Research Article

Evaluation of Rural Tourism Spatial Pattern Based on Multifactor-Weighted Neural Network Algorithm Model in Big Data Era

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In recent years, due to the rapid development of rural tourism, rural tourism has lost its unique rurality, which has led to a certain impact on the sustainable development of rural tourism. Primarily, based on the rural characteristics, the social environment development, population development, and economic development are taken as the research indexes, and the evaluation index system of rural tourism destination is constructed. Afterward, an empirical study on the spatial pattern of rural tourism is carried out with examples, and the model is simulated and analyzed by MATLAB software. Finally, the spatial autocorrelation method is used to analyze the evolution characteristics of the rural tourism spatial pattern. The results show that through the analysis of the evaluation error curve of the Back Propagation Neural Network (BPNN), the evaluation error and the actual error range are within 0.08%, which proves that the BPNN algorithm has good calculation accuracy. The BPNN rural tourism destination rurality evaluation model established here can make an effective evaluation of rural tourism space. The results show that the proportion of employees in the primary industry and the penetration rate of mobile phones are the decisive factors in the adjustment of industrial structure and social environmental factors, respectively. Rural per capita tourism income and the proportion of primary industry output value will also have a certain impact on rural evolution. Certain guiding significance is provided for the sustainable development of rural tourism.

1. Introduction

With the rapid development of information technology and Internet technology, the importance of big data technology is increasingly focused by various industries. Big data refer to massive and complex data that cannot be processed by traditional data processing methods. Both accurate analysis of consumers' consumption behavior and decision-making can be realized through big data technology so that various business activities can be carried out in a targeted manner. With the rapid development of China's urbanization process, people's demand for rural and urban tourism is getting higher and higher. Meanwhile, China's rural tourism has developed very well in recent years [1]. However, problems in rural tourism have occurred during the rapid development of rural tourism, among which the most

important one is the marketization of tourism destinations, which leads to the gradual weakening of the rural nature of rural tourism destinations and conflicts with the sustainable development of rural tourism.

Due to the rapid advancement and development of urbanization, the population flow between cities and villages has become increasingly frequent, thus strengthening the interaction of economic and social development factors cities and villages. The rural industrial structure and layout are constantly being adjusted. The fading of "homesickness" memory and rural spatial differentiation have made the rural research increasingly significant. Scholars from all walks of life have begun to pay attention to the study of rural nature [2]. At present, researchers all over the world have made a series of researches and discussions on the rural theory. Gao et al. [3] constructed the framework of rural spatial

reconstruction driven by tourism. The changing process of rural spatial reconstruction was revealed by using geographic information system and participatory field investigation. The research showed that rural spatial reconstruction driven by tourism was the result of internal and external forces, while land consolidation was the direct way to trigger rural spatial reconstruction. Rural tourism can accelerate land consolidation and realize rural revitalization. Panzer-Krause et al. [4] conducted a standardized survey on tourists in Giant Causeway, the most visited scenic spot in Northern Ireland. The results showed that the awareness of sustainability had declined from individual tourists to long-distance tourists and then to cruise tourists, so it is necessary to manage sustainability in specific market segments. Rural tourism hot spots should be the hub to coordinate and promote the network of regional tourism providers, so as to realize their real integration into rural communities. Verma et al. [5] used data from the land satellite to conduct a survey on rural areas in Varanasi County. Also, results showed that the agricultural area (accounting for 50% of the land cover area) increased by 37% and the building area increased by 236% during 1993–2013 in Varanasi County. A relative rural development index was developed to understand the comparative development of rural blocks in the region. Qi et al. (2021) [6] took 169 villages in Jingyuan County as the research object, and the evaluation index system of rural development level was constructed from the perspective of factor structure function. The rural development level and spatial structure characteristics of Jingyuan County were analyzed by rural development index, regional function index, nearest neighbor index, and exploratory spatial data analysis, and the types and specific paths of rural development are determined. The results showed that the rural development level of Jingyuan County was low, which can be described as “high developing level in south areas but low developing level in north areas.” Yang et al. (2021) [7] used multisource data, such as remote sensing images, building data, official websites, and field surveys to investigate the morphology and social evolution of rural communities from the perspective of tourism, and analyzed its driving factors.

