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Research Article

Performance Evaluation Method of Rural Forestry Economic Cooperation Organization Based on Intelligent Fuzzy Algorithm

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Aiming at the problems of low accuracy and long evaluation time of performance evaluation of rural forestry economic cooperation organizations, a performance evaluation method of rural forestry economic cooperation organizations based on intelligent fuzzy algorithm is proposed. Under the principles of scientificity, feasibility, comprehensiveness, and importance, build the performance evaluation system of rural forestry economic cooperation organization, and obtain 17 evaluation indexes, such as the supply of means of production, the internal management of the cooperation organization, and the unified product brand. Deal with the missing data and standardize the index data, construct the evaluation index judgment matrix according to the judgment matrix scale, and test the consistency of the judgment matrix through CI. The square root method is used to calculate the performance evaluation index weight of rural forestry economic cooperation organization. Intelligent fuzzy algorithm is used to evaluate the performance of rural forestry economic cooperation organization. Simulation results show that this method has high accuracy and short evaluation time.

1. Introduction

Forestry is a basic industry and public welfare undertaking related to the national economy and people's livelihood [1]. China has established 11.15 million forestry professional cooperative organizations, including 1356.32 million farmers, accounting for 9% of the total number of farmers. In the past three years, the number of professional forestry cooperative organizations has increased by 44%, the number of professional forestry cooperative organizations has increased by 82%, and the number of forest right management service institutions has reached 1296. At present, the production scope of forestry professional cooperation organizations includes the fields of understory economy and forest products, flowers, and plants, Chinese herbal medicine planting, economy, forest tourism, and so on. Through the optimal combination of forestry production factors, the competitiveness of products has been improved, and the employment and income of farmers have been significantly improved [2]. The State Forestry Administration has determined the establishment activities of 200 demonstration counties of forestry professional cooperation organizations. However, at present, the deep-seated problems of China's forestry development are becoming more and more obvious. The backward economic development in forest areas leads to unreasonable benefit distribution and excessive burden on forest farmers, which is difficult to improve the quality of life of forest farmers [3–5].

Reference [6] puts forward the changes of equity distribution system and performance evaluation methods of rural collective economy. Taking Nanhai, Guangdong Province as an example, this paper analyzes the deep logic of the emergence and evolution of equity distribution system. Under the condition of institutional equilibrium, the new equity distribution system constructs the formal constraints of clear collective property rights, reconstructs the rural security resource allocation and rural governance order, and maximizes the net income under the institutional logic. Reference [7] uses factor analysis method to comprehensively evaluate the financial performance indicators of listed enterprises in agriculture, forestry, animal husbandry, and fishery in 2020 from the five

dimensions of profitability, operation, debt repayment, development, and innovation ability. It is found that the overall performance management level of China's listed enterprises in agriculture, forestry, animal husbandry, and fishery is unbalanced, and there are obvious weak links in the financial performance management of some enterprises. However, the accuracy of the above two performance evaluation methods is low, resulting in poor evaluation effect. Reference [8] introduces BSC theory into the performance evaluation of rural forestry enterprises. Combined with the characteristics of the industry and its own operation and management, this paper constructs the performance evaluation model of rural forestry enterprises from the four dimensions of finance, customers, internal operation, learning, and growth and obtains the evaluation results. Reference [9] comprehensively considers the economic added value, ecological value, and ecological value of forest resources and constructs the performance evaluation system of rural forestry economic cooperation organization. However, the performance evaluation time of the above two methods is long, resulting in low evaluation efficiency.

Aiming at the problems existing in the above methods, a performance evaluation method of rural forestry economic cooperation organization based on intelligent fuzzy algorithm is proposed. Under the principle of evaluation system construction, the performance evaluation system of rural forestry economic cooperation organization is constructed. Preprocess the obtained evaluation indexes and calculate the weight of the evaluation indexes. The fuzzy comprehensive evaluation matrix is established by intelligent fuzzy algorithm, and the final evaluation results are output. The experimental results show that the application of this method can provide a scientific basis for the system construction and mechanism innovation of farmers' professional cooperative organizations.

