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The Construction of the Landscape- and Village-Integrated Green Governance System Based on the Entropy Method: A Study from China

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Abstract: Improving the landscape- and village-integrated green governance (LVIGE) is currently a problem faced by various countries. China has also put forward the revitalization strategy of "rural development, the environment is the background color". How to judge and evaluate the landscape- and village-integrated green governance (LVIGE) is the main research purpose of this study. This study is based on the rural data from 2012 to 2021 in China to construct an evaluation system, which mainly includes three dimensions: economic production construction, social and cultural construction, and ecological environment construction. This study uses the relevant entropy method to calculate the landscape- and village-integrated green governance (LVIGE), and the following conclusions are drawn: There is a significant difference in the data on the ecological factors among rural areas in various provinces of China, and there is a gap in green governance. Many provinces still do not pay sufficient attention to rural development, especially the problem of rural green governance. Northeast China ranks at the bottom in terms of economic production construction, social and cultural construction, and ecological environment construction with a large gap. The rapid improvement of the landscape- and village-integrated green governance (LVIGE) is inseparable from the national policies. Therefore, to improve the development of the landscape- and village-integrated green governance (LVIGE), not only national policy support is needed, but also the local government should pay full attention to the development of the rural economy, social culture, and ecology, especially the construction of an ecological environment. The construction of the evaluation system of the LVIGE not only corresponds to the national policy, but also promotes the provinces' attention to the environment.

Keywords: landscape- and village-integrated; green governance; landscape- and village-integrated green governance; entropy method; evaluation system construction

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Citation: Zhang, J.; Wang, Y. The Construction of the Landscape- and Village-Integrated Green Governance System Based on the Entropy Method: A Study from China. *Agriculture* **2023**, *13*, 1821. https://doi.org/10.3390/agriculture13091821

Academic Editor: Yasuo Ohe

Received: 1 August 2023
Revised: 7 September 2023
Accepted: 15 September 2023
Published: 16 September 2023

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1. Introduction

With the rapid economic growth, the ecological damage problem is becoming increasingly serious [1]. The rural ecological situation is becoming worse and worse, which is not optimistic. There is a renewed interest in rural areas with traditional village–landscapes and evaluating the landscape quality of rural areas [2–4]. Village–landscapes must be protected to maintain national identity and culture and ensure sustainable development in rural areas [5]. China has a history of over 7000 years of agricultural civilization, and traditional villages contain rich historical, ethnic, and regional cultural information [6]. Due to this, China has always attached great importance to environmental concerns [7]. The important thought of "clear water and green mountains are gold and silver mountains" is put forward. Therefore, to promote a more perfect integration of the landscape and villages, the rural environment is the core attraction. Countries should pay attention to the protection of rural cultural values and effectively improve the production, living, and cultural environment of rural living. Taking coordinated development as the goal and

focusing on the implementation of ecological engineering will effectively promote the coordinated development of rural residential environmental and rural leisure tourism [8–11]. Therefore, how do we promote the perfect integration of the landscape and countryside? How to better evaluate the development level of the landscape- and village-integrated green governance (LVIGE) is the focus of this study.

Firstly, we review the literature on the green governance of landscape and village integration (LVIGE). As for the research theme of the green governance of landscape and village integration, the existing research mainly focus on the benefits and paths of landscape and village integration, and the evaluation system mostly focuses on green evaluation and the landscape and village integration evaluation, lacking the system construction of the landscape- and village-integrated green governance (LVIGE). As shown in Figure 1, "Cite-space 6.1" software is used to draw the clustering diagram of the landscape and village integration.

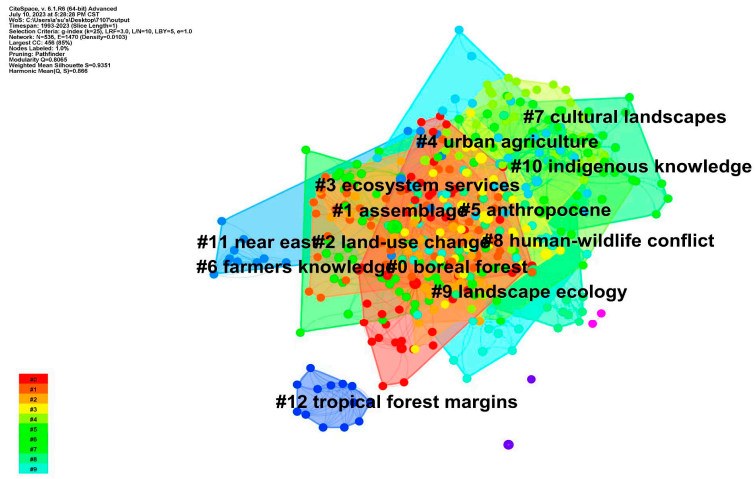


Figure 1. Clustering diagram of landscape and village integration.

Secondly, we construct and analyze the evaluation system according to the connotation and purpose of the landscape- and village-integrated green governance (LVIGE). We take the rural areas of 30 provinces in China as the research samples and use the entropy method to measure the landscape- and village-integrated green governance (LVIGE). Although it is relatively difficult to obtain rural data, it is more meaningful and innovative than urban development to study rural development. Finally, a series of conclusions are drawn according to the evaluation results. Through the comparative analysis of the level of the landscape- and village-integrated green governance (LVIGE) in various provinces, relevant suggestions are put forward. Scholars in both developed and developing countries should balance the research in urban and rural areas. Thus, it plays a key role in the development, as shown in Figure 2.

The contributions of this study are as follows: in the aspect of data selection, overcoming the difficulties of rural data collection and studying rural development; to measure the landscape- and village-integrated green governance (LVIGE), the entropy method was used to construct the relevant evaluation system, and the score was used to determine the level of the landscape- and village-integrated green governance (LVIGE) in each province of China; in terms of content, through the analysis of the three dimensions of comprehensive score, economic production construction, social and cultural construction, ecological environment construction, and the different regions of the province, the paper provides theoretical and technical support for the landscape- and village-integrated green governance (LVIGE) and the environmental development of rural areas.

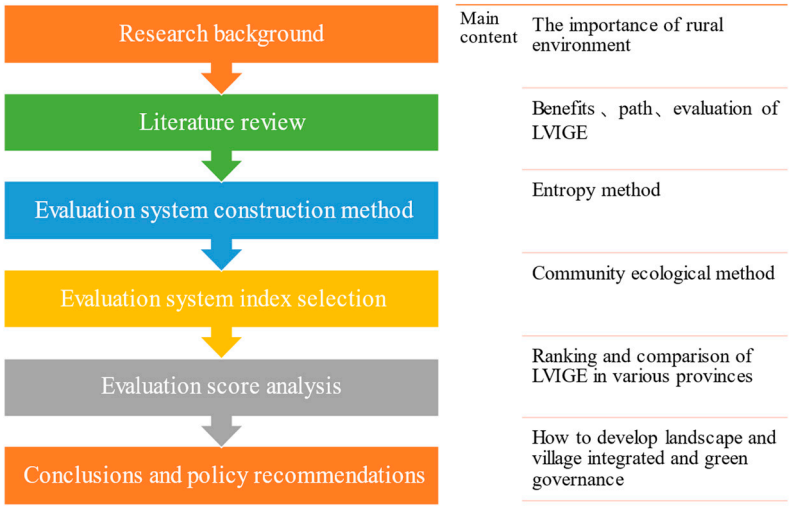


Figure 2. Research framework.