Rural settlements are places where ancestors lived, and some unique landscape elements become the foundation of rural nature [8]. However, due to the rapid development of urbanization and rural tourism, rural development is facing new problems and challenges. One of the most important problems is that the development of some rural areas is disorderly and spontaneous. Urban characteristics, landscape construction, and the phenomenon in the process of rural tourism marketization are on the rise. Consequently, the original rural settlement landscape has been greatly negatively affected [9,10]. The originally good natural ecological environment in rural areas has been destroyed, and the problems in rural economic structure, villagers’ culture, and lifestyle have become increasingly prominent. As a kind of rural tourism, its most basic charms have been seriously ignored in rural areas, and its rural nature is gradually losing in rural tourism areas [9]. The sustainable development of rural tourism will face severe challenges, and it is urgent to pay attention to rural development from a deeper and wider

FIGURE 1: BPNN structure.

level. Tourism destinations must enhance their value cognition level and implement rural protection of tourism destinations. Therefore, the influencing factors of rural tourism destination are taken as the breakthrough point. An evaluation model of the rural tourism spatial pattern based on the neural network algorithm is implemented to evaluate the spatial pattern of rural tourism. Certain guiding significance is provided for the sustainable development of rural tourism.

2. Method

2.1. BP Neural Network. Back propagation neural network (BPNN) has become one of the most commonly used algorithms in the field of machine learning (ML) in recent years [11,12]. The artificial neural network (ANN) is composed of interconnected neurons. Also, each neuron receives the information sent by the neurons in the previous layer and transmits the received information through nonlinear transformation. The neural network can approach complex mapping relations through training and has wide applications in pattern recognition, function approximation, and classification prediction [13]. BPNN consists of three parts: input layer, hidden layer, and output layer. The hidden layer can have multiple layers, and each layer can contain different numbers of neurons [14]. When BPNN works, primarily, data samples are imported through the input layer. Then, through a series of mathematical calculations, the laws between the data are obtained. Finally, all prediction datasets are calculated by using these laws, and the prediction results are obtained. Figure 1 displays the structure of BPNN.

The specific expression of BP is as follows:

$$W_{R \times S} = \begin{bmatrix} W_{0,0} & W_{0,1} & \cdots & W_{0,S-1} \\ W_{1,0} & W_{1,1} & \cdots & W_{1,S-1} \\ \vdots & \vdots & \vdots & \vdots \\ W_{R-1,0} & W_{R-1,1} & \cdots & W_{R-1,S-1} \end{bmatrix} \quad (1)$$

$$W_{S \times N} = \begin{bmatrix} W_{0,0} & W_{0,1} & \cdots & W_{0,S-1} \\ W_{1,0} & W_{1,1} & \cdots & W_{1,S-1} \\ \vdots & \vdots & \vdots & \vdots \\ W_{R-1,0} & W_{R-1,1} & \cdots & W_{R-1,S-1} \end{bmatrix}.$$

FIGURE 2: Algorithm flow of BPNN.

The matrices V and W are the connection weight matrices of the output layer and the hidden layer, and the connection weight matrices of the hidden layer and the input layer, respectively.

In the process of calculation, the data are propagated forward. In this process, the weights and deviations of hidden neurons are obtained randomly. The neural network is propagated forward to obtain the sum of each neuron, and the data on the neuron are transmitted to the next neuron through the activation function [15]. The neurons in the output layer also apply the activation function to complete the forward propagation of the neural network, and calculate the error between the output value and the actual output value of the output layer. The specific expression is as follows:

$$E = \frac{1}{2}(t - y)^2, \quad (2)$$

where E stands for the square of error, t refers to the expected value of the sample output, and y represents the actual output result.

Figure 2 signifies the algorithm flow of BPNN.

