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Cohesion of Agricultural Crowdfunding Risk Prevention under Sustainable Development Based on Gray–Rough Set and FAHP-TOPSIS

Ye Xue * and Ying Li

College of Economics and Management, Taiyuan University of Technology, Taiyuan 030024, China
* Correspondence: xueye0412@126.com or liying0970@link.tyut.edu.cn

Abstract: Agricultural crowdfunding has promoted the development of China's agriculture and rural economy. Ensuring the sustainable development of agricultural crowdfunding is a key issue that needs attention against the current background. The concept of cohesion is introduced into the study of agricultural crowdfunding risk prevention, and the cohesion evaluation index system is determined with the help of the gray-rough set method, weights of which are determined by using triangular fuzzy hierarchy analysis. The TOPSIS method is used to evaluate it, four crowdfunding projects are selected for case studies, and the models are compared and analyzed. Finally, the influencing factors are comprehensively analyzed. The results show that: (1) The case evaluation results are consistent with its actual situation, and the comparison with the model presents the accuracy of the selected model, both of which verify the feasibility of the evaluation model. (2) Collaboration, organizational leadership, and the degree of assurance of the quantity and quality of agricultural products are important factors affecting the improvement of the cohesion in agricultural crowdfunding risk prevention. (3) The most significant factors in enhancing the cohesiveness of agricultural crowdfunding risk prevention are "responsiveness" and "safety of agricultural products". Finally, the targeted countermeasures and suggestions are expected to provide the decision-making basis for the risk management of agricultural crowdfunding and realize the sustainable development of agricultural crowdfunding.

Keywords: agricultural crowdfunding; risk prevention cohesion; cohesion evaluation; impact factor analysis; sustainable development

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1. Introduction

In recent years, agricultural development model innovation has become one of the hot topics in the field of agriculture. Agricultural crowdfunding as a new funding model has received wide attention, not only to optimize the agricultural financing environment, but also to promote the sustainable development of agriculture [1]. In 2019, China's State Council issued the Opinions on Establishing a Sound Institutional Mechanism and Policy System for Integrated Development of Urban and Rural Areas, which stated that new models such as agricultural crowdfunding should be explored, rural e-commerce support policies should be improved, and a mechanism for cultivating new industries and new business models should be established, giving greater attention to the sustainable development of agricultural crowdfunding [2]. Since its official entry into China in 2014, agricultural crowdfunding has gradually become a major hit in the agricultural field and has achieved rapid development, with a large number of agricultural crowdfunding platforms being established one after another overnight. So-called agricultural crowdfunding is the use of crowdfunding platforms to display information about multiple projects to attract consumers to invest, and farmers to carry out agricultural production according to the requirements of investment orders and deliver agricultural products directly to consumers [3]. This new model reduces the transaction costs of agricultural products, which ensures the profitability of consumers, as well as the production and marketing safety of agricultural products, and promotes sustainable agricultural development [4]. In the COVID-19 pandemic, the increased public acceptance of online agricultural products has given a stronger impetus to the digitalization of agriculture and the development of agricultural crowdfunding [5,6].

As a new form of financing in the "Internet+" era, agricultural crowdfunding also faces many challenges. In existing studies, many scholars have started to focus on the effects that the model of agricultural crowdfunding brings to the process of agricultural development [7–9], as well as the dilemmas and risks faced by agricultural crowdfunding [10–12]. However, due to the constraints of trust, legal, and other risks, the development of agricultural crowdfunding is still in its initial stage. We need to deeply analyze the risks faced by agricultural crowdfunding, focus on the goal of sustainable development, and effectively improve adaptation and response to risks. This is the current and future development direction of agricultural crowdfunding risk prevention. Therefore, evaluating the risk prevention cohesion of agricultural crowdfunding and putting forward effective countermeasures has positive significance for the sustainable development of agricultural crowdfunding and the formulation, adjustment, and implementation of risk prevention measures in the future.

2. Literature Review

This section reviews the literature that is closely related to our research. The studies can be classified into three categories: (1) Agriculture and agricultural crowdfunding under sustainable development; (2) Risk prevention in agricultural crowdfunding; and (3) Evaluation of risk prevention cohesion.

2.1. Agriculture and Agricultural Crowdfunding under Sustainable Development

With the increasing degree of information technology, the integration of new economic development models in the agricultural economy can promote its sustainable development. Zhao et al. [13] proposed the use of modern science and technology to achieve efficient agriculture with simultaneous development of comprehensive benefits based on the concept of sustainable agricultural development. Lv et al. [14] pointed out that the integration and development of the agricultural economy and the Internet can expand the development space of the agricultural economy by analyzing the bottlenecks that restrict its sustainable development. Wang et al. [15] discussed that technology-based agriculture will replace the traditional development model to promote optimal allocation of resources in the agricultural industry. Li et al. [16] analyzed the impact of agricultural crowdfunding on the development of specialty agriculture. Liu et al. [17] pointed out the dual functions of agricultural crowdfunding, which are the financial function and the function of reshaping agricultural production models, respectively.

