118	−0.506	−0.290 **	0.060	−0.310 *	−0.229
	(−2.02)	(−0.76)	(−1.29)	(−2.07)	(0.42)	(−1.70)	(−1.13)
Observations	760	760	610	550	360	940	580
Individual effects	Control	Control	Control	Control	Control	Control	Control
Time effect	Control	Control	Control	Control	Control	Control	Control
R2	0.632	0.583	0.539	0.653	0.785	0.503	0.748

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.2.2. Regional Heterogeneity Analysis

According to the regional attributions of the provinces where the sample cities are located, sample cities are divided into three regional types for eastern, central, and western China. The results in Table 4, columns (3), (4), and (5), show that the regression coefficient of IAT on rural green development in the central and western region is significantly positive at the level of 1%, while the regression coefficient of IAT in eastern China is positive but not significant, which means that IAT has a significant positive role in promoting rural green development in central and western China. The reason is that eastern China has a developed economy, relatively complete rural infrastructure, and advanced development concepts; local governments have paid more attention to the ecological environment and green development; and IAT is relatively mature, which can still have a positive role in promoting rural green development, but the marginal effect is small and not obvious enough. The central and western regions are relatively backward in absorbing high-skilled talent, technological innovation, and ecological management; the construction of rural ecological civilization is relatively lagging behind, coupled with the lag in public infrastructure; IAT is in a rapid growth period, which can play a positive role in promoting rural green development, and its marginal effect is rapidly increasing.

4.2.3. Heterogeneity Test on Grain-Producing Areas

According to the opinions on *Further Deepening the Reform of the Grain Circulation System* issued by the State Council of China in 2001, the sample cities were divided into major grain-producing areas and non-major grain-producing areas respectively. Among them, the major-grain-producing areas include 13 provinces, including Liaoning, Jilin, Heilongjiang, Inner Mongolia, Hebei, Shandong, Anhui, Jiangsu, Jiangxi, Henan, Hunan, Sichuan, and Hubei. Columns (6) and (7) of Table 4 show that the coefficient of IAT in non-major grain-producing areas is significantly positive at the level of 1% and in major grain-producing

areas is significantly positive at the level of 10%, Results show that IAT in non-major grain-producing areas has a more significant role in promoting rural green development than that in major grain-producing areas. The reason is that agricultural production in the major grain-producing areas is relatively developed, and IAT emphasizes "agriculture-oriented, tourism empowerment", which belongs to the extended development model of agriculture, and the share is relatively small. IAT in non-major grain-producing areas emphasizes "carrying tourism with agriculture and promoting agriculture with tourism", which makes it easier to promote the deep integration and development of agriculture and tourism, and which, in non-major grain-producing areas, has both breadth and depth; the green industrial system is also relatively complete, and the role of IAT in promoting rural green development is also more significant.

4.3. Transmission Mechanism Test

In order to avoid the problem that reverse causality in the above benchmark regression analysis would be omitted, which may lead to deviation of the estimation results from consistency, this paper constructs a simultaneous equation set to test the complex causality between rural green development and IAT so as to systematically explore the transmission effect of IAT on rural green development through the labor structure, capital investment, and technological progress. The system estimation method can make full use of the constraints and information of all equations to estimate each equation and determine all parameter estimates for each equation at the same time, and the three-stage least-squares method as the system estimation method can simultaneously determine all parameters of the simultaneous equation system and obtain an asymptotic, effective, unbiased estimator. The system of simultaneous equations is set as follows:

$$\begin{aligned} Index_{it} &= \alpha_2 + \alpha_2 A\&T_{it} + \beta_2 Labor + \beta_2 Control_{it} + \delta_t + \lambda_i + \varepsilon_{it} \\ Labor_{it} &= \alpha_3 + \alpha_3 A\&T_{it} + \beta_3 Control_{it} + \delta_t + \lambda_i + \varepsilon_{it} \end{aligned} \quad (7)$$