2. Performance Evaluation Method of Rural Forestry Economic Cooperation Organization

2.1. Construction Principles of Evaluation System

2.1.1. Scientific Principle. The performance evaluation of rural forestry economic cooperation organization needs to select indicators according to the actual needs. Each evaluation index needs to accurately reflect the evaluation content. The construction of the index system should combine theory with practice, not divorced from the actual situation, and can provide reasonable and practical suggestions for the development of cooperative organization [10].

2.1.2. Feasibility Principle. To be operable, the evaluation method can be correctly applied in the performance evaluator. For the indicators to be quantified, the quantitative methods must be scientific and reasonable; real and effective evaluation contents can be obtained in the actual investigation to ensure the accuracy of data [11].

2.1.3. Principle of Comprehensiveness. The combination of quantitative and qualitative methods can make the analysis more scientific and accurate. At the same time, we should also consider the evaluation results of relevant subjects in rural forestry economic cooperation organizations, so as to avoid one-sided evaluation and establish a fair and objective performance evaluation system.

2.1.4. Principle of Importance. In order to achieve the purpose of performance evaluation of rural forestry economic cooperation organization, the indicators must cover complete information, focus on the objective importance of evaluation indicators, reduce the duplication of indicators, lead to the confusion of evaluation system, and make the evaluation results more scientifically reflect the real performance level of rural forestry economic cooperation organization.

2.2. Construction of Performance Evaluation System of Rural Forestry Economic Cooperation Organization. Under the above evaluation system construction principles, construct the performance evaluation system of rural forestry economic cooperation organization. Firstly, the factors affecting the performance evaluation of rural forestry economic cooperation organization are analyzed from three aspects: farmers, organization operation, and social impact.

3. Serving Farmers

The nonprofit organization composed of farmers is also known as the rural forestry economic cooperation organization. To provide better services for farmers, the core purpose of rural forestry economic cooperation organization is to increase farmers' actual income. Therefore, to carry out the performance evaluation and analysis of the rural forestry economic cooperation organization, the first step should first investigate the service content of the cooperation organization to farmers, whether it provides convenience for farmers, and whether it allows farmers to reduce costs in the process of production [12]. Therefore, in order to improve performance evaluation, the core lies in whether farmers are really satisfied with cooperative organizations. The following are the selected indicators: supply of means of production, internal management of cooperative organizations, unification of brands, coordination of interests, training and education, production quality standards, storage of agricultural products, and satisfaction with information sharing of cooperative organizations.

4. Organization and Operation

For performance evaluation, another focus is on the actual operation of the cooperative organization and the real scale of the cooperative organization. Cooperative organizations are mainly a combination formed to enable farmers to obtain more rights and interests. If the cooperative organization develops well and expands in scale, farmers can obtain more rights and interests. Therefore, both the actual operation ability and the actual management ability of the cooperative organization are closely related to the actual state of the operation performance of the cooperative organization [13]. The following are the indicators that can reflect the organization's operation indicators, which are divided into six aspects: first, the number of members who master professional skills; second, the actual proportion of

members in the total number of farmers; third, fixed assets; fourth, annual business performance; and fifth, the formulation of the institutional system of the cooperative organization.

5. Social Impact

Rural forestry economic cooperation organization has a certain degree of commercial nature, which can promote local economic development and promote the development of all aspects of society [14]. Therefore, China actively encourages the development of cooperative organizations and formulates and improves the corresponding laws, regulations, policies, and systems. The following indicators can reflect the impact of cooperative organizations on society: first, farmers' satisfaction with the development of cooperative organizations, including members and nonmembers; secondly, with the help of cooperative organizations, the transaction volume of agricultural products actually obtained by other nonmembers; thirdly, the number of factories with trade contacts in the cooperative organization; and finally, the impact of cooperative organizations on local economic development.

According to the above analysis results, on the basis of following the principles of scientificity, feasibility, comprehensiveness, and importance, the influencing factors of performance evaluation of rural forestry economic cooperation organization are determined from three aspects: farmers, organizational management, and social influence. Considering that the above three influencing factors are difficult to describe quantitatively, this paper constructs the performance evaluation system of rural forestry economic cooperation organization by using the advantage that the analytic hierarchy process is suitable for the target system with hierarchical and staggered evaluation indicators, which can solve the decision-making problems that the target value is difficult to describe quantitatively, as shown in Table 1.

