Evaluation of Agricultural Science and Technology Talents Competitiveness Based on Analytic Hierarchy Process

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Abstract. With the rapid development of the market economy, scientific and technological innovation has become an important factor affecting market competitiveness. Establishing a team of high-tech innovative talents has a direct impact on the development of China's agricultural economy. The evaluation of agricultural science and technology talent competitiveness is an effective means to measure the level of agricultural science and technology talent competition. At present, the evaluation index system of the current evaluation method of agricultural technology talent competitiveness is not perfect. The consistency coefficient between the evaluation results and the actual situation is low in practical application, which can not truly reflect the situation of agricultural technology talent competitiveness. Based on this, this paper puts forward the research on the competitiveness evaluation of agricultural science and technology talents based on the analytic hierarchy process. According to the factors affecting the competitiveness of agricultural science and technology talents, this paper selects the evaluation index, builds the evaluation index system of talent competitiveness, uses the analytic hierarchy process to scale the index, and calculates the index weight. Quantitative analysis of talent competitiveness was carried out by using the evaluation function, and the level of talent competitiveness was determined to complete the qualitative evaluation of agricultural science and technology talent competitiveness. The experiment proves that the consistency coefficient of the evaluation results of the method designed in this paper and the actual situation is higher than that of the traditional method, which provides strong theoretical support for the evaluation of the competitiveness of agricultural science and technology talents.

Keywords: Analytic Hierarchy Process, Agricultural Science and Technology Talents, Competitiveness, Index System, Weight

1 Introduction

Analytic Hierarchy Process (AHP), also known as Analytical Hierarchical Process (AHP), is proposed by a famous American operational research expert, Satie Process.

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It is a systematic analysis method combining qualitative analysis with quantitative analysis. Through the establishment of a hierarchical structure, the judgment of complex problems is transformed into the comparison of the importance of several factors. Analytic Hierarchy Process (AHP) regards a complicated decision problem that is made up of many targets that restrict each other as a system. It decomposes the total target into many indexes or rules and then decomposes them into many administrative levels of many targets. It adopts the method that combines quantitative analysis with qualitative analysis to judge whether the targets of every level can realize the relative connection degree between the target and the rule. By using the method of solving the eigenvector of the judgment matrix, the standard weight of each element in each level to an element in the previous level is obtained. Xu Xiaohu et. al [1]. proposed that the weight of each sub-objective or criterion to the general objective is obtained by using the weight. The advantages and disadvantages are compared and selected, which can solve these problems more efficiently. It is characterized by using less quantitative information to make the thinking process of decision-making mathematical on the basis of in-depth analysis of the nature, influencing factors and internal relations of complex decision-making problems, so as to provide a simple decision-making method for complex decision-making problems with multi-objective, multi-criteria or no structural characteristics.

The research of Chinese scholars on the competitiveness of talents is mainly analyzed from three aspects: the age, title and education level of grass-roots agricultural science and technology extension talents. Scholars agree that at present, the competitiveness of agricultural promotion talents in China is not strong, which was proposed by Shi Xiaoyu et. al [2]. There is a structural shortage. In terms of quantity and quality, China's agricultural science and technology talents are difficult to meet the talent needs of China's transformation from traditional agricultural power to an agricultural power. Through the analysis of the data of the second national survey of scientific and technological workers, it is found that the structure of China's agricultural technology extension team shows the characteristics of "one high and two low" with high age, low educational background and low professional title, and the development ability and potential are seriously inadequate.