2. Literature Review

2.1. The Benefits of LVIGE

Since the end of the 19th century, the British government has gradually noticed the negative impact of the industrial revolution on the countryside. In order to curb the rapid spread of cities, two acts were successively issued in the 1930s to ensure the survival of the rural landscape and made requirements on the scope and area of the green space between urban and rural areas to protect rural land. France's urbanization rate is later than that of Britain [12]. After the 1960s, the crisis of rural development became obvious, and the French government immediately introduced relevant policies. The government began to pay attention to the balanced development of agricultural activities and environmental protection. In the late 1980s, the United States began to carry out the comprehensive ecological transformation of rural areas [13]. In a study on the benefits of the LVIGE, some scholars believe that the development of countryside and rural tourism can satisfy the pursuit of the economic interests of rural tourists and change the rural lifestyle, which has an important impact on the economy, society, and culture [14–21]. The above western practices fully demonstrate the importance of the integration of the landscape and village.

In terms of research methods, a case analysis is commonly used by scholars, and rural study case areas are concentrated in countries with more developed rural tourism. For example, in Britain, Japan, the United States, France, Germany, and Canada, their rural tourism started early, had a long development time, and was in a mature and typical stage, which is conducive to summarizing the common laws and exploring the development model, and its mature and typical development process is conducive to the exploration of laws. British rural tourism promotes the "reverse flow" of the population from the city to the countryside, bringing huge ecological environment, social, and economic benefits to the countryside [22]. Japan's rural development has improved the level of mechanization and clustering of agriculture and has changed the severe situation of the aging and overthinning of rural agriculture. In empirical research, scientific mathematical statistics methods, modern technology and models, empirical analysis, the Koronis model, the Logit Binomial model, and so on are used [23–25].

The LVIGE in this paper mainly refers to the integration of the economic industry, cultural development, and ecological governance in the process of rural development. In order to better evaluate the development level of the landscape- and village-integrated green governance in rural China, this paper constructs a relevant system to provide data support and theoretical basis for the following analysis and suggestions.

2.2. The Path of LVIGE

In the study of the integration path of the landscape and village, European and American countries have carried out various forms of rural development (construction) movements since the early 20th century, aiming at realizing agricultural and rural modernization and the balanced development of urban and rural areas. Typical foreign rural development (construction) practices include Germany's "rural area development" from the 1950s, the Netherlands' "agricultural land consolidation" movement from the 1960s, Japan's "One village, one product" project from the 1970s, and South Korea's "New village movement" [26]. Most rural development in major developed countries has gone through three stages: the improvement of rural infrastructure, the reform of rural production and the development mode, and the transformation of rural thinking, that is, the transformation from the initial single priority of agricultural development and the improvement of rural infrastructure to the realization of the endogenous sustainable development of rural areas and the pursuit of multi-dimensional demands such as economic value, ecological value, cultural value, tourism value, and leisure value [27,28]. Throughout the development of rural tourism, the government plays an important role. For example, rural tourism in France has the obvious characteristics of government promotion in terms of land and capital [29,30].

2.3. The Evaluation of Landscape and Village Integrated and Green Governance

The evaluations of landscape and village integration. Wang Xin (2021), based on the rural landscape evaluation index system of AVC and combined with the analytic Hierarchy Process (AHP) and other methods, discussed the relationship between rural planning and the vitality, attractiveness, and ability of the AVC theory [31]. Kong et al. (2021) constructed the concept of land-use function integration in "Production-life-ecology" (PLE), a comprehensive evaluation system based on traditional village vitality protection [32]. In terms of the green governance evaluation, most studies have focused on urban green governance, and there are few evaluation studies on rural green governance [33–35]. Scholars mostly use the TOPSIS model to study green efficiency [36]. Singh et al., (2012) studied an index system for sustainable development [37]. Lin et al. (2016) constructed an evaluation index system for ecological civilization from four aspects: economic development, environmental protection, social development, and security system, and conducted an empirical study on Fujian Province [38].

3. LVIGE Evaluation System Construction

3.1. Evaluation System Construction Principles

The following principles should be followed during the construction of the evaluation system, as shown in Figure 3.

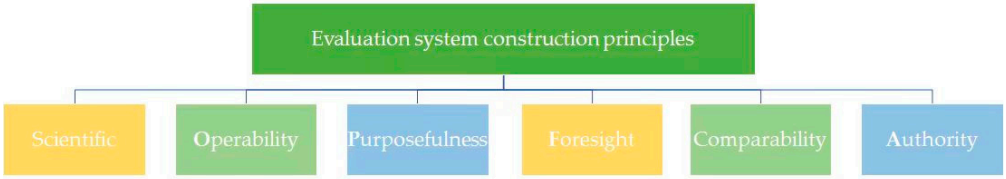


Figure 3. Evaluation system construction principles.

(1) Scientific. The index selection, calculation, and analysis of each subsystem in the evaluation system of the LVIGE should focus on collecting data from aspects such as the landscape and village integration status and the green governance status in rural areas. In an in-depth analysis, an index system can be constructed scientifically, and the level of the LVIGE can be reasonably evaluated to provide a credible reference for improving the policy suggestions of the LVIGE in China. To a certain extent, the scientific nature guarantees the objectivity, that is, the construction of the basic indicator system for the evaluation of the LVIGE can not only rely on subjective

judgment, but should rely on the objective actual situation as much as possible. For example, the weight of the indicator and the constraint value of the "red line" indicator cannot be subjectively inferred but should be determined via objective and reasonable methods. In the process of index selection, this paper fully collates the literature and selects the index frequently used in most of the literature as the index of this paper.

(2) Operability. The operability of the index system is such that the data of the index is easy to collect and calculate. The index design of the LVIGE is wide, and some of the data are difficult to obtain via statistics, which causes certain difficulties in the evaluation practice and affects the operability of the index system. To ensure the operability of the evaluation index system, indicators with a strong representation and high recognition should be selected to ensure that the index data are easy to collect and collate and can be continuously obtained over a long period of time in the future. It should be able to quantify and carry out the quantitative evaluation to achieve objective, accurate, and scientific results.

(3) Purposefulness. The evaluation system of the LVIGE is required to evaluate the conclusion by gradually developing the purpose of the comprehensive evaluation, accurately reflect the situation of the LVIGE, and objectively monitor and describe the essential characteristics and main components of the object, to serve the monitoring and evaluation activities, as there is no literature to show how to better measure the LVIGE. Therefore, independent and interrelated indicators are selected to form a whole to guide the construction of the evaluation system for the LVIGE, to reflect the LVIGE scientifically and completely, and to lay the groundwork for the analysis and suggestions in the following paper.