A “gradient descent method” is used to optimize the weights of neural networks, and the differential chain rule is mainly used to calculate the partial derivatives of error E relative to the weights of networks W_{ij} [16]. Utomo (2017) [17] proposed a gradient-based BPNN method to improve the optimization of stock price prediction. In the BPNN method, the gradient descent method is used to adaptively determine the learning rate, the training cycle, and other parameters, to obtain the best value in the stock data processing process, and to obtain the accuracy of the

prediction during training. The calculation method is as follows:

$$\frac{\partial E}{\partial w_{ij}} = \frac{\partial E}{\partial o_j} \frac{\partial o_j}{\partial \text{net}_j} \frac{\partial \text{net}_j}{\partial w_{ij}}, \quad (3)$$

where j represents the neuron input and net_j refers to constraint neuron J . In the equation $o_j = y$, the derivative y is used to indicate the rate of change of the value, and the derivative or the slope is used to minimize the error. The partial derivative of the error term relative to the output of a specific neuron j is calculated as follows.

The method of expressing the neuron output partial derivative of the input neuron is as follows:

$$\frac{\partial o_j}{\partial \text{net}_j} = \frac{\partial}{\partial \text{net}_j} \varphi(\text{net}_j)(1 - \varphi(\text{net}_j)). \quad (4)$$

The partial derivative of the actual output value o_i is calculated as follows:

$$\frac{\partial \text{net}_j}{\partial w_{ij}} = \frac{\partial}{\partial w_{ij}} \left(\sum_{k=1}^n w_{ik} o_k \right) = \frac{\partial}{\partial w_{ij}} w_{ij} o_k = o_i. \quad (5)$$

The weights of neurons in each layer of BPNN can be determined by a partial derivative and a learning rate. When using BPNN for calculation, it is necessary to repeat the above steps continuously until the error between the output value and the expected value reaches the allowable range or reaches the maximum times of iterations of NN. The advantage of using gradient descent method to improve BPNN is that the adjustment of weights and thresholds can further eliminate the instability in the neural network caused by the

large variation of gradient value in the gradient adjustment process.

2.2. Study Area. Rural tourism refers to tourism activities that take nature, humanities, and cultures of villages as objects and attractions [18]. The meaning of rural tourism includes two features: the first feature is that the rural tourism destination is in the rural areas, and the second feature is the unique rural nature. These two points must be met in tourist activities at the same time to be called rural tourism [19,20]. Therefore, in the process of developing rural tourism, attention should be paid to the maintenance of rural images. Only by maintaining the original features of rural areas can urban people return to nature and the sustainable development of rural environment be ensured [21,22]. Rural nature is a restatement of the concept of rural regions. It is the harmony among human beings, architecture, and nature. It runs through rural history and is the result of harmonious coexistence between human beings and nature. Population characteristics and production scales are the basis of sustainable development and inheritance of human civilization.

Jiahu District of Hangzhou City in the north of Zhejiang Province is taken as the study area, which has been a land of fish and rice resources since ancient times, with flat terrain and beautiful scenery. The Zhejiang hinterland is a province with dense water resources, eutrophication of water bodies, and high degree of landscape ecology, which occupies a very important position in water resources and landscape ecosystem. A Hangzhou-Jiaxing-Huzhou region has a unique humanistic style and rich rural tourism resources, which provides conditions for the development of rural tourism. Based on local resources and existing farmers' production factors, a number of famous rural tourism brands have been created, which are identified as "Zhejiang Agricultural Villages" in small towns (villages) and "Hangjianghu agricultural areas." From the aspect of social and economic development, through the analysis of tourism resources, tourism level, geographical environment, and traffic location, results show that Jiahu District of Hangzhou is the largest rural tourism development zone in Zhejiang Province, with the highest management level and the largest scale. Zhejiang Province has become one of the first provinces to develop rural tourism in China. Taking the construction of beautiful villages as the carrier, it is one of the most abundant and mature areas of tourism resources in China. The Hangzhou-Jiaxing-Huzhou region gives a full play to the interactive role of new rural construction and rural tourism development. Through the development of rural tourism, the vast number of rural residents get employed, which strengthens the economic strength of rural areas and realizes the rapid development of rural economy. Significant changes have taken place in rural areas, and farmers' lives have also been greatly improved, which has become a classic example of urbanization of new rural cooperative economic organizations in China's ecological civilization construction. Therefore, it is a typical and representative problem to choose this area as the research object.