"Science and technology is the first productive force" has become the slogan of the knowledge economy in the 21st century. Science and technology, as one of the most important factors of production, is related to the comprehensive strength of a region or a country, and also has an important impact on the development of an industry. As the carrier of agricultural science and technology knowledge, agricultural science and technology talents have obviously become the first resource that can affect the agricultural competitiveness of various regions and countries. Agricultural scientific and technological talents are not only the applicators and disseminators of agricultural scientific knowledge but also the important strategic resources for the development of the regional agricultural economy [3]. With the development of agricultural resources and competition, agricultural science and technology team has been growing, and agricultural science and technology talents have become the primary driving force in the development of agricultural productivity. For a region or a country, the quality and quan-

tity of agricultural science and technology talents are the representatives of the comprehensive strength of the country and region, which can affect the development potential of the region and country to a certain extent. Therefore, it is necessary to adopt corresponding evaluation techniques and means to accurately understand the competitiveness level of agricultural science and technology talents. Because the domestic research on the competitiveness evaluation of agricultural science and technology talents started relatively late, the existing evaluation theory is not mature enough. The evaluation index system of traditional evaluation methods is not perfect enough. The selected evaluation index is weak. The evaluation results can not truly reflect the actual level of the competitiveness of agricultural science and technology talents, and the consistency coefficient between the evaluation results and the actual situation is low, which can not meet the actual needs. Thus, this paper puts forward the evaluation of agricultural science and technology talent competitiveness based on the analytic hierarchy process.

2 Evaluation method of competitiveness of agricultural science and technology talents

2.1 Set up a comprehensive evaluation index system

Based on the principles of scientificity, objectivity and independence, the competitiveness evaluation index of agricultural science and technology talents is selected. Talent competitiveness in agricultural science and technology is mainly reflected in talent stock, talent performance, talent environment and talent sustainable development, so these four indicators are selected as first-level indicators. The competitiveness of talent stock is reflected by the number of talents, educational index and professional title index. Talent performance competitiveness is reflected by three indicators: the total number of talent applications and invention patents, the number of agricultural science and technology papers published by talent, and the turnover of agricultural science and technology contract. The competitiveness of talent environment is reflected by four indicators: per capital financial income, per capital GDP, per capital consumption and housing area. The sustainable development of talents is reflected by the number of agricultural science and technology personnel training institutions and schools, the proportion of government investment in the education and training of agricultural science and technology personnel in GDP, and the growth rate of agricultural scientists. Therefore, on the basis of the first-level indicators, 13 second-level indicators are selected to build the evaluation index system of the competitiveness of agricultural science and technology talents, as shown in Figure 1 below.

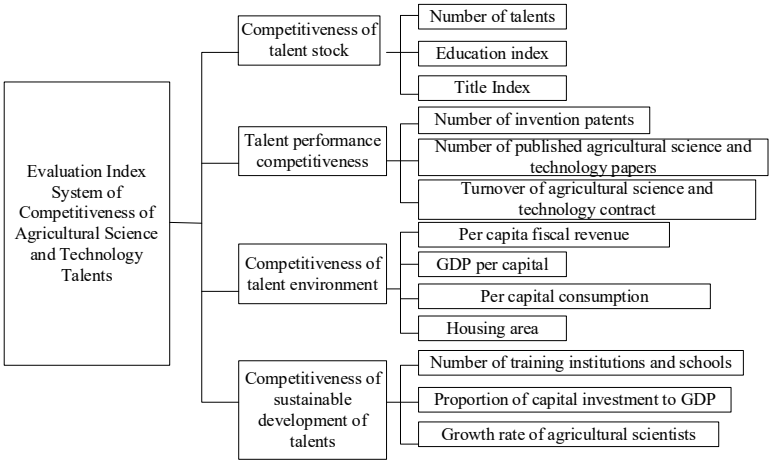

Fig. 1. Evaluation index system of agricultural science and technology talents competitiveness

As shown in Figure 1, the evaluation index system consists of an element layer, namely, the evaluation of the competitiveness of agricultural science and technology talents, four first-level index layers and thirteen second-level index layers, which quantify the competitiveness of agricultural science and technology talents from various aspects.

2.2 Index weight calculation based on analytic hierarchy process

Each index has different influence on the competitiveness of agricultural science and technology talents, so the weight is used to express the importance of the index to the competitiveness of talents. According to the actual demand, the analytic hierarchy process is used to scale the evaluation index system [4]. The scale value indicates the relative importance of the two indicators in the evaluation of talent competitiveness. The scale is divided into five levels: 1, 3, 5, 7, 9, and 2, 4, 6, 8. Its specific meaning is shown in Table 1.