(4) Foresight. The indicators set up in the construction of the LVIGE should be based on the actual situation of the evaluated region and should follow the international advanced sustainable development results and related domestic frontier construction results. Forward-looking indicators should be summarized from international conventions, rules, agreements, and national planning and applied to the evaluation practice of the LVIGE.

(5) Comparability. On the one hand, the establishment of an evaluation system for the LVIGE should take into account the stage of regional development and the dynamic nature of environmental problems to ensure the horizontal development and vertical continuity of the selected indicators, and at the same time, make it possible to compare the provinces and regions in the country. Thus, we can scientifically and accurately judge the level of the LVIGE and the level and advantages of each rural area in its sub-system.

(6) Authority. The establishment of an evaluation system for the LVIGE is of great significance to future decision-making, so it is necessary to ensure the authority of the evaluation index system. Authority is mainly reflected in the selection of indicators and the indicator data sources and should be selected as far as possible in the government, statistics bureau, other official authorities statistics, and the published indicators are generally accompanied by a more detailed, specific meaning and a statistical caliber description, where the statistical methods are relatively scientific and authoritative. The relevant data can be searched in the statistical yearbook with authority and accuracy. At the same time, the construction of the LVIGE system also selects indicators according to the relevant government policies. The Chinese government believes that rural areas should also pay attention to ecological development in the process of developing the economy and culture.

3.2. Evaluation System Assignment Method

Based on the research purpose and content, this study selected the weighting method of the entropy value method to provide a basis for scientifically evaluating the level of the LVIGE in China.

In the information theory, entropy is a measure of uncertainty [39]. The greater the uncertainty, the greater the entropy and the greater the information contained; the smaller the uncertainty, the lower the entropy and the less the information it contains [40]. For example, if the values of the sample data are all equal under a certain index, the influence of the index on the overall evaluation is zero and the weight is zero [41]. Entropy reflects the variation difference degree of each index by calculating the weight of the index, avoiding the index deviation caused by human factors, and has a strong mathematical basis via comprehensive evaluation. The entropy method is very suitable for systematic research, and the rural industry integration has a strong systematic nature, where more objective results can be obtained via entropy evaluation [39]. Therefore, it is particularly appropriate to use the entropy method to determine the weight of the green governance indicators of landscape and village integration. The specific steps are as follows:

(1) As the units of measurement of the indicators are not uniform, the normalization of indicators should be standardized before using them to calculate the comprehensive indicators, that is, the absolute value of the indicators is converted into a relative value to solve the homogenization problem of different quality indicators. In addition, the values of positive and negative indicators represent different meanings. Therefore, different algorithms need to be adopted for the data standardization processing of positive and negative indicators.

$$\text{positive indicators}: \ X_{ij} = \frac{X_{ij} - min\{X_{1j}, \ldots, X_{nj}\}}{max\{X_{1j}, \ldots, X_{nj}\} - min\{X_{1j}, \ldots, X_{nj}\}}$$

$$\text{negative indicators}: \ X_{ij} = \frac{max\{X_{1j}, \ldots, X_{nj}\} - X_{ij}}{max\{X_{1j}, \ldots, X_{nj}\} - min\{X_{1j}, \ldots, X_{nj}\}}$$

(2) Calculate the proportion of the i sample value for item j in this index.

$$p_{ij} = \frac{X_{ij}}{\sum_{i=1}^{n} X_{ij}}, i = 1, \ldots, n, j = 1, \ldots, m$$

(3) Calculate the entropy of the j-th index.

$$e_j = -k \sum_{i=1}^{n} p_{ij} ln(p_{ij}), j = 1, \ldots, m$$

Among, $k = 1/ln(n) > 0$, satisfy $e_j \geq 0$;

(4) Compute the information entropy redundancy (variance).

$$d_j = 1 - e_j, \ j = 1, \ldots, m$$

(5) Calculate the weights of each indicator.

$$w_j = \frac{d_j}{\sum_{j=1}^{m} d_j}, j = 1, \ldots, m$$

(6) The combined score for each sample was calculated.

$$s_i = \sum_{j=1}^{m} w_j x_{ij}, i = 1, \ldots, n$$

Among the above values, x_{ij} is the standardized data.

3.3. The Selection of Evaluation System Index

According to the reading and sorting of the literature, the selection of evaluation indicators mainly focuses on the following 30 indicators [42–47]. According to the literature reading, the study used the calculation method of community ecology to evaluate

the importance of all evaluation indicators involved in the literature. According to the calculation method of community ecology, the importance value is determined via three factors: relative density, relative frequency, and relative significance. The specific algorithm is as follows:

(1) I represents the importance of the indicator, d represents the relative density of the indicator, f represents the relative frequency of the indicator, and s represents the relative significance of the indicator.

$$I = (d + f + s)/3$$

(2) ti is the number of occurrences of item i in all the literature. $\sum_{t=1}^{k} ti$ represents the number of occurrences of all k indices in the entire literature.

$$d = ti/\sum_{t=1}^{k} ti$$

(3) ni is the number of the literature in item i, and N is the number of all the literature examined.

$$f = ni/N$$

(4) wij represents the weight of index i in article j.

$$s = \sum_{j=1}^{m} wij/\sum_{i=1}^{k}\sum_{i=1}^{m} wij$$

The studies are arranged in order from largest to smallest, as shown in Figure 4.

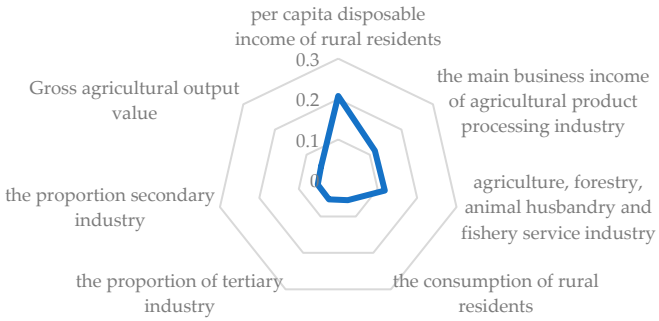


Figure 4. Economic production and construction index weights.

The indicators are as follows: per capita disposable income of rural residents, intensity of fertilizer use, proportion of facility agriculture area, income from the main business of the agricultural product processing industry, proportion of the added value of the agriculture, forestry, animal husbandry, and fishery service industry, rate of the harmless treatment of rural domestic sewage, rate of the harmless treatment of domestic waste, forest coverage rate, rate of effective agricultural irrigation, intensity of pesticide use, number of specialized farmers cooperatives per 10,000 rural residents, and agricultural labor productivity, per capita water resources, natural population growth rate, tap water penetration rate, rural residents' consumption level, arable land area, social security coverage rate, sanitary toilet penetration rate, rural per capita electricity consumption, air quality compliance rate, total agricultural output value, rural population with education, population density, green coverage rate, clean energy household rate, tertiary industry proportion, secondary industry proportion, per capita housing construction area, and soil erosion control area. The above indicators can be divided into three categories: economic production construction (seven indicators), ecological environment construction (13 indicators), and social and cultural construction (10 indicators). The relevant specific gravity is shown in Appendix A, Figure A1.