2.2. Risk Prevention in Agricultural Crowdfunding

Agricultural crowdfunding is currently at an early stage of development, leading to a series of risks associated with crowdfunding, so conducting research on risk prevention in agricultural crowdfunding can have a positive impact on promoting rural agricultural economic development. Cui et al. [18] combined the current "Internet+" action plan with the platform and other dimensions to build a risk prevention mechanism from the government, and showed that improving the level of risk prevention in agricultural crowdfunding can effectively complement and enrich the crowdfunding model. Ji et al. [19] identified the credit, legal, and financial business risk factors of equity-based agricultural crowdfunding from the perspective of vulnerable investors and developed preventive measures for these risks. He et al. [20] proposed a risk prevention mechanism for internal and external risks through a multivariate analysis of agricultural crowdfunding risks in Beijing. Zhou et al. [21] conducted a risk analysis based on the whole process of crowdfunding and suggested the establishment of a rating mechanism, as well as the application of blockchain technology, to safeguard the development of agricultural crowdfunding. Zhang et al. [22] analyzed the systemic risks and legal risks that may be caused by technical security risks from the perspective of "blockchain + agriculture crowdfunding" and put forward legal regulation suggestions. Gao et al. [23] analyzed the operation mode of typical agricultural crowdfunding platforms in China and put forward corresponding countermeasures and suggestions.

2.3. Evaluation of Risk Prevention Cohesion

As risk prevention research progresses, researchers have found that improving cohesion improves risk prevention and leads to sustainable development. Shi et al. [24] systematically studied the scientific connotation of cohesion from the basic principles of comprehensive risk prevention, and initially established a model of cohesion to improve the existing comprehensive risk prevention theory system. Wang et al. [25] qualitatively described how cohesion can enhance the prevention capability in the process of risk response. Wang et al. [26] developed a theoretical system of risk vulnerability, resilience, adaptability, and cohesion, and constructed a single-to multi-factor research framework. Jiang et al. [27] explored cohesion as a high degree of unity between efficiency and effectiveness in risk prevention. Wu et al. [28] studied multi-subject consensus on risk prevention from the cognitive and affective dimensions. In terms of cohesion evaluation research, a representative evaluation method has not been developed yet. Hu et al. [29] proposed a network cohesiveness model based on the concept of cohesion to adjust the structure and function of the system by integrating key parameters. Wu et al. [30] discussed that a multi-scenario simulation study can help predict changes in cohesion and provide an important reference for planning. Yang et al. [31] constructed a cohesion indicator system and developed a national cohesion evaluation method based on a three-stage model. Yang et al. [32] conducted a study on cohesion levels using hierarchical analysis.

Compared with the existing studies, the contributions of this paper are as follows. First, the concept of cohesion is introduced into the study of agricultural crowdfunding risk prevention, and the four participating subjects of initiators, investors, crowdfunding platforms, and governments are considered comprehensively, which is more conducive to improving the ability to cope with risks. Second, a qualitative analysis of agricultural crowdfunding risk prevention cohesion is conducted, and then the results of the qualitative analysis are further quantified to make the indicator system more complete. The combination of qualitative and quantitative methods makes the model more operable, which in turn optimizes the results and provides a theoretical reference for the development of agricultural crowdfunding. Finally, there are few studies on the evaluation methods of risk prevention cohesion. The FAHP-TOPSIS model is used to evaluate crowdfunding projects, and the application process of FAHP and TOPSIS is designed to combine the advantages of both methods, which can enrich the related research.

3. Methods

3.1. GCA-RS

Gray correlation analysis (GCA) can solve the problem of ambiguous objects that are not easy to analyze and process, while not being limited by the study sample [33]. Rough set (RS) theory does not require the use of a priori knowledge such as probability distribution density when dealing with uncertain information and is not subject to more preconditions, and the principle of rough set attribute simplification eliminates the redundancy of attributes [34]. In this paper, a combined GCA-RS index screening method is used to optimize the evaluation index system of agricultural crowdfunding risk prevention cohesion [35,36].