Table 1. Scaling table of evaluation indexes based on analytic hierarchy process

Number	Scale	Meaning
1	1	Both indicators are equally important.
2	3	Comparing the two indicators, the former is slightly more important than the latter.
3	5	Comparing the two indicators, the former is obviously more important than the latter.
4	7	Comparing the two indicators, the former is more important than the latter.
5	9	Comparing the two indicators, the former is more important than the latter.
6	2, 4, 6, 8	Adjacent judgment median

Randomly select two indicators, and determine the scale value of the indicators according to the scale rules in the above table [5]. The expert scoring method is used to score each index. According to the index score and scale, the weight of the index is calculated by using the judgment matrix. The calculation formula is as follows:

$$w = \sum_{n=1} a_n e_n \tag{1}$$

In the formula, w represents the weight value of the index; n represents the number of evaluation indexes; a_n represents the scale value of the n th index; e_n represents the expert score of the n th index [6]. The above formula is used to calculate the index weight. Since the expert scoring has a certain objectivity, the index weight is normalized, which is expressed by the formula:

$$w_n = \frac{\overline{w}}{\sum_{i=1} \overline{w_i}} \tag{2}$$

Where w_n represents the weight of the n th index; i represents the number of elements of the index vector; and $\overline{w_i}$ represents the weight of the i th element [7]. The calculated index weight is marked into the evaluation index system, which lays the foundation for the follow-up comprehensive evaluation and analysis of talent competitiveness.

2.3 Comprehensive evaluation and analysis of talent competitiveness

On the basis of the above, the competitiveness of agricultural science and technology talents is rated quantitatively. Each index is quantified and normalized according to the actual situation, and the talent competitiveness value is calculated by using the evaluation function, the calculation formula is:

$$k = \sum_{n=1} w_n x \varepsilon \tag{3}$$

In the formula, k represents the competitiveness value of agricultural science and technology talents; x represents the attribute value of the index; ε represents the quantitative value of the index [8]. The calculated talent competitiveness value ranges from 0 to 1. According to the calculation results of formula (3), the competitiveness of agricultural science and technology talents is qualitatively evaluated [9]. According to the needs of talent competitiveness evaluation, five levels are designed, namely, very strong, relatively strong, general, relatively weak and very weak. If the value of talent competitiveness is between 0 and 0.2, it means that the competitiveness of agricultural science and technology talents is very weak, and strong measures and countermeasures need to be taken to improve the competitiveness of talents. If the value of talent competitiveness is between 0.2 and 0.4, it means that the competitiveness of agricultural science and technology talents is relatively weak, and it is necessary to take appropriate measures and countermeasures to improve the competitiveness of talents. If the value of talent competitiveness is between 0.4 and 0.6, it means that the competitiveness of

agricultural science and technology talents is in the middle level, and effective talent training programs and strategies can be formulated and implemented to change the current situation of talents. If the value of talent competitiveness is between 0.6 and 0.8, it means that the competitiveness of agricultural science and technology talents is relatively strong, and it is in the middle and upper level. If the value of talent competitiveness is between 0.8 and 1, it means that the competitiveness of agricultural science and technology talents is very strong, and the status quo can be maintained continuously [10]. According to the above criteria, the competitiveness of agricultural science and technology talents is qualitatively evaluated. The level of competitiveness of talents is determined to realize the evaluation of the competitiveness of agricultural science and technology talents by technical hierarchy analysis.