According to the selection principle of the evaluation indicators and index weights, a total of 19 indicators were selected in five, five, and nine items of economic production construction, social, and cultural construction and ecological environment construction, respectively, to build an evaluation system to measure the level of the LVIGE in the rural areas of each province.

(1) Construction of economic production

The top five weights were selected. The indicators are the per capita disposable income of rural residents (X1), the main business income of the agricultural product processing industry (X2), the added value of the agriculture, forestry, animal husbandry and fishery service industry (X3), the consumption of rural residents (X4), and the proportion of tertiary industry (X5), as shown in Figure 4.

(2) Social and cultural construction

The top five weights were selected. The indicators are the natural population growth rate (X6), water penetration rate (X7), per capita electricity consumption in rural areas (X8), proportion of rural population with education level (X9), and per capita housing construction area (X10), as shown in Figure 5.

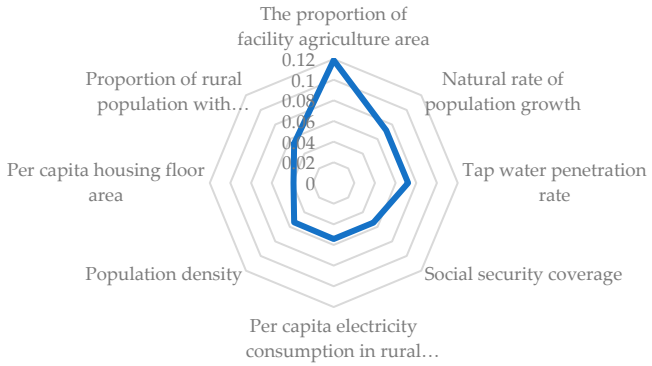


Figure 5. Social and cultural construction index weights.

(3) Ecological environment construction

The top nine weights were selected. The indicators are the fertilizer intensity (X11), harmless treatment rate of rural domestic sewage (X12), harmless treatment rate of household garbage (X13), forest coverage rate (X14), effective irrigation rate (X15), pesticide use intensity (X16), cultivated area (X17), access to sanitary toilets (X18), and clean energy penetration rate (X19), as shown in Figure 6.

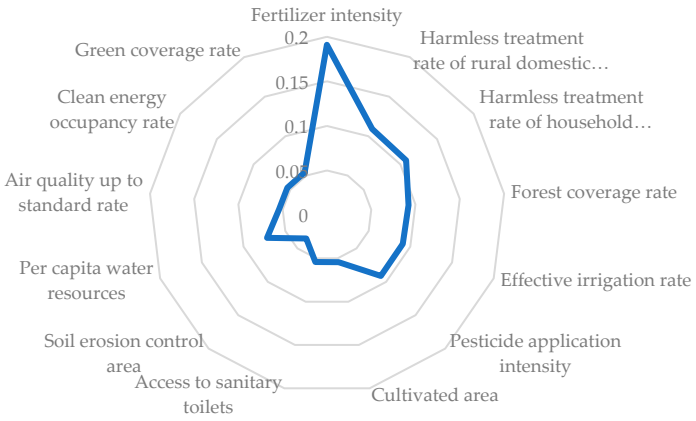


Figure 6. Ecological environment construction index weights.

4. Evaluation and Analysis of LVIGE

4.1. Data Source and Description

As this chapter constructs the evaluation system for the LVIGE, the relevant indicators are all provincial rural data. Therefore, the index data in the index system mainly come from the "China Statistical Yearbook", the "China Rural Statistical Yearbook", and the "China Environmental Statistical Yearbook" issued by the authoritative statistical departments of the state. In terms of the selection of indicator years, since the rural revitalization strategy was proposed in 2017, this chapter selects the data for 10 years from 2012 to 2021 to compare the before and after of the rural revitalization strategy that was proposed. In the selection of the rural subjects in provincial areas, owing to the difficulty in obtaining the relevant data of Tibet, the remaining 30 provinces in Tibet were removed for analysis, and the relevant missing values were supplemented via the linear interpolation method. Due to the different units of the selected indicators, we standardized the data to enhance the accuracy of the conclusions. Table 1 describes the calculation of these indicators.

Table 1. Landscape- and village-integrated green governance evaluation system indicators' descriptions.

Target Layer	Criterion Layer	Index Level	Index Attribute
Landscape- and village-integrated green governance (LVIGE)	Economic production construction	X1	positive
		X2	positive
		X3	positive
		X4	positive
	Social and cultural construction	X5	positive
		X6	positive
		X7	positive
		X8	negative
		X9	positive
	Ecological environment construction	X10	positive
		X11	negative
		X12	positive
		X13	positive
		X14	positive
		X15	positive
		X16	negative
		X17	positive
		X18	positive
		X19	positive

4.2. Measurement Process and Evaluation Result

First, due to the different orders of magnitude and statistical caliber of the original data, it will be difficult for subsequent measurements and comparisons, and it is necessary to carry out data standardization processing for each evaluation index data. According to the formula, Stata15 was used to standardize the positive and negative indicators. After standardization, the calculated entropy and difference coefficients were obtained with four decimal places reserved. The results are shown in Table 2.

Table 2. The index entropy and difference coefficient of LVIGE evaluation system.

Index	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
entropy	0.9660	0.9701	0.9480	0.9161	0.9632	0.9443	0.9903	0.9931	0.9780	0.9557
difference coefficient	0.0340	0.0299	0.0523	0.0839	0.0368	0.0557	0.0097	0.0069	0.0220	0.0443
	X11	**X12**	**X13**	**X14**	**X15**	**X16**	**X17**	**X18**	**X19**	
entropy	0.9913	0.9952	0.9958	0.9636	0.9408	0.9861	0.9459	0.9949	0.9454	
difference coefficient	0.0087	0.0048	0.0042	0.0364	0.0592	0.0139	0.0541	0.0051	0.0546	

Second, the entropy and difference coefficients calculated via the entropy method are used to calculate the weight of the index, and the weight results obtained are shown in Table 3.

Table 3. LVIGE evaluation system weight table.