The data come from the statistical yearbooks of Hangzhou City, Zhejiang Province in 2010, 2015, and 2020, while other data are obtained through the compound calculation.

2.3. Construction of Rural Indicators of Rural Tourist Destinations Based on Neural Networks. The comprehensive description of rural development is the result of multifactors' integration, and the change of each factor determines the alternation of the direction of rural development. According to the research content on the concept and connotation of rurality in the rurality theory, rurality is the unique attribute of rural regions, including land use structure, industrial structure, infrastructure, and other factors. In addition, the current relevant research results usually display indicators from the population settlement, economic development, social development, land use, infrastructure, and other aspects, which are used to construct the rurality evaluation index system. Based on this, it is preliminarily proposed to construct the rurality evaluation index system of tourism destinations from the aspects of population development, economic level, social environment development, and infrastructure. Through the study of relevant literature, combined with the particularity of rural tourism destination, the representative, comparable, and easily accessible indicators are comprehensively selected. The four primary indicators of social environment development, economic level, population development, and infrastructure and the 15 secondary indicators after subdivision are taken as evaluation indicators. Figure 3 shows the rural evaluation index system.

2.4. Rural Tourism Evaluation Index Weight. The calculation method of rural index (RI) of rural tourist destination is a linear weighting method, and the method of determining index weight W_j is an entropy weight method. Because the dimensions of data are different, it will lead to inconvenient calculation. Therefore, the data should be standardized. The method used here is the range standardization, namely, using the maximum or minimum value according to the standard value of the index value. By calculating the difference between the current value and the maximum or minimum value of each index value, the ratio between each index value and each index value standardization is realized.

When parameter X_{ij} is a positive indicator,

$$A_{ij} = \frac{X_{ij} - \min(X_j)}{\max(X_j) - \min(X_j)}. \quad (6)$$

When parameter X_{ij} is a negative indicator,

$$A_{ij} = \frac{\max(X_j) - X_{ij}}{\max(X_j) - \min(X_j)}. \quad (7)$$

Among equations (6) and (7), X_{ij} indicates the value of the j th index of the i th county, A_{ij} represents the normalized index value, $\min(X_j)$ refers to the minimum value of item j , and $\max(X_j)$ stands for the maximum value of item j index.

Specific calculation steps are as follows.

FIGURE 3: Rural evaluation index system of rural tourism destination.

Step 1. Calculate the specific gravity value.

$$B_{ij} = \frac{A_{ij}}{\sum_{i=1}^m A_{ij}}. \quad (8)$$

Step 2. Calculate entropy.

$$e_j = -K \sum_{i=1}^m B_{ij} \ln B_{ij} \left(\text{among them, } K = \frac{1}{\ln m}, j = 1, 2, 3 \dots n \right). \quad (9)$$

Step 3. Calculate the weight of indicators.

$$W_j = \frac{1 - e_j}{\sum_{j=1}^n (1 - e_j)}. \quad (10)$$

The rural index of rural tourism destination can be calculated as

$$RX_i = \sum_{j=1}^n A_{ij} W_j. \quad (11)$$

Among equations (8)–(11), A_{ij} says the standardized index value, B_{ij} is the specific gravity value, m equals to the total amount of county units, W_j indicates the weight of j indexes, and RX_i represents the rural index of i county unit, where the rural index will change with the change of the value. E_j is the entropy value, and n stands for the total number of indicators.