According to the performance evaluation system of rural forestry economic cooperation organization constructed above, 17 evaluation indexes such as supply of means of production, internal management of cooperation organization, unified product brand, interest coordination, education and training, storage of agricultural products, production quality standards, and satisfaction of information sharing of cooperation organization are obtained [15].

5.1. Evaluation Index Pretreatment. Because the performance evaluation index data of rural forestry economic cooperation organization will be missing or the numerical data will be inconsistent, the loss of data will reduce the quality of performance evaluation index of rural forestry economic cooperation organization, and the evaluation factors of performance evaluation index data of rural forestry economic cooperation organization are not fixed and unified. The lack of evaluation index data or inconsistent numerical data will affect the evaluation accuracy. In order to ensure the integrity and availability of the performance evaluation index data set of rural forestry economic cooperation organization, the above obtained performance evaluation index data of rural forestry economic cooperation organization are processed with data missing and normalization [16], and the specific steps are as follows:

5.1.1. Data Missing Processing. Lagrange interpolation method is used to fill in the missing performance evaluation index data of rural forestry economic cooperation organization, and its expression is

$$R(e) = \frac{c(t)}{r(e)n}. \tag{1}$$

In Formula (1), $c(t)$ represents the Lagrange interpolation polynomial with the same value point pair, $r(e)$ represents the Lagrange interpolation basis function, and n represents the number of value points [17].

5.1.2. Normalization Processing. Through the range transformation method, the numerical data are normalized to the i interval by dimensionless processing, and the expression is

$$y_{ki} = \frac{x_{ki} - x_{\min\ (i)}}{x_{\max\ (i)} - x_{\min\ (i)}} \times 100\%. \tag{2}$$

In formula (2), y_{ki} represents the original data of the i secondary index in the k primary index, x_{ki} represents the dimensionless data of the i secondary index in the k primary index, $x_{\min\ (i)}$ represents the smallest dimensionless data of the i secondary index, and $x_{\max\ (i)}$ represents the largest dimensionless data of the i secondary index. In Table 1, the value range of each index is concentrated between $[0, 100]$.

5.2. Calculation of Performance Evaluation Index Weight of Rural Forestry Economic Cooperation Organization. Calculate the weight of the performance evaluation index of the rural forestry economic cooperation organization after the above pretreatment. Firstly, determine the performance evaluation factor set of the rural forestry economic cooperation organization, and form the evaluation factors into a factor set, which is expressed as

$$U = \{u_1, u_2, u_3, \cdots, u_n\}. \tag{3}$$

In Formula (3), $u_i (i = 1, 2, 3, \cdots, n)$ represents the performance evaluation index factors of rural forestry economic cooperation organization and n represents the number of evaluation factors at the same level [18].

Then, construct the evaluation matrix, and use the 1~9 scale method to express the mutual importance of the performance evaluation indicators of rural forestry economic cooperation organizations. The larger the number, the more important it is. The scale of the judgment matrix at all levels and its meaning is shown in Table 2.

In view of the characteristics of many indicators and contents of the performance evaluation index system of rural forestry economic cooperation organizations constructed in this paper, this paper defines the evaluation set as very good, good, average, poor, and worse and divides the performance evaluation grades of rural forestry economic cooperation organizations, that is, the five grades of evaluation set $V =$ {Very good, good, average, poor, worse} [19]. Analyze the evaluation grade membership r_{ij} corresponding to all factor

Table 1: Performance evaluation system of rural forestry economic cooperation organization.

Primary index	Secondary index	Tertiary indicators
Performance of rural forestry economic cooperation organization A	Serving farmers B_1	Supply of means of production C_{11}
		Internal management of cooperative organization C_{12}
		Unified product brand C_{13}
		Interest coordination C_{14}
		Education and training C_{15}
		Storage of agricultural products C_{16}
		Production quality standard C_{17}
		Cooperative organization information sharing satisfaction C_{18}
	Organization and operation B_2	Number of members professionalized C_{21}
		Percentage of members in the total number of farmers C_{22}
		Fixed assets of cooperative organization C_{23}
		Annual turnover C_{24}
		Establishment of cooperative organization system C_{25}
	Social influence B_3	Farmers' satisfaction C_{31}
		The cooperative organization drives nonmembers to complete the turnover of agricultural products C_{32}
		Actual number of manufacturers with trade contacts in the cooperative organization C_{33}
		Comprehensive impact of cooperative organizations on local economic development C_{34}

Table 2: Scale of judgment matrix and its meaning.