Target Layer	Criterion Layer	Index Level	Weight Results
Landscape- and village-integrated green governance (LVIGE)	Economic production construction (0.3844191)	X1	0.05520112
		X2	0.0484262
		X3	0.08491117
		X4	0.13610622
		X5	0.05977439
	Social and cultural construction (0.22466432)	X6	0.09029397
		X7	0.01572151
		X8	0.0111227
		X9	0.03570861
		X10	0.07181753
		X11	0.01409085
		X12	0.00781971
	Ecological environment construction (0.3909166)	X13	0.00677985
		X14	0.0590224
		X15	0.09600119
		X16	0.02252747
		X17	0.08782294
		X18	0.00827794
		X19	0.08857425

According to the weight results in Table 3, it can be seen from the criterion layer that the weight of ecological environment construction in the LVIGE accounts for approximately 40%, and the weight of economic production construction in the LVIGE accounts for approximately 38%, with a small gap between the two, indicating that the ecological environment and economic production construction are equally important in the LVIGE process. Green governance should not be ignored when developing scenic villages and integrating economic growth. At the same time, it also proves that the data of ecological factors differ greatly in the comparison process between the rural areas in different provinces in China. However, the weight of social and cultural construction is only approximately 22%, indicating that the degree of social and cultural construction is similar among provinces, and the gap is not large. From the index layer, it can be seen that in the economic production construction of integrated green governance in scenic villages, the weight of the agricultural product processing industry ranks first, about 0.1361, followed by the total output value of the agriculture, forestry, animal husbandry, and fishery service industry, about 0.0849, indicating that in the process of the integrated development of the scenic village, the processing of agricultural products is very important, which can attract tourists through the processing of agricultural products and enhance the degree of integration of the scenic village. At the same time, the agriculture, forestry, animal husbandry, and fishery service industry also improve the development of the tertiary industry and promotes an important indicator of economic production. In social and cultural construction, the proportion of the rural educated population is about 0.0357, indicating that the rural education level is low, and the education level still needs to be improved.

5. Analysis of the Evaluation Results of LVIGE in Chinese Provinces

5.1. LVIGE Score and Ranking Analysis

According to the weight of the evaluation system of the LVIGE calculated in Table 3. We calculated the comprehensive score of integrated green governance in the rural areas of 30 provinces from 2012 to 2021 and determined the level of the LVIGE according to the comprehensive score. Considering the brevity of the analysis, we integrated the scores

of integrated the LVIGE in each province from 2012 to 2021 and calculated their average values, as shown in Table 4.

Table 4. Average score of LVIGE and ranking.

District	Average Score of LVIGE	Ranking	District	Average Score of LVIGE	Ranking
Shandong	0.5531	1	Fujian	0.3232	16
Henan	0.4741	2	Guangxi	0.3171	17
Sichuan	0.4669	3	Shanxi	0.2873	18
Jiangsu	0.4358	4	Jilin	0.2809	19
Heilongjiang	0.4339	5	Xinjiang	0.2760	20
Guangdong	0.4070	6	Guizhou	0.2742	21
Heibei	0.4047	7	Chongqing	0.2731	22
Hubei	0.3907	8	Beijing	0.2611	23
Hunan	0.3900	9	Shanxi	0.2570	24
Anhui	0.3839	10	Shanghai	0.2397	25
Zhejiang	0.3787	11	Gansu	0.2288	26
Inner mongolia	0.3641	12	Tianjin	0.2201	27
Yunnan	0.3397	13	Hainan	0.1858	28
Liaoning	0.3330	14	Ningxia	0.1557	29
Jiangxi	0.3318	15	Qinghai	0.1267	30

According to the definition of the comprehensive score of entropy weight, the smaller the comprehensive index of entropy weight, the lower the LVIGE; the higher the entropy weight comprehensive index, the higher the LVIGE. According to the analysis of Table 4, it is found that the region with the highest average entropy weight comprehensive score is Shandong, with a value of 0.5531, ranking in first place, and is the only region with a comprehensive score of more than 0.5. Followed by Henan, with a value of 0.4741, ranking in second place, and Sichuan, with a value of 0.4669, ranking in third place, the comprehensive value of the three provinces is above 0.45. It shows that, according to the selected index system, the LVIGE in Shandong Province is the best in the analysis range. The region with the lowest average comprehensive score of entropy weight is Qinghai, whose value is 0.1267, ranking in the 30th place, which is preceded by Ningxia, whose average comprehensive index is 0.1557, ranking in the 29th place.

The results show that under the selected index system, the ecological environment of Qinghai is the worst, preceded by Ningxia. The provinces with average composite index values between 0.40 and 0.45 ranked via the average composite index values are Jiangsu, Heilongjiang, Guangdong, and Hebei, ranking fourth to seventh in the country. This shows that within the research range, the green governance of the landscape–village integration in the above provinces gradually deteriorates and is in the middle and upper position of the provinces studied in the country (taking the mean of the number of provinces studied as the dividing line), which again indicates that the green governance of the landscape–village integration in the above provinces in the country is better. The provinces with average composite index values of 0.35 to 0.40 are Hubei, Hunan, Anhui, Zhejiang, and Inner Mongolia, respectively ranking eighth to twelfth in the country. It indicates that the quality of the integrated green governance of scenic villages in the above regions nationwide deteriorates successively, which is in the middle position of the ecological environment quality of the provinces in the country. It further indicates that the LVIGE in the above provinces nationwide is also at a good level. The provinces with average composite index values of 0.30 to 0.35 are Yunnan, Liaoning, Jiangxi, Fujian, and Guangxi, respectively ranking 12th to 17th in the country. It shows that the integrated green governance of scenic villages in the above regions of the country has gradually decreased, and it is in the middle and lower position of the ecological environment quality of the provinces in the country, indicating that the LVIGE in the above provinces of the country is average. The comprehensive index is below 0.30, indicating that there are many problems in the rural

areas of China in the integration of village development and green governance, where many provinces still do not pay enough attention to rural development. Especially concerning the problem of rural green governance, provinces such as Ningxia and Qinghai displayed the worst integration of village green governance, which should arouse the government's great attention.

The reason for this may not only be environmental problems, but may also closely related to economic development and cultural development. The evaluation of the LVIGE not only has ecological construction, but also needs economic production construction and social and cultural construction. Therefore, Shandong ranks first because its economic level and cultural level are in a good position. Especially, both the urban and rural areas in Shandong pay special attention to education. When the knowledge level and economic level are good at the same time, the ecological environment will play a key role in the LVIGE. In Guangxi, Ningxia, and other regions, economic development and education level are limited, so even if the ecological environment is in a dominant position, there is still a phenomenon of low scores of the green governance integration of the landscape and village.

5.2. LVIGE Grading Analysis

Based on the average value of the comprehensive score and considering the number of provinces, this study divides the level of the LVIGE from 2012 to 2021 into five levels, as shown in Table 5.

Table 5. Level of the LVIGE in each province from 2012 to 2021.