2.5. Spatial Autocorrelation Analysis. Global spatial autocorrelation analysis can describe the spatial characteristics of attribute values of research objects in the whole region. It can also measure the overall spatial correlation between different regions and the degree of difference between them. The mathematical expectation of global Geary's C is constant 1, which is not affected by spatial weight, observation value, and sample size, resulting that the statistical performance of Geary's C is worse than that of global Moran's I . Only the distance-defined spatial proximity method can be adopted to form the weight matrix from Local Getis-Ord G , which performs poorly when identifying negative spatial autocorrelation. Moran's I index is a global index used to measure spatial autocorrelation, and its calculation is as follows:

$$I = \frac{n}{S_o} \frac{\sum_{i=1}^n \sum_{j=1}^n W_{ij} Z_i Z_j}{\sum_{i=1}^n Z_i^2}. \quad (12)$$

In equation (12), Z_i refers to the deviation between the attribute of element i and its average value, W_{ij} represents the spatial weight, n stands for the total number of elements, and S_o indicates the aggregation of all spatial weights. When the global Moran's I changes between 0 and 1, it means positive spatial correlation; otherwise, it means negative spatial correlation.

The local Moran's I index, also known as clustering and outlier analysis, is different from the global Moran's I . The global Moran's I index is only used to judge whether the global elements have spatial correlation, but the local

FIGURE 4: Rural index of counties in “Hangjiahua area,” Zhejiang Province (x: names of the counties in “Hangjiahua area,” Zhejiang Province; y: rural index).

Moran’s I can be used to show the spatial correlation among various elements. The calculation is as follows:

$$I = Y_i \sum_{i=1}^n W_{ij} Y_j. \quad (13)$$

In equation (13), Y_i and Y_j are the standardized values of the observed values of spatial unit i and unit j , respectively, and W_{ij} indicates the spatial weight. Local spatial autocorrelation can analyze the relationship between a certain point and the surrounding points of the cluster, including high-high clustering, high-low clustering, and low-high clustering.

3. Results

3.1. Overall Evaluation of Rural Tourism in “Hangjiahua Area”. Figure 4 shows the calculation of the rural index of “Hangjiahua area” in Zhejiang Province in 2010, 2015, and 2020.

Figure 4 reveals that from 2010 to 2020, the overall trend of rural index of all county units included in the “Hangjiahua area” of Zhejiang Province is decreasing year by year, and the rural differences among these county units are also gradually weakening. The rurality index of 18 counties in the “Hangjiahua area” of Zhejiang Province is the highest in Chun’an County during 2010–2015, with values of 0.811 and 0.728, respectively. Also, the lowest indexes are all in Hangzhou City, with values of 0.316 and 0.211, respectively. The highest index in 2020 is in Jiande, with a value of 0.676, and the lowest is in Hangzhou. This indicates that the rurality index of Hangzhou is the lowest. In order to deeply

FIGURE 5: Evolution of regional difference of county rural index in the “Hangjiahua area,” Zhejiang Province (x: particular year; y: the values of maximum, minimum, average, and standard deviation of rural index).

analyze the regional differences of rural characteristics in the “Hangjiahua area” of Zhejiang Province and the evolution of polarization degree in time sequence in these areas, a descriptive statistical analysis is made on the rural characteristics index, as Figure 5.

Figure 5 indicates that from 2010 to 2020, the maximum value of rural index of all county units in the “Hangjiahua area” of Zhejiang Province decreased from 0.812 in 2010 to 0.678 in 2020, the minimum value decreased from 0.317 in 2010 to 0.211 in 2020, and the average value decreased from 0.564 in 2010 to 0.478 in 2020. Therefore, the results show that the impact of rural tourism development on rural economy and society is increasing. The standard deviation of rural index of each county unit is also decreasing year by year, from 0.15 in 2010 to 0.145 in 2020, which indicates that the rural difference in the “Hangjiahua area” of Zhejiang Province is decreasing and the difference is weakening year by year.

In order to further analyze the spatial differentiation and spatial pattern evolution of rural areas in the Hangzhou-Jiaxing-Huzhou region of Zhejiang Province from 2010 to 2020, a global Moran’s I statistical test was carried out on the rural indexes in the Hangzhou-Jiaxing-Huzhou region in 2010, 2015, and 2020. Figure 6 reveals the results.