Score a_{ij}	Compared with i and j, i is more important than j	Meaning
1	Equally important	Two factors are equally important to an attribute, one factor, and the other
3	Slightly important	Two factors are slightly important to an attribute, one factor, and the other
5	Obviously important	Two factors are obviously important to an attribute, one factor, and the other
7	Strongly important	Two factors are strongly important to an attribute, one factor, and the other
9	Absolutely important	Two factors are extremely important to an attribute, one factor, and the other
2,4,6,8	Is the median value of the above adjacent judgment	Indicates the scale at the time of compromise between two adjacent scales
1/2,1/3,...,1/9	Is the reciprocal number of the above judgment value	If the scale of factors i and j is a_{ij}, the scale of factors j and i is $a_{ji} = 1/a_{ij}$

u_i in the performance evaluation factor set of rural forestry economic cooperation organization, and judge the single factor of factor i, Formula (5) is obtained.

$$r_i = (r_{i1}, r_{i2}, r_{i3}, r_{i4}, r_{i5}). \tag{4}$$

Normally, $r_{ij} > 0$.

Normalization treatment r_{ij} obtains

$$\sum_{j=1}^{5} r_{ij} = 1. \tag{5}$$

The single factor evaluation matrix is

$$R = \left(r_{ij}\right)_{nm}. \tag{6}$$

In Formula (6), among them, the number of elements in factor set and evaluation set is expressed as n and m, respectively.

The performance of rural forestry economic cooperation organization is evaluated by analytic hierarchy process, and the comparison interval number judgment matrix $R = [(r_{ij}^{-})_{m\times n}, (r_{ij}^{+})_{m\times n}]$ of service farmers B_1, organization operation B_2, and social impact B_3 on the performance evaluation

A of rural forestry economic cooperation organization is obtained.

Based on the interval number judgment matrix, CI is used to check the consistency of the judgment matrix:

$$C.I. = \frac{\lambda_{\max}}{n-1}. \tag{7}$$

In Formula (7), $\lambda_{\max}$ represents the maximum eigenvalue of the matrix and n represents the order of the matrix [20].

The smaller the value of $C.I.$ is, the closer the judgment process is to consistency. On the contrary, the more deviation it is.

When $n < 3$, the judgment matrix has complete consistency; when $n \geq 3$, the ratio of random consistency needs to be introduced. The calculation formula of $C.R.$ (consistency ratio) index is

$$C.R. = \frac{C.I.}{R.I.}. \tag{8}$$

In Formula (8), $C.I.$ represents the index of consistency of the same order and $R.I.$ represents the average random consistency index [21].

When $C.R.<0.01$, the judgment matrix has acceptable consistency; when $C.R.>0.01$, revise the judgment matrix again until $C.R.<0.01$, so as to achieve reasonable consistency.

After the consistency test of the judgment matrix, the square root method is adopted to calculate the weight of the performance evaluation index of rural forestry economic cooperation organization, as shown in

$$F = \lambda_{\max} R. \tag{9}$$

5.3. Performance Evaluation of Rural Forestry Economic Cooperation Organization Based on Intelligent Fuzzy Algorithm. Intelligent fuzzy algorithm is a general algorithm of fuzzy mathematics. It is a scientific algorithm to obtain clarity and precision in the fuzziness of objective things. This algorithm uses asymptotic or approximate description and characterization to deal with fuzzy phenomena [22]. Therefore, fuzzy algorithm is different from both quantitative and qualitative methods. It is a people-oriented quantitative method, or a qualitative method based on the full development of quantitative methods [23]. The emergence and application of intelligent fuzzy algorithm makes a breakthrough in the development of computer science to people's natural mechanisms, which is widely used in scientific research at all psychological levels.