1. Create the scoring matrix X

For the initially constructed factor system, senior experts in the field of agricultural crowdfunding risk prevention were invited to score the five dimensions of systematicity, scientificity, adaptability, sustainability, and conciseness, and the sum of each expert's scores for each dimension (0~20 points) was taken as the expert evaluation result (out of 100 points) [37]. Setting up an agricultural crowdfunding risk prevention cohesion evaluation index system as a multi-attribute decision information system:

$$S = \{U, C, G, V, g\}$$

where $U = \{u_1, u_2, \ldots, u_i, \ldots, u_m\}$ is the set consisting of m evaluation experts and C is the index system, G is the sample clustering result set, V is the set of attribute values, g refers to the property value of each object in U (that is, the rating value of evaluation object u_i on indicator c_j). There are differences in ratings depending on the attributes; the original matrix of observations needs to be normalized. This article uses the polarization method to standardize the data, and the standardized $m \times n$ order scoring matrix $X = [x_{ij}]$ is obtained by Equation (1), where $i = 1, 2, \ldots, m; j = 1, 2, \ldots, n$.

$$x_{ij} = \frac{v_{ij} - v_{i\min}}{v_{i\max} - v_{i\min}}, \tag{1}$$

2. Construct the association matrix E

Let $X' = \{x_1^1, x_2^2, \ldots, x_m^n\}$ denote the characteristic series of indicator score changes. Let ε_{ik}^j $(i, k = 1, 2, \ldots, m;\ j = 1, 2, \ldots, n)$ denote the correlation coefficient of evaluation object u_i to u_k at indicator c_j.

$$\varepsilon_{ik}^j = \frac{\min_i \min_j \left| x_k^j - x_i^j \right| + \rho \max_i \max_j \left| x_k^j - x_i^j \right|}{\left| x_k^j - x_i^j \right| + \rho \max_i \max_j \left| x_k^j - x_i^j \right|}, \ \rho \in [0, 1], \tag{2}$$

$$\varepsilon_{ik} = \frac{1}{n} \sum_{j=1}^{n} \varepsilon_{ik}^j, \tag{3}$$

According to Equations (2) and (3), E is obtained as follows:

$$E = \begin{pmatrix} \varepsilon_{11} & \varepsilon_{12} & \cdots & \varepsilon_{1m} \\ & \varepsilon_{22} & \cdots & \varepsilon_{2m} \\ & & \ddots & \vdots \\ & & & \varepsilon_{mm} \end{pmatrix}, \tag{4}$$

When $i = k$, $\varepsilon_{ik} = 1$, let λ be the threshold value and $\lambda = [0, 1]$. When $\varepsilon_{ik} \geq \lambda$ $(i \neq k)$, then the evaluation objects u_i and u_k belong to the same kind of features, and the feature variables $e_1, e_2, \ldots, e_m$ are gray correlation clusters under the threshold λ.

3. *F*-statistic to determine the optimal threshold λ

The classification of indicators is influenced by the threshold value λ. Different values of λ are taken and different classification results are obtained. In order to make the classification of indicators more scientific, the optimal threshold λ was determined using the *F*-statistic method.

Let the number of classifications under the threshold λ be r and m_t denote the number of evaluation objects contained in the tth class $(t = 1, 2, \ldots, r)$, then

$$\overline{x}_{tj} = \frac{1}{m_t} \sum_{i=1}^{m_t} x_{ij}, \ (j = 1, 2, \ldots, n), \tag{5}$$

is the average of the scores of category t evaluation subjects on indicator c_j.

$$\overline{x}_j = \frac{1}{m} \sum_{i=1}^{m} x_{ij}, \ (j = 1, 2, \ldots, n), \tag{6}$$

is the average of the scores of all evaluation subjects on indicator c_j. F can be obtained as follows:

$$F = \frac{\sum_{t=1}^{r} m_t \sum_{j=1}^{n} (\overline{x}_{tj} - \overline{x}_j)^2 / (r-1)}{\sum_{t=1}^{r} \sum_{i=1}^{m_t} \sum_{j=1}^{n} (x_{ij} - \overline{x}_{tj})^2 / (m-r)}, \quad (7)$$

In Equation (7), the denominator represents the intra-class inter-sample distance, and the numerator represents the inter-class inter-sample distance. Therefore, the size of the F-value can reflect the effect of classification. The larger the F-value, the more significant the classification difference, and vice versa, the less significant. When F satisfies $F > F_\alpha(r-1, m-r)(\alpha = 0.05)$, it means that the difference is more significant and the classification is more reasonable. If multiple F-values satisfy the inequality $F > F_\alpha(r-1, m-r)$ at the same time, take the λ corresponding to $\max\{(F - F_\alpha)/F\}$ as the best threshold and the corresponding classification as the best classification.