Figure 6 notes that the Moran’s I indexes of rural areas ranged from 0.038 to 0.052 from 2010 to 2020, all of which were positive, and the overall trend was increasing year by year, and the significance level of z test was $P < 0.5$. The research results showed that the rural index of the Hangzhou-Jiaxing-Huzhou area in Zhejiang Province appeared with an aggregation distribution state in space. From 2010 to 2020, with the continuous development and advancement of rural tourism and urbanization, the differences between counties and cities in the Hangzhou-Jiaxing-Huzhou area of Zhejiang Province are shrinking year by year.

FIGURE 6: Global Moran's I statistical test results. (a) Correlation test results (x: particular year; y: values of global Moran's I statistical test); (b) significant test results (x: particular year; y: values of Z-score).

3.2. Index Weight Results of Neural Network Model. When using the ANN model to evaluate the spatial pattern of rural tourism, it is necessary to calculate and sort the weights of each index. Table 1 presents the weights of each index.

Table 1 indicates that the weight of employees in the primary industry (W1) is 0.523, that of rural tourism professionals (W2) is 0.462, that of rural per capita tourism income (W5) is 0.464, that of primary industry output value (W7) is 0.394, that of rural informatization level (W10) is 0.467, that of rural road mileage per capita W (13) is 0.431, and that of mobile phone population rate (W15) is 0.412. Also, the weight values of these eight indicators are relatively large, which shows that these eight indicators have a great influence on the rural nature of rural tourist destinations.

3.3. BPNN Simulation Results. After the completion of the network training, the feasibility of the established evaluation system of rural tourism in the "Hangjiahu area" of Zhejiang Province is simulated by using the neural network toolbox in MATLAB software and 10 groups of samples. Figure 7 shows the comparison between the evaluation results obtained by the network and the actual evaluation results.

After the BPNN evaluation model for rural tourism destination being verified and tested, Figures 7 and 8 indicate that the actual value output is basically consistent with the expected value, and the difference between them is very small. By analyzing the BPNN evaluation error curve, it is found that the evaluation error and the actual error range are within 0.08%, which proves that the BPNN algorithm has good accuracy. Therefore, the BPNN evaluation model for rural tourism destination implemented here can make a good evaluation of rural tourism space.

TABLE 1: Weight value of rural evaluation index of rural tourism destination.

Evaluating indicator	Weight
W1	0.523
W2	0.462
W3	0.281
W4	0.181
W5	0.464
W6	0.192
W7	0.394
W8	0.123
W9	0.178
W10	0.467
W11	0.242
W12	0.518
W13	0.431
W14	0.139
W15	0.412

3.4. Analysis of Influencing Factors of Rural Tourism Spatial Pattern Evolution

3.4.1. Factor Analysis of Industrial Structure Adjustment. Correlation analysis is made between the proportion of employees in the primary industry (W1), the proportion of rural tourism professionals (W2), the per capita tourism income in rural areas (W5), the proportion of the output value of the primary industry (W7), and the rural index in each county and city. Table 2 lists the results.

Table 2 and Figure 9 signify that Pearson correlation coefficients of rural per capita tourism income (W5) and rural index in 2010, 2015, and 2020 are -0.582 , -0.654 , and -0.703 , respectively, and the test results of significance level are 0.012 (less than 0.05), 0.005 (less than 0.01), and 0.01,

TABLE 2: Correlation and significance analysis of rural index.

Age	Evaluating indicator	Pearson correlation	Significant (bilateral)
2010	W1	0.752**	0.002
	W2	-0.529*	0.021
	W5	-0.582*	0.012
	W7	0.711**	0.001
2015	W1	0.746**	0.000
	W2	-0.604**	0.006
	W5	-0.654**	0.005
	W7	0.681**	0.003
2020	W1	0.725**	0.000
	W2	-0.609**	0.003
	W5	-0.703**	0.000
	W7	0.676**	0.001

Note. *means a significant correlation at 0.05 level (bilateral); ** means a significant correlation at 0.01 level (bilateral).