Rank	Value	Province
I	$X \geq 0.45$	Shandong, Henan, Sichuan
II	$0.45 > X \geq 0.35$	Jiangsu, Heilongjiang, Guangdong, Hebei, Hubei, Hunan, Anhui, Zhejiang, Inner mongolia
III	$0.35 > X \geq 0.25$	Yunnan, Liaoning, Jiangxi, Fujian, Guangxi, Shanxi, Jilin, Xinjiang, Guizhou, Chongqing, Beijing, Shanxi
IV	$0.25 > X \geq 0.2$	Shanghai, Gansu, Tianjin
V	$0.2 > X$	Hainan, Ningxia, Qinghai

According to the classification in Table 5, it is found that provinces in level II and level III are the mainstream, indicating that China's overall LVIGE is in a good state. However, it cannot be ignored that some provincial rural areas are in grade IV and grade V, where the comprehensive score of the LVIGE is low and the pace of ecological civilization construction must be accelerated. There are three provinces in level I, nine provinces in level II, 12 provinces in level III, three provinces in level IV, and three provinces in level V. It can be seen that the number of provinces in the first level, the second level, and the third level has reached 24, accounting for 80% of the total number of provinces in the country, indicating that the ecological civilization construction of most provinces in China is in a good state of development, of which some provinces are more advanced, but it is also seen that there are three provinces in the fifth level, lagging behind, and the gap is large.

Although there is a gap between the provinces in the LVIGE, it can also be seen from Table 5 that provinces have made efforts towards the integration of green governance in the landscape and village, and the scores of most provinces have increased year by year, showing a growing trend. However, the six provinces and cities of Liaoning, Jilin, Shanghai, Jiangsu, Zhejiang, and Shaanxi have experienced a decline in the past 10 years, with alternating positive and negative changes, but the overall is stable and the decline is not large. This study holds that the downward trend is not only affected by the natural environment and resource endowment itself, but also by human factors, and the influence of human factors gradually increases with the passage of time. From the analysis of the positive and negative change rate of the LVIGE comprehensive score with roughly the same amplitude, it can be seen that due to the implementation of the development mode

of "pollution first, treatment later", when the environmental pollution gradually increases and the environmental problems become more and more prominent, relevant government departments begin to carry out environmental governance, such as carrying out special environmental remediation activities. At this time, the change rate of the comprehensive score of the LVIGE changed from negative to positive, and the quality of ecological environment was improved. With the continuous control of environmental pollution, restricted by local economic development, the delayed upgrading of industrial structure, and the reduction in local government tax revenue, government departments began to allow polluting enterprises to carry out production. At this time, the rate of change in the comprehensive index of ecological status changed from positive to negative, and the quality of ecological environment gradually deteriorated. As pollution continues, environmental problems become prominent again, resulting in environmental problems with greater impact, and government departments once again strengthen environmental governance.

5.3. Analysis of LVIGE District Division

According to the above analysis, the LVIGE may differ due to the different regional locations and what differences exist. We conducted an in-depth study on the level of the LVIGE into the eastern region, the central region, the western region, and the northeast region. According to the above division, the level of the LVIGE in the four regions is calculated, and the results are shown in Table 6.

Table 6. LVIGE in four region villages.

Region	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Eastern	2.9503	3.0185	3.1407	3.2564	3.3580	3.4745	3.4586	3.6742	3.7852	3.9747
Central	1.7902	1.9709	2.0506	2.1094	2.2124	2.2808	2.3415	2.4177	2.5041	2.5965
Western	2.5294	2.7043	2.8270	2.9268	3.0428	3.1734	3.2803	3.4045	3.5301	3.6771
Northeast	0.9444	0.9660	0.9845	1.0050	1.0274	1.0476	1.0596	1.1128	1.1461	1.1840

First, according to the analysis of the four regions in Table 6, the LVIGE in the eastern, central, western, and northeastern regions show an upward trend. Since the number of provinces contained in each plate is different, the level of the LVIGE in each region is determined according to the growth rate of the score. Among them, the growth rate of the rural comprehensive score in the western region is about 45.37%, ranking in first place, mainly because the country needs to promote the process of common prosperity while deeply implementing the regional coordinated development strategy, especially to increase the help of the eastern region to the central and western regions and help the central and western regions to restructure the production factors and optimize the economic structure, creating an internal driving force for development. At the same time, the geographical location of the west is also in an environmental advantage. The central region followed with a growth rate of about 45.03%. About 34.72% of the total is in the eastern region, which enjoys innate advantages and a series of preferential policies supported by the state finance. It is superior to other regions in terms of economic production construction, social and cultural construction, and ecological and environmental construction. There are bottlenecks in the development. The comprehensive score of rural areas in Northeast China is relatively low and the growth rate is slow, mainly because Northeast China is much easier to use fertilizer in farming, and its economic development is far lower than that of eastern China, which is far away from the economic center.

6. Conclusions and Policy Recommendations

By referring to other relevant evaluation systems, this study constructs an evaluation index system for the landscape- and village-integrated green governance and analyzes the development of the landscape- and village-integrated green governance in different types of provinces from the perspectives of economic production construction, social and cultural

construction, and ecological environment construction. It also analyzed the differences in the landscape- and village-integrated green governance in different scenic villages in the eastern, central, western, and northeast regions and clarified the key directions for improvement in each province, to provide theoretical and technical support for the integrated green governance in scenic villages and the environmental development in rural areas. Through the above evaluation, we draw the following conclusions: (1) There is a significant difference in the data on ecological factors among rural areas in various provinces of China, and there is a gap in green governance. (2) Northeast China ranks at the bottom in terms of economic production construction, social and cultural construction, and ecological environment construction, with a large gap. (3) The rapid improvement of the landscape- and village-integrated green governance (LVIGE) is inseparable from the national policies.

Based on the above analysis, the following suggestions are put forward: (1) In the process of the landscape- and village-integrated development, countries should base their resource advantages and choose the advantageous characteristic industries suitable for the integrated development of the rural landscape and village with the strategy of "making grain better, making special and making forest better". Rural enterprises should also consider the development of environmental performance and learn from the ways and methods of clean enterprises to maintain the rural environmental governance while promoting the sustainable development of enterprises [48,49]. (2) On the basis of maintaining the harmony of rural production, life, and ecological space, the rural industry has ornamental value and aesthetic value through planning and design. At the same time, it integrates the production and processing experience tourism services to create industrial landscape nodes such as cultural and creative guest houses, rural leisure experience areas, and tourism and pension bases, attracting people flow, logistics, information flow, and capital flow, and promoting the improvement of the rural landscape system. (3) Promote the deep integration of agriculture, the processing industry, and the tertiary industry and constantly extend the agricultural industrial chain and value chain. We intend to improve the benefit sharing mechanism for cross-regional cooperation and enhance the diffusion effect of rural landscape integration activities in the region on other regions. (4) Strengthen exchanges and contacts between regional rural activities while promoting the integrated development of regional scenic villages. A number of provinces (municipalities) can jointly create a number of regional characteristics of famous brands, improve rural awareness and influence, provide farmers with more adequate employment opportunities and entrepreneurial conditions, and expand income channels.