Intelligent fuzzy algorithm is a widely used fuzzy mathematics method at present. According to the principle of fuzzy mathematics, the fuzzy relationship is fixed through membership degree, and the final evaluation result is obtained with the help of fuzzy transformation theory. The main implementation process of intelligent fuzzy algorithm is shown in Figure 1.

According to the evaluation process shown in Figure 1, assuming that there are N rules, the two exogenous variables input into the rules are defined as Q' and P' (performance evaluation index coefficient of rural forestry economic cooperation organization), and then, a comprehensive fuzzy rule O' is obtained according to the following process:

For any fuzzy inference rule, first calculate the characteristic coefficients x and y of two exogenous variables, and the process is as follows:

$$\begin{cases} x = \sup Q'c, \\ y = \sup P'c. \end{cases} \tag{10}$$

In Formula (10), c represents the membership function of exogenous variables [24]. Fuzzy evaluation rules are

$$O' = \forall(x \wedge y \wedge N). \tag{11}$$

With fuzzy evaluation rules obtained according to Formula (11), a fuzzy relation matrix is established, which is usually represented byR_i[25]. The expert scoring method is applied to establish the membership matrix of each factor, as shown in

$$R_i = \begin{bmatrix} r_{i11} & r_{i12} & \cdots & r_{i1n} \\ r_{i21} & r_{i22} & \cdots & r_{i2n} \\ \vdots & \vdots & \ddots & \vdots \\ r_{im1} & r_{im2} & \vdots & r_{imn} \end{bmatrix}. \tag{12}$$

The fuzzy evaluation matrix of each factor [26] was established to obtain the performance evaluation results of rural forestry economic cooperation organizations, as shown in:

$$B_i = O'R_i = \left(O'_{i1}, O'_{i2}, \cdots, O'_{im}\right) \begin{bmatrix} r_{i11} & r_{i12} & \cdots & r_{i1n} \\ r_{i21} & r_{i22} & \cdots & r_{i2n} \\ \vdots & \vdots & \ddots & \vdots \\ r_{im1} & r_{im2} & \vdots & r_{imn} \end{bmatrix}. \tag{13}$$

To sum up, the performance evaluation method of rural forestry economic cooperation organization based on the intelligent fuzzy algorithm proposed in this paper is shown in Figure 2.

6. Simulation Experiment Analysis

6.1. Experimental Setup. In order to verify the effectiveness of the performance evaluation method of rural forestry economic cooperation organization based on intelligent fuzzy algorithm in the experiment, a simulation experiment was carried out. The simulation environment is as follows: VS2010+opencv2 4.13, windows10 operating system Intel (R) Xeon (R) CPU E5-2603v4@2.20GHz, the memory is 32GB, and the database is matlab. An independent computer room is selected as the laboratory at the experimental site, and three computers with the same configuration are randomly selected as the experimental test host. The simulation experimental environment is shown in Figure 3.

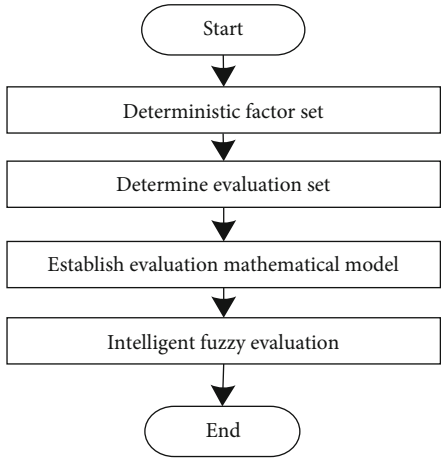

Figure 1: Flow chart of intelligent fuzzy algorithm evaluation.