$$\begin{aligned} Index_{it} &= \alpha_2 + \alpha_4 A\&T_{it} + \beta_4 Cap + \beta_4 Control_{it} + \delta_t + \lambda_i + \varepsilon_{it} \\ Cap_{it} &= \alpha_5 + \alpha_5 A\&T_{it} + \beta_5 Control_{it} + \delta_t + \lambda_i + \varepsilon_{it} \end{aligned} \quad (8)$$

$$\begin{aligned} Index_{it} &= \alpha_2 + \alpha_6 A\&T_{it} + \beta_6 Tech + \beta_6 Control_{it} + \delta_t + \lambda_i + \varepsilon_{it} \\ Tech_{it} &= \alpha_7 + \alpha_7 A\&T_{it} + \beta_7 Control_{it} + \delta_t + \lambda_i + \varepsilon_{it} \end{aligned} \quad (9)$$

First, the transmission effect of the labor structure on IAT to promote rural green development is analyzed. IAT can promote the non-agricultural transfer of rural labor and the quality of rural labor through technological progress and management innovation, thereby improving the production efficiency of rural industries; with increasing labor transferred to tourism and reduced agricultural labor input, agriculture effective output level will be improved and resource waste and loss also reduced. On the other hand, IAT will accelerate the concentration of capital in rural industries to develop new industrial forms and attract rural labor to returning to promote the green development of the industry. This paper takes the ratio of the number of employees in the primary industry to the total population at the end of the year as the proxy variable for labor structure (Labor), and the estimation results in column (1) in Table 5 show that the regression coefficient of IAT on labor structure is significantly negative at the level of 5%, which means that IAT can promote the transfer of agricultural labor. The results in column (2) show that the regression coefficients of IAT and labor structure on rural green development are significantly positive at the level of 1%, which indicates that IAT has a direct promoting effect on rural green development and can promote the green development of rural ecology by promoting structural changes such as labor transfer and return.

Second, the transmission effect of capital investment on IAT promoting rural green development is analyzed. A sound public infrastructure and transportation system will help reduce logistics costs and energy consumption and promote rural ecological environmental protection. IAT can attract capital investment in new industrial forms such as low-carbon tourism and health care and guide low-carbon consumption and optimize consumption

structures for promoting rural green development. In particular, innovative rural tourism development models such as smart tourism and digital tourism "spillover" can promote agricultural digitalization and increase capital investment, digital empowerment, and information management to promote the transformation of rural industries so as to change the situation of resource dependence, excessive waste, and ecological imbalance caused by extensive traditional agricultural management. In this paper, the ratio of rural fixed asset investment to crop sown area is used as the proxy variable of capital input (Cap), and its logarithm is used for quantitative analysis. From columns (1) and (2) of Table 5, it can be seen that the regression coefficient of IAT to capital input is significantly positive at the level of 5%, the regression coefficient of IAT and capital investment for rural green development is significantly positive at the level of 1%, and IAT can promote rural ecological construction by increasing the level of capital investment.

Table 5. Test of the transmission mechanism.

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	**Labor**	**Index**	**Cap**	**Index**	**Tech**	**Index**
A&T	−0.642 **	0.269 ***	0.928 **	0.254 ***	1.779 ***	0.252 ***
	(−2.53)	(10.30)	(2.12)	(9.74)	(4.45)	(9.56)
Labor		0.061 ***				
		(4.41)				
Cap				0.081 ***		
				(4.85)		
Tech						0.053 ***
						(2.86)
GFS	0.022 *	0.012 ***	0.240 ***	0.010 ***	−0.010	0.012 ***
	(1.79)	(9.18)	(11.29)	(7.58)	(−0.49)	(9.40)
ECS	0.156 ***	0.010 ***	1.704 ***	−0.002	0.319 ***	0.010 ***
	(5.49)	(3.29)	(34.81)	(−0.44)	(7.14)	(3.35)
EPCI	−0.035 **	0.014 ***	0.023	0.013 ***	0.016	0.013 ***
	(−2.45)	(9.31)	(0.93)	(8.92)	(0.73)	(8.94)
IPD	0.020 **	−0.004 ***	0.004	−0.003 ***	0.015	−0.003 ***
	(2.25)	(−3.98)	(0.28)	(−3.76)	(1.10)	(−3.78)
ECC	0.081	0.053 ***	0.772 ***	0.048 ***	−0.418 **	0.057 ***
	(0.73)	(4.70)	(4.03)	(4.23)	(−2.39)	(4.94)
Control	−3.207 ***	−0.126	−30.450 ***	0.073	−3.280 **	−0.149
	(−3.63)	(−1.38)	(−19.96)	(0.71)	(−2.36)	(−1.63)
Observations	1520	1520	1520	1520	1520	1520
Individual effects	Control	Control	Control	Control	Control	Control
Time effect	Control	Control	Control	Control	Control	Control
R2	0.988	0.977	0.955	0.977	0.851	0.976