4. Rough Set Indicator Simplification

In the information system $S = \{U, C, G, V, g\}$, the indistinguishable relation of C is denoted as $Ind(C)$, and the relation $U/Ind(C)$ constitutes a division of U and can be denoted as $Ind(C)$ or U/C. Define the division of U into s sets of equivalence classes denoted as follows:

$$U/C = \{U_1, U_2, \ldots, U_s\}, \quad (8)$$

If $Ind(U) = Ind\left(U - \{c_j\}\right)$, $c_j \in U$ holds, then c_j is said to be redundant in U, otherwise c_j is necessary in U; U is said to be independent if every c_j is necessary in U. In this paper, the metrics that have been abbreviated are unnecessary metrics in the evaluation of cohesive risk prevention indicators for agricultural crowdfunding. The principle is to compare the clustering results of gray samples under all indicators with the clustering results of gray samples after deleting indicator c_j. If the clustering results are the same, the indicator is considered to be reduced; if not, the indicator is considered to be retained.

3.2. FAHP-TOPSIS

The current approach to cohesion evaluation is mainly focused on hierarchical analysis. However, for the evaluation process of risk prevention cohesion design multiple qualitative indicators, the traditional hierarchical analysis method has a strong subjectivity in the process of weight allocation, which is not able to deal effectively with the uncertainty existing in the decision-making process. Based on this analysis, FAHP introduces fuzzy set theory, which can effectively quantify the experts' fuzzy and uncertain evaluations [38]. The main goal of MCDM is for the decision maker to select the best option from among many alternatives with the help of expert judgment [39]. The TOPSIS method has a strong objectivity and has the property of approximating the ideal solution [40,41]. Therefore, combining the two in this paper can quantify the qualitative factors in the selection process of agricultural crowdfunding projects and also achieve a quantitative evaluation in general [42].

To further illustrate the superiority of the FAHP-TOPSIS model applied to cohesion evaluation, the common methods are compared, as shown in Tables 1 and 2.

Table 1. Comparison of the advantages and limitations of empowerment approaches.

Approaches to Empowerment	Advantages	Limitations
FAHP	Optimize assessment results by transforming incomplete information into fuzzy concepts	Ignores secondary factors
FUCOM [43]	Simple and efficient quantitative processing using the simplified pairwise comparison principle	Highly subjective
SWARA [44]	No pairwise comparisons are required. Weights are simple to determine and easier to implement	Empowerment according to the subjective judgment of decision makers, which is highly subjective
BWM [45]	Consistent results can be obtained with less information	Deals with attribute weights where there is no association between attributes

Table 2. Comparison of the advantages and limitations of some MCDM approaches.

Approaches to MCDM	Advantages	Limitations
TOPSIS	More in line with the actual situation	Difficulty in determining indicator weights
MABAC [46]	Easy to calculate and stable results	Addresses issues related to independent metrics only
MAIRCA [47]	Each alternative has the same priority and is more objective	More uses in natural disaster risk assessment such as fire and flooding
VIKOR [48]	A compromise with priorities can be obtained	More than one best solution is not conducive to decision making

As shown in Tables 1 and 2, the advantages of the FAHP-TOPSIS model for risk prevention cohesion evaluation are reflected in the following.

1. FAHP not only has the advantages of quantitative and objective AHP, but also has the inclusiveness of FCE (Fuzzy Comprehensive Evaluation Method). It is more objective compared with FUCOM, SWARA, etc., and can handle the problem of attribute weighting without correlation compared with BWM. Therefore, FAHP is more applicable.
2. TOPSIS can accurately reflect the gap between evaluation programs. It is more conducive to managers' decision making compared to VIKOR. Based on the fact that the indicators constructed in this paper are not independent of each other, TOPSIS is more suitable than MABAC for this paper. MAIRCA is used more for disaster risk assessment. Therefore, TOPSIS has better applicability.

The evaluation process of FAHP-TOPSIS is shown in Figure 1.
The specific steps are as follows:

5. Construct the integrated triangular fuzzy judgment matrix $\widetilde{A}^h$ for each layer

Each value of the triangular fuzzy judgment matrix indicates the importance of the previous factor over another factor, and the fuzzy judgment matrix is established by the relevant experts in accordance with the listed indicators and using the 1–9 scale method to make a two-by-two comparison judgment of each indicator in the range of 1–9, according to the definition of the triangular fuzzy number. For the evaluation results of multiple experts, the experts' opinions are integrated by taking the average value using the algorithm of triangular fuzzy numbers to obtain the integrated triangular fuzzy judgment matrix $\widetilde{A}^h$ of the indicators in layer