3 Experimental demonstration and analysis

To verify the feasibility and reliability of the evaluation idea of the competitiveness of agricultural science and technology talents, a total of 25000 agricultural science and technology talents in a region were selected as the evaluation object, aged between 21 and 64, of which 65.16% were male, 34.84% were female, and 12.32% were doctoral degree talents [11]. Talents with master's degrees accounted for 14. 62%, talents with bachelor's degrees accounted for 28. 62%, and talents with professional education accounted for 44. 26%. Using this designed method and traditional method, the competitiveness of agricultural science and technology talents in this region was comprehensively evaluated and analyzed. According to the above evaluation process, the evaluation index system is built, the index weight is calculated, and the comprehensive evaluation of the index system is carried out to obtain the evaluation result [12]. In the experiment, agricultural science and technology talents were randomly divided into five groups, taking the number of talents as a variable. The number of agricultural science and technology talents in the first group was 5000, the second group was 5000 more than the first group, and the fifth group was 25000. The evaluation results of each group are as follows: strong competitiveness, general competitiveness, general competitiveness, weak competitiveness and general competitiveness. The consistency coefficient is used to evaluate the accuracy of the two methods, and its value range is between 0 and 1. The larger the value, the higher the evaluation accuracy. According to the consistency coefficient reflecting the evaluation accuracy of the design method on the competitiveness of agricultural science and technology talents, the index is calculated by using IHRA software, and the bar chart is drawn according to the experimental data as follows.

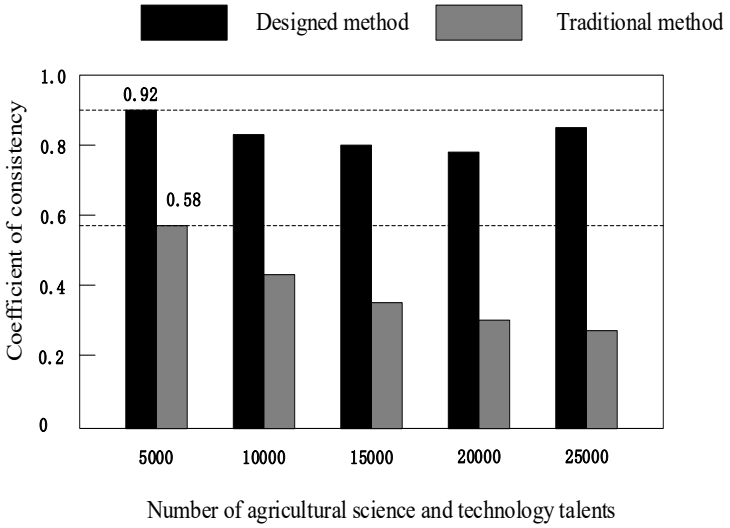

Fig. 2. Comparison of consistency coefficients of the two methods

Through the analysis of the data in Figure 2, the following conclusions can be drawn: the maximum value of the consistency coefficient between the evaluation results of the design method and the actual situation is 0.92. The minimum value is 0.81, and the average consistency coefficient is 0.86, indicating that the evaluation results are highly consistent with the actual situation and have high evaluation accuracy. In the traditional method, the highest consistency coefficient is only 0.58. The minimum consistency coefficient is 0.34, and the average consistency coefficient is 0.42, which is far lower than the design method. Therefore, the experimental results show that the designed method is superior to the traditional method in terms of evaluation accuracy, and is more suitable for the evaluation of agricultural science and technology talent competitiveness than the traditional method.

4 Conclusion

In view of the shortcomings and drawbacks of the traditional methods, this paper uses the analytic hierarchy process to put forward a new evaluation idea of the competitiveness of agricultural science and technology talents, and verifies the feasibility and reliability of the evaluation idea through experiments, which effectively improves the evaluation accuracy of the competitiveness of agricultural science and technology talents. The experiment proves that this designed method is superior to the traditional method, and is more suitable for the evaluation of the competitiveness of agricultural science and technology talents than the traditional method.

This study has a good practical significance to promote the extensive application of AHP in the evaluation of the competitiveness of agricultural science and technology talents, to improve the technical level of the evaluation of the competitiveness of agricultural science and technology talents, and to enrich the research theory in this area. Due to the limited time of this study, there may be some shortcomings in the content of the study, which will be explored in depth in future research to provide a theoretical reference for the evaluation of the competitiveness of agricultural science and technology talents.

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