respectively. In addition, Pearson correlation coefficients of rural tourism professional ratio (W2) and rural index in 2010, 2015, and 2020 are -0.529, -0.604, and -0.609, respectively. The test results of significance level are 0.021 (less than 0.05), 0.006 (less than 0.01), and 0.003 (less than 0.01), respectively. Pearson correlation coefficients of the proportion of primary industry output value (W7) and rural index in 2010, 2015, and 2020 are 0.711, 0.681, and 0.676, respectively, and the test results of significance level are 0.001 (less than 0.01), 0.003 (less than 0.01), and 0.001 (less than 0.01), respectively. Pearson correlation coefficients of the proportion of employees in the primary industry (W1) and rural index in 2010, 2015, and 2020 are 0.752, 0.746, and 0.725, and the test results of their significance levels are 0.002, 0.000, and 0.000, respectively. There is a significant positive correlation between the proportion of employees in the primary industry (W1) and the rural index. From 2010 to 2020, the per capita rural tourism income (W5) and the proportion of rural tourism professionals (W2) in every county and city in the Jiahu area of Hangzhou are also increasing year by year. Moreover, the growth of surrounding counties with Hangzhou as the core is most obvious. This fully shows that the development of the primary industry is not paid enough attention to, so it has become one of the important factors that restrict the rural level in the Hangzhou-Jiaxing-Huzhou area. Results indicate that the development process of urbanization can be directly promoted by the tourism industry, but it will also be accompanied by the decline of the rural level.

3.4.2. Analysis of Traffic Factors. Correlation analysis is made between the per capita rural road mileage (W13) and the rural index in each county and city. Table 3 displays the results.

Table 3 presents that the Pearson correlation coefficients of the evaluation index of rural road mileage per capita (W13) and rural index in 2010, 2015, and 2020 are -0.474, -0.573, and -0.672, respectively, and the significance level test results are 0.048, 0.015, and 0.013, respectively, which are all less than 0.05. From 2010 to 2020, the per capita rural road

FIGURE 7: Performance comparison of BPNN algorithm (x: the orders of the samples; y: values of output and actual evaluation).

FIGURE 8: BPNN model training and error comparison (x: the orders of the samples; y: errors in training and test).

mileage (W13) of all counties and cities in this region showed a trend of increasing year by year, and the most obvious increase was in the surrounding counties with Hangzhou as the center. The rural index in this region showed a declining trend and an agglomeration distribution trend, which forms a cold spot with Hangzhou as the center. This fully shows that the accessibility of road traffic can promote the development of commercial and economic activities to a certain extent, so as to lower the rural level. Therefore, the improvement of traffic factors has a significant impact on the rural level.

3.4.3. Analysis of Social Environment Factors. The correlation analysis is made between the three factors of mobile

TABLE 3: Correlation and significance analysis of rural index.

Evaluating indicator	Age	Pearson correlation	Significant (bilateral)
W13	2010 years	-0.474*	0.048
	2015	-0.573*	0.015
	The year of 2020	-0.672*	0.013

Note. *indicates a significant correlation at 0.05 level (bilateral).

TABLE 4: Correlation and significance analysis of rural index.

Year	Evaluating indicator	Pearson correlation	Significant (bilateral)
2010	W10	-0.470*	0.047
	W12	-0.498*	0.035
	W15	-0.562*	0.014
2015	W10	-0.552*	0.013
	W12	-0.502*	0.039
	W15	-0.688**	0.003
2020	W10	-0.658*	0.016
	W12	-0.598*	0.035
	W15	-0.706**	0.001

Note. * means a significant correlation at the 0.05 level (bilateral); ** means a significant correlation at the 0.01 level (bilateral).

phone penetration rate (W15), rural per capita electricity consumption (W12), and rural informatization level (W10) and the rural index. Table 4 and Figure 10 display the results.