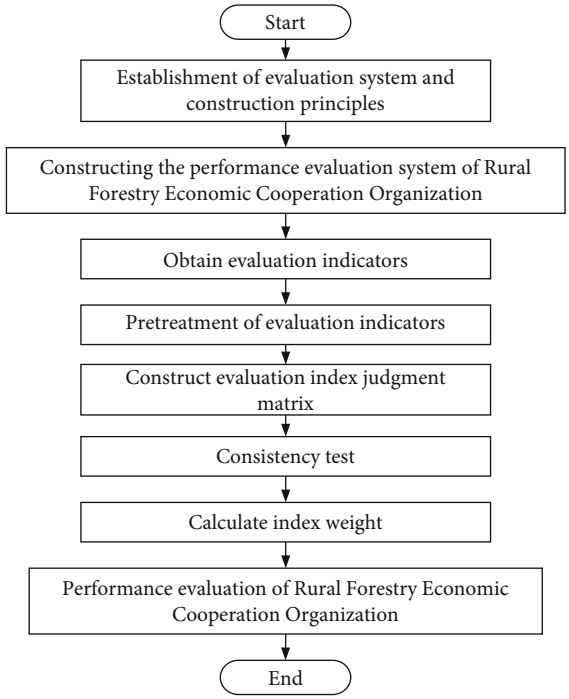

Figure 2: Specific flow chart of performance evaluation method of rural forestry economic cooperation organization based on intelligent fuzzy algorithm.

6.2. Experimental Subjects. The average value of the total afforestation area of Fujian Forestry Cooperation Organization is 1197 mu, 35% are within 200 mu, 31% are over 1000 mu, and the average value of forest coverage is 80%, of which 13% are within 50% and 56% are over 80%. The average number of nonmember farmers is 77, of which 65% are within 20 and 10% are over 150. The average number of cooperative matters with members is 2, the minimum value is 1, the maximum value is 6, and 79% of them are within 3. In cooperation in afforestation and provision of home-based forest services, there are 35 companies providing technology, 34 companies selling uniformly, 21 companies purchasing uniformly, 18 companies providing three prevention services, 12 companies striving for preferential policies or unified trademarks, and 7 companies processing uniformly. Therefore, this paper selects Fujian forestry professional cooperative organizations as the experimental object, combined with factors such as serving farmers, organization operation and social impact, and samples 72 forestry cooperative organizations: 3 in Xianyou County, 32 in Guangze County, 2 in Changtai County, and 1 in Nanjing County; 9 in Youxi County and 12 in Yong'an City; 5 in Anxi County; and 4 in Yongtai County and 4 in Minqing County.

Figure 3: Simulation experiment environment.

6.3. Analysis of Experimental Results. The performance evaluation method of rural forestry economic cooperation organization based on the intelligent fuzzy algorithm, reference [6] method, and reference [7] method proposed in this paper are used to evaluate the performance of rural forestry economic cooperation organization, and the error between the evaluation results and the actual performance results of rural forestry economic cooperation organization is compared. The comparison results are shown in Figures 4–6.

From Figures 4–6, the actual performance evaluation results of this method are quite different from those of the reference [6] method and reference [7] method in the performance evaluation of rural forestry economic cooperation organization, but the performance evaluation method of rural forestry economic cooperation organization based on intelligent fuzzy algorithm proposed in this paper has high accuracy in the evaluation.

In order to further verify the effectiveness of this method, the performance evaluation method of rural forestry economic cooperation organization based on intelligent fuzzy algorithm, reference [6] method, and reference [7] method proposed in this paper is used to compare and analyze the time used in the performance evaluation of rural forestry economic cooperation organization. The comparison results are shown in Figure 7.

According to Figure 7, the performance evaluation method of rural forestry economic cooperation organization based on the intelligent fuzzy algorithm proposed in this paper takes 10 s to evaluate the performance of rural forestry economic cooperation organization, 16 s to evaluate the performance of rural forestry economic cooperation organization based on reference [6], and 25 s to evaluate the performance of rural forestry economic cooperation organization based on reference [7]. The performance evaluation method of rural forestry

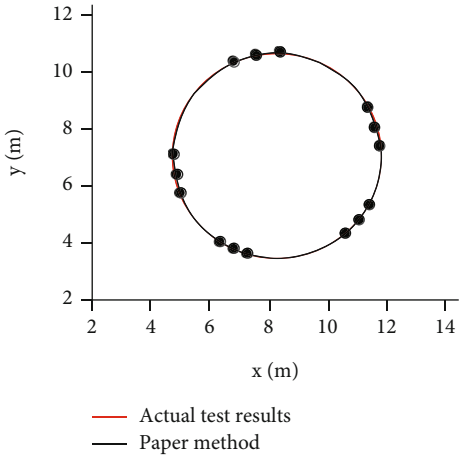

Figure 4: Comparison results between this method and actual test.