Although this study has contributed to the landscape- and village-integrated green governance, there are still some limitations, but we believe that these limitations will be solved in the future. First, in terms of data selection, only the data from 2012 to 2021 are selected for research, which may affect the universality of the research results. Second, the fact that our study was conducted in the context of China may limit the generality of our findings. Finally, we must determine whether there are other missing indicators in the study that affect the landscape- and village-integrated green governance. Therefore, scholars can increase the sample time and the data of other countries in the case of comprehensive data and put forward more perfect development suggestions for the landscape- and village-integrated green governance. We will also continue to study the related fields to make the research on the landscape- and village-integrated green governance more complete.

Author Contributions: Software, Y.W.; writing—original draft, Y.W. and J.Z.; writing—review and editing, Y.W. and J.Z.; supervision, J.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the National Social Science Foundation Project (21BJY189).

Institutional Review Board Statement: Not applicable.

Data Availability Statement: The datasets analyzed for this study are publicly available in the "China Rural Statistical Yearbook", the "China Agriculture Yearbook" and the "China Environmental Statistics Yearbook". https://data.cnki.net/Yearbook/Single/N2019120190. https://data.cnki.net/Yearbook/Single/N2021090092. https://data.cnki.net/Yearbook/Single/N2021030182.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Appendix A is the proportion of the indicators calculated in Section 3.3, and the indicators of landscape- and village-integrated green governance are screened through Appendix A.

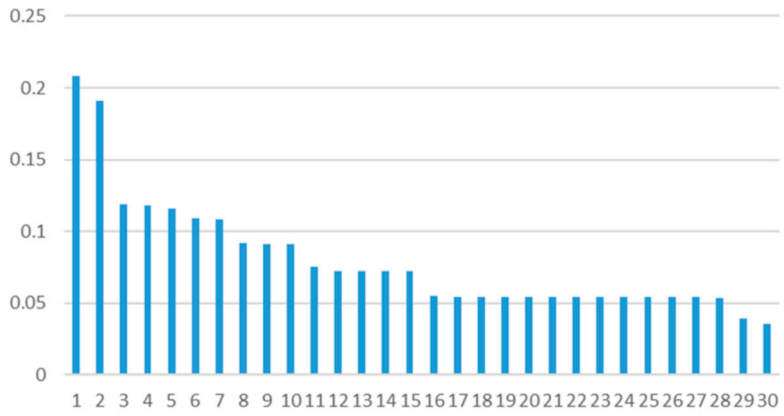


Figure A1. Important values of evaluation indicators.

References

1. Ge, W.; Zhang, G. Resilient Public Transport Construction in Mega Cities from the Perspective of Ecological Environment Governance. *J. Environ. Public Health* **2022**, *2022*, 9143618. [CrossRef]
2. Wei, D.; Wang, Z.; Zhang, B. Traditional Village Landscape Integration Based on Social Network Analysis: A Case Study of the Yuan River Basin in South-Western China. *Sustainability* **2021**, *13*, 13319. [CrossRef]
3. Eetvelde, V.V.; Antrop, M. Indicators for assessing changing landscape character of cultural landscapes in Flanders (Belgium). *Land Use Policy* **2009**, *26*, 901–910. [CrossRef]
4. Palang, H.; Helmfrid, S.; Antrop, M.; Alumäe, H. Rural Landscapes: Past processes and future strategies. *Landsc. Urban Plan.* **2005**, *70*, 3–8. [CrossRef]
5. Cohen, I.A.; Sofer, M. Integrated rural heritage landscapes: The case of agricultural cooperative settlements and open space in Israel—ScienceDirect. *J. Rural. Stud.* **2017**, *54*, 98–110. [CrossRef]
6. Yuwen, H.A.; Chengcai, T.A.; Chunyu, Y.A.; Ning, L.V. An analysis of knowledge map on traditional village tourism research in Mainland China based on CiteSpace. *World Reg. Stud.* **2019**, *28*, 200.
7. Gao, L.; Ma, C.; Zeng, J.; Wang, B.; Li, Y. How Did Poverty Reduction in China Contribute to the World? Viewing from the Implementation of the UN MDGs and SDGs. *Chin. J. Urban Environ. Stud.* **2019**, *7*, 1940007. [CrossRef]
8. Helgadóttir, G.; Dashper, K. 20 years of Nordic rural tourism research: A review and future research agenda. *Scand. J. Hosp. Tour.* **2021**, *21*, 60–69. [CrossRef]
9. Sujarwo, W. Stand biomass and carbon storage of bamboo forest in Penglipuran traditional village, Bali (Indonesia). *J. For. Res.* **2016**, *27*, 913–917. [CrossRef]
10. Lim, J.-C.; Choi, B.-K.; Kim, S.-Y.; Eom, B.-C.; Kim, J.-W. Korean traditional village forest (Ma-Eul-Soop) and potential natural vegetation: A case study on the Sachon-Ri Garo-Soop in Gyeongsangbuk-do, South Korea. *J. Plant Biol.* **2016**, *59*, 515–524. [CrossRef]
11. Hoang, T.T.H.; Van Rompaey, A.; Meyfroidt, P.; Govers, G.; Vu, K.C.; Nguyen, A.T.; Hens, L.; Vanacker, V. Impact of tourism development on the local livelihoods and land cover change in the Northern Vietnamese highlands. *Environ. Dev. Sustain.* **2020**, *22*, 1371–1395. [CrossRef]
12. Cogordan, C.; Kreft-Jaïs, C.; Guillemont, J. Effects of Alcoholic Beverage Control Policies and Contextual Factors on Alcohol Consumption and its Related Harms in France From 1960 to 2000. *Subst. Use Misuse* **2014**, *49*, 1633–1645. [CrossRef]
13. Yu, Z.; Xiao, L.; Chen, X.; He, Z.; Guo, Q.; Vejre, H. Spatial restructuring and land consolidation of urban-rural settlement in mountainous areas based on ecological niche perspective. *J. Geogr. Sci.* **2018**, *28*, 131–151. [CrossRef]
14. Putzel, S. Farm Holidays: Combining Agriculture and Recreation. *Agrologist* **1984**, 20–21.
15. Pearce, P.L. Farm tourism in New Zealand. *Ann. Tour. Res.* **1990**, *17*, 337–352. [CrossRef]