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Third, the transmission effect of technological progress on IAT to promote rural green development is analyzed. Technological innovation is the internal driving force of industrial integration [57]. The level of technological application and technological innovation is important for promoting industrial integration. On the one hand, IAT promotes industrial innovation and development and enhances competitiveness through the spillover of technology and experience. On the other hand, the industry continues to cross-penetrate and reorganize, expanding into new industrial forms; in order to survive and benefit, enterprises continue to improve their abilities in technology application and transformation by stimulating technological innovation through competition, then new momentum for industrial development is enhanced, industrial transformation is accelerated, and carbon emission is reduced as well. In this paper, the ratio of the total power of agricultural machinery to crop sowing area is used as the proxy variable for technological progress (Tech),

and its logarithmic value is quantitatively analyzed. The results in columns (5) and (6) of Table 5 show that the regression coefficient of IAT on technological progress is significantly positive at the level of 1% and the regression coefficients of IAT and technological progress on rural green development are both significantly positive at the level of 1%, indicating that IAT can promote technological progress and has a positive impact on rural green development and that technological progress is an effective transmission channel for IAT promoting rural green development.

5. Conclusions, Discussion and Prospect

5.1. Conclusions

In this paper, the internal mechanisms of IAT promoting rural green development was systematically analyzed, a comprehensive index evaluation system for rural green development was constructed from three dimensions, including rural production, life, and ecology, a comprehensive index system for IAT was constructed based on industrial factors, performance, and structure, the panel data of 152 prefecture-level cities containing leisure agriculture and rural tourism demonstration counties in China from 2010 to 2019 were selected to empirically test the promotion mechanisms of IAT on rural green development. Preliminary conclusions were drawn. First, IAT can effectively promote rural green development, it has a positive role in promoting rural green development, and this conclusion is still valid after testing the endogeneity based on instrumental variables and robustness testing. Second, the promoting effect of IAT on rural green development shows the significant characteristics of human capital level, major grain-producing area type, and geographical spatial heterogeneity, among which high human capital, central and western China, and non-major grain-producing areas have a more significant role in promoting rural green development. Third, IAT can not only directly promote rural green development, but can also have an indirect transmission effect that promotes rural green development through labor structure, capital input, and technological progress.

5.2. Discussion

5.2.1. Theoretical Contribution

Compared with existing research, the theoretical contributions of this paper are mainly reflected in the following aspects. First, existing studies on the measurement of rural green development level not only have evaluation criteria focusing on the degree of rural green production, life, and ecological development from a macro perspective [58], these studies also have an evaluation system integrating the developmental levels of rural green foundations, resources, the environment, and technology [59]. There are also quantitative indicators focusing on rural resource utilization, environmental friendliness, ecological protection, and rural development as the measurement standards in rural green development [60]. According to the perspective of complex systems, this paper constructed a comprehensive indicator evaluation system for rural green development from the three dimensions of rural production development, livability, and ecological beauty based on existing research and the perspective of "three living". Second, existing studies on the measurement of IAT are mainly characterized by the ratio of the number of prefecture-level cities selected as national leisure agriculture and rural tourism demonstration counties to the number of all county-level administrative units (including county-level cities) under the jurisdiction of the city [3,16,49,61,62]. Some scholars build and measure a comprehensive indicator system for the development level of IAT based on the three dimensions of industrial relevance, the economic benefits of integrated development, and the integration of new business forms [46]. Existing studies on the measurement of IAT are not comprehensive or complete. Therefore, based on previous research, this paper constructed a comprehensive indicator evaluation system of IAT from the perspective of industrial integration with industrial factors, performance, and structure. Third, IAT and rural green development are integrated into the unified analysis framework to deeply analyze the promotion mechanisms, heterogeneity, and transmission effects of IAT on rural

green development, and 152 prefecture-level cities panel data were selected from 2010 to 2019 for empirical testing. This paper refers to the research of existing scholars on the levels of human capital [34,39] and the division of main grain production areas [61]. The three dimensions of geographical location [3,16,49] were systematically and comprehensively analyzed for heterogeneity and tested with panel data.