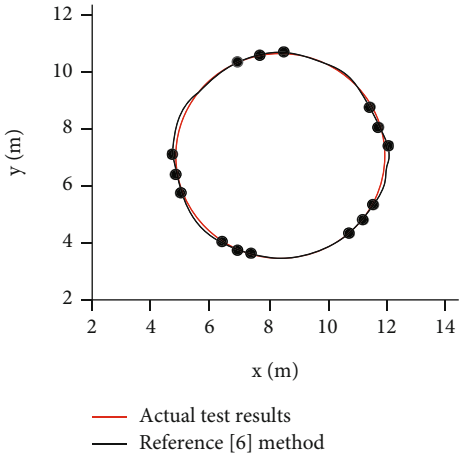

Figure 5: Comparison results between the method in reference [6] and the actual test.

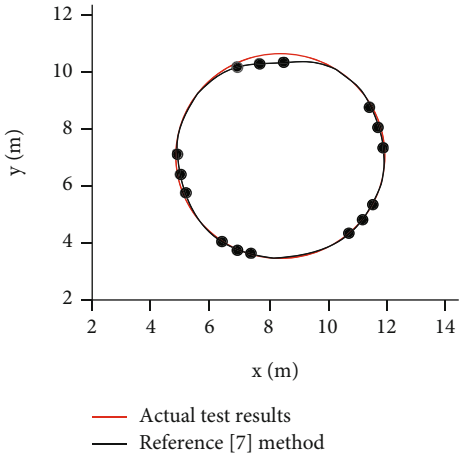

Figure 6: Comparison results between the method in reference [7] and the actual test.

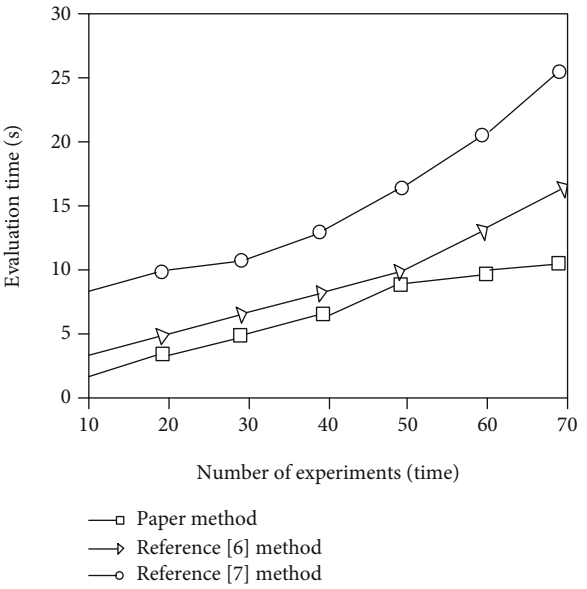

Figure 7: Comparison results of performance evaluation time of rural forestry economic cooperation organization with three methods.

economic cooperation organization based on intelligent fuzzy algorithm proposed in this paper consumes the shortest time and has the highest evaluation efficiency.

7. Conclusion

Although the existing research has done a good exploration into the actual performance, evaluation system construction, evaluation methods, and performance influencing factors of rural forestry economic cooperation organizations, it can be clearly seen from the review of previous research that scholars have not reached a consensus on the important issues of the performance of rural forestry economic cooperation organizations, which will inevitably affect the accurate evaluation of the performance of rural forestry economic cooperation organizations by the academic community. Therefore, this paper proposes a performance evaluation method of rural forestry economic cooperation organization based on an intelligent fuzzy algorithm, and the effectiveness of this method is verified by simulation experiments. The application of this method can improve the accuracy and efficiency of performance evaluation of rural forestry economic cooperation organizations. In the theoretical and empirical research on the performance evaluation of rural forestry economic cooperation organizations in the future, the main work is to clarify the basic concepts of performance and organizational performance.

Data Availability

The author can provide all the original data involved in the research.

Conflicts of Interest

The authors indicate that there was no conflict of interest in the study.

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