16. Benjamin, C. The growing importance of diversification activities for French farm households. *J. Rural. Stud.* **1994**, *10*, 331–342. [CrossRef]
17. Fleischer, A.; Pizam, A. Rural tourism in Israel. *Tour. Manag.* **1997**, *18*, 367–372. [CrossRef]
18. Mason, P.; Cheyne, J. Residents' attitudes to proposed tourism development. *Ann. Tour. Res.* **2000**, *27*, 391–411. [CrossRef]
19. Sharpley, R. Rural tourism and the challenge of tourism diversification: The case of Cyprus. *Tour. Manag.* **2002**, *23*, 233–244. [CrossRef]
20. Thompson, C.S. Host Produced Rural Tourism: Towa's Tokyo Antenna Shop. *Ann. Tour. Res.* **2004**, *31*, 580–600. [CrossRef]
21. Briedenhann, J.; Wickens, E. Tourism routes as a tool for the economic development of rural areas—vibrant hope or impossible dream? *Tour. Manag.* **2004**, *25*, 71–79. [CrossRef]
22. Boyne, S.; Hall, D. Place promotion through food and tourism: Rural branding and the role of websites. *Place Brand.* **2004**, *1*, 80–92. [CrossRef]
23. Walford, N. Patterns of development in tourist accommodation enterprises on farms in England and Wales. *Appl. Geogr.* **2001**, *21*, 331–345. [CrossRef]
24. Aliza, F.; Anat, T. Does rural tourism benefit from agriculture? *Tour. Manag.* **2005**, *26*, 493–501.
25. Reichel, A.; Lowengart, O.; Milman, A. Rural tourism in Israel: Service quality and orientation. *Tour. Manag.* **2000**, *21*, 451–459. [CrossRef]
26. Böcher, M. Regional Governance and Rural Development in Germany: The Implementation of LEADER+. *Sociol. Rural.* **2008**, *48*, 372–388. [CrossRef]
27. Murphy, A.; Williams, P.W. Attracting Japanese tourists into the rural hinterland: Implications for rural development and planning. *Tour. Manag.* **1999**, *20*, 487–499. [CrossRef]
28. Hall, D. Rural tourism development in southeastern Europe: Transition and the search for sustainability. *Int. J. Tour. Res.* **2004**, *6*, 165–176. [CrossRef]
29. Vandenbroucke, P. L'exploitation familiale et son rapport au territoire de 1960 à aujourd'hui. Bulletin de l'association de géographes français. *Géographies* **2015**, *92*, 306–321.
30. Sceau, R.; Plancoulaine, V. Les contrats de pays d'accueil dans la région Rhône-Alpes: Une amorce de politique régionale de développement du tourisme en espace rural/The system of" contrats de pays d'accueil" in the Rhône-Alpes region: The beginning of a regional development policy for tourism in rural areas. *Géocarrefour* **1988**, *63*, 226–236.
31. Wang, X. The practice teaching of regional cultural expression in rural landscape planning and design under the background of urban–rural integration. *Int. J. Electr. Eng. Educ.* **2021**, 002072092098430. [CrossRef]
32. Kong, L.; Xu, X.; Wang, W.; Wu, J.; Zhang, M. Comprehensive Evaluation and Quantitative Research on the Living Protection of Traditional Villages from the Perspective of "Production–Living–Ecology". *Land* **2021**, *10*, 570. [CrossRef]
33. Coffey, B.; Bush, J.; Mumaw, L.; de Kleyn, L.; Furlong, C.; Cretney, R. Towards good governance of urban greening: Insights from four initiatives in Melbourne, Australia. *Aust. Geogr.* **2023**, *51*, 189–204. [CrossRef]
34. Nikolaidou, S.; Klöti, T.; Tappert, S.; Drilling, M. Urban Gardening and Green Space Governance: Towards New Collaborative Planning Practices. *Urban Plan.* **2016**, *1*, 5. [CrossRef]
35. Wellbrock, W.; Roep, D.; Mahon, M.; Kairyte, E.; Nienaber, B.; García, M.D.D.; Kriszan, M.; Farrell, M. Arranging public support to unfold collaborative modes of governance in rural areas. *J. Rural. Stud.* **2013**, *32*, 420–429. [CrossRef]
36. Meng, F.W.W. Analysis of Eco-Efficiency in China's Key Provinces along the "Belt and Road" Based on Grey TOPSIS-DEA. *J. Grey Syst.* **2020**, *32*.
37. Singh, R.K.; Murty, H.R.; Gupta, S.K.; Dikshit, A.K. An overview of sustainability assessment methodologies. *Ecol. Indic.* **2012**, *15*, 281–299. [CrossRef]
38. Lin, T.; Ge, R.; Huang, J.; Zhao, Q.; Lin, J.; Huang, N.; Zhang, G.; Li, X.; Ye, H.; Yin, K. A quantitative method to assess the ecological indicator system's effectiveness: A case study of the ecological province construction indicators of China. *Ecol. Indic.* **2016**, *62*, 95–100. [CrossRef]
39. Zhang, Y.; Huang, F.; Deng, X.; Jiang, W. A New Total Uncertainty Measure from A Perspective of Maximum Entropy Requirement. *Entropy* **2021**, *23*, 1061. [CrossRef]
40. Feria, E.H. Linger thermo theory: Part I: The dynamics dual of the stationary entropy/ectropy based latency information theory//2013 IEEE International Conference on Cybernetics (CYBCO). *IEEE* **2013**, 197–204.
41. Han, X.; Zhao, S.; Wei, Z.; Bai, W. Planning and Overall Economic Evaluation of Photovoltaic-Energy Storage Station Based on Game Theory and Analytic Hierarchy Process. *IEEE Access* **2019**, *7*, 110972–110981. [CrossRef]
42. Niu, X.; Liao, F.; Liu, Z.; Wu, G. Spatial–Temporal Characteristics and Driving Mechanisms of Land–Use Transition from the Perspective of Urban–Rural Transformation Development: A Case Study of the Yangtze River Delta. *Land* **2022**, *11*, 631. [CrossRef]
43. Wei, C.; Zhang, Z.; Ye, S.; Hong, M.; Wang, W. Spatial-Temporal Divergence and Driving Mechanisms of Urban-Rural Sustainable Development: An Empirical Study Based on Provincial Panel Data in China. *Land* **2021**, *10*, 1027. [CrossRef]
44. Larsson, M. Using environmental evaluation systems and their contribution to sustainable development. *Evaluation* **2021**, *27*, 453–472. [CrossRef]
45. Li, Y.; Li, H.; Li, D.; Zhang, Z.; Feng, Y. Construction of rural water ecological civilization index system in China. *Water Pract. Technol.* **2020**, *15*, 797–806. [CrossRef]

46. Li, J.K.; Zhang, J.; Gao, Z.H.; Chen, Q.; Liu, Z.X. An evaluation system of ecology-safe and environment-friendly society—green production system. *Bulg. Chem. Commun.* **2017**, *49*, 107–112.
47. Wang, C.; Li, Q.; He, Y.; Long, Z. Evolution of Rural Production Space Systemand its Sustainable Development Capacitywith Information Entropy in China. *Pol. J. Environ. Stud.* **2021**, *30*, 4227–4240. [CrossRef] [PubMed]
48. Jan, A.A.; Lai, F.-W.; Asif, M.; Akhtar, S.; Ullah, S. Embedding sustainability into bank strategy: Implications for sustainable development goals reporting. *Int. J. Sustain. Dev. World Ecol.* **2023**, *30*, 229–243. [CrossRef]
49. Jan, A.A.; Lai, F.-W.; Tahir, M. Developing an Islamic Corporate Governance framework to examine sustainability performance in Islamic Banks and Financial Institutions. *J. Clean. Prod.* **2021**, *315*, 128099. [CrossRef]

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