5.2.2. Practical Implications

The above research conclusions have important practical implications for how to effectively promote IAT to realize rural green development: First, local governments should actively implement the strategy of energy efficiency improvement and carbon emission reduction. In particular, local governments should scientifically develop IAT projects; combine the agricultural and rural tourism resource endowments of various regions; scientifically promote IAT; cultivate and develop the whole industrial chain and value chain of IAT; and form a new pattern of multi-subject participation, multi-factor aggregation, and multi-format development so as to achieve coordination between economic and ecological development. Considering the actual resource endowments of various regions, local governments should focus on the production, life, and ecological development goals of rural green development, giving full play to the role of IAT in promoting rural green development. According to local conditions and reality, local governments should formulate scientific and effective development plans for IAT, then realize rural green development.

Second, according to the characteristics of human capital, grain-producing areas, and the geographical spatial heterogeneity of IAT promoting rural green development, local governments should combine resource endowments and comparative advantages to produce "tailor-made" supporting policies and ecological protection systems to promote IAT according to local conditions. Governments should provide supporting policies and institutional guarantees for the introduction of high-level talent into rural tourism enterprises; focus on introducing high-level technical and management talents in the field of IAT, especially for the areas with good agricultural and tourism resource endowments; and give full play to the "pulling effect" of policy resources on IAT. Central and western China should take advantage of local resources, location, and other things to do well on service quality, project characteristics, product innovation, etc., so as to realize the branding and characteristic development of rural industries, enhance the vitality of IAT, and effectively promote rural green development.

Third, effective measures should be taken to improve the transmission mechanisms of labor structure, capital input, and technological progress to promote rural green development during the development of IAT. All regions should give full play to the leading advantages of policies, through building pilot projects for the integrated development of leisure agriculture and rural tourism to achieve comprehensive promotion and actively attract high-quality labor, especially migrant workers returning to their hometowns for employment, therefore transferring more rural labor to non-agricultural industries. At the same time, all regions should take measures to increase the intensity of attracting of investment and talent and expand with new industrial forms to cultivate new business entities, create jobs, accelerate capital accumulation, expand capital and technology investment, and create a good environment for IAT, so as to effectively realize carbon emission reduction and rural green development.

5.3. Shortcomings and Research Prospects

There are still some limitations and deficiencies in this paper, which deserve further research in the future. First of all, due to the availability and continuity of data, this paper could only select 152 total samples from 202 prefecture-level cities including IAT demonstration counties. However, in general, the number of samples selected accounts for 75% of the total number of samples, which are representative. In the future, we hope for the continuous accumulation of data in the fields of agriculture, tourism, and rural "production, life and ecology." On the one hand, we should constantly improve the

comprehensive evaluation system for rural green development and IAT development level. On the other hand, we can further dynamically analyze how the development of IAT affects rural green development and the changing relationship of its transmission mechanisms and deeply explore whether there are other transmission paths besides changing the labor structure, capital investment, and technological progress. This will help to analyze how the IAT can promote rural green development under different paths. It has practical significance for IAT to promote rural green development. Secondly, this paper conducted empirical testing on the basis of quantitative analysis, but lacks case analyses. In the future, it is hoped that some case analysis can be introduced to achieve a combination of quantitative and qualitative analysis. Finally, this paper focuses on IAT in promoting rural green development and investigates prefecture-level cities in China that contain demonstration counties for IAT. In the future, international comparisons can be made, and more internationally specific indicators can be included to enrich the comprehensive indicator system for rural green development and IAT, so as to make further contributions to research on IAT to promote rural green development.

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