Table 4 and Figure 10 signify that the Pearson correlation coefficients between the three factors of mobile phone penetration rate (W15), rural per capita consumption (W12), and rural informatization level (W10) and the rural index are -0.470, -0.552, -0.658; -0.498, -0.502, -0.598; and -0.562, -0.688, -0.706. The test results of significance level are 0.047, 0.013, 0.016; 0.035, 0.039, 0.035; and 0.014, 0.003, 0.001, respectively, all of which are less than 0.05. Rural informatization level (W10) is negatively correlated with rural index, and the negative correlation tends to increase. Rural per capita consumption (W12) is negatively correlated with rural index, and the negative correlation tends to increase. The mobile phone penetration rate (W15) is negatively correlated with rural index. Also, this negative correlation shows a growing trend. From 2010 to 2020, the rural informatization level (W10), mobile phone penetration rate (W15), and rural per capita electricity consumption (W12) in all counties and cities are increasing year by year. Conclusion is drawn that a strong modern civilization can strengthen a region's commercial awareness and the concept of market economy. It can also promote the presentation of more capital, technology, and talent advantages, to lower the rural level. Therefore, social and environmental factors will have a significant impact on the rural level.

In the future development of rural tourism, more attention should be paid to the construction of rural ecological environment and the protection of rural cultural characteristics. Therefore, creating an upgraded version of beautiful countryside is a policy that helps to protect rurality. In the process of creating an upgraded version of the beautiful countryside, the government should establish a sense of

FIGURE 9: Correlation trend of rural index from 2010 to 2020 (x: evaluating indicator; y: Pearson correlation coefficient).

FIGURE 10: Correlation trend of village index from 2010 to 2020 (x: evaluating indicator; y: Pearson correlation coefficient).

regulation, scientifically formulate rural construction plans, fully demonstrate the connotation of the countryside, realize the unification of the economic value, social value, and ecological value of the countryside, and make "green" as the main tone of beautiful countryside. In the process of constructing the beautiful countryside, the green development is always the main line. The transformation should be gradually realized in the agricultural production mode, rural construction mode, and farmers' lifestyle. Meanwhile, the basic principle should keep still, which is adhering to the organic combination of local characteristics and ecological environmental protection requirements and carrying out differentiated construction according to local conditions.

Based on maintaining the landscape and pastoral scenery and historical and cultural characteristics of each village, the pattern of “one village, one product, one industry, one village, one rhyme” is formed to realize the sustainable development of the countryside. Besides, in the process of construction of beautiful countryside, the government should change its role, from the leader of rural construction to the guide and the coordinator, and the government should constantly strengthen the propaganda and education of all levels of society and improve the cognitive level of all levels of society on rural value according to the local traditional history, cultural accumulation, resource endowment, ecological environment, and other characteristics through various forms, using various platforms and carriers.

4. Conclusion

With the rapid development of urbanization and rural tourism, great changes have taken place in the traditional rural structure and lifestyle, followed by the gradual disappearance of the original unique rural nature and importance of the countryside. Based on rural characteristics, factors such as social environment development, population development, and economic development are taken as the research indicators, and the evaluation index system of rural tourism destination is constructed. The spatial pattern of rural tourism is empirically studied with examples, the rural index of the region in 2010, 2015, and 2020 is calculated, and the model is simulated and analyzed by MATLAB software. Finally, the spatial autocorrelation method is used to analyze the evolution characteristics of rural tourism spatial pattern. The research results show that by analyzing the evaluation error curve of BPNN, the evaluation error and the actual error range are within 0.08%, which proves that the BPNN algorithm has good accuracy. The BPNN evaluation model for rural tourism destination implemented here can make a good evaluation of rural tourism space. From 2010 to 2020, the proportion of employees in the primary industry and the penetration rate of mobile phones are the decisive factors in the adjustment of industrial structure and social environment, respectively. Rural tourism income per capita and the proportion of the output value of the primary industry also have a certain impact on the rural evolution. A certain guiding significance is provided for the sustainable development of rural tourism, but the deficiency lies in that only each county and city in Hangzhou Jiahu District is taken as the research object due to the availability of data. Some internal differences among county-level administrative regions have not been fully studied. In the future improvement research of BPNN, the variable coefficient method can also be used to modify the connection weight to accelerate the convergence speed of the network.

Data Availability

The labeled dataset used to support the findings of this study is available from the corresponding author upon request.

Conflicts of Interest

The author declares no conflicts of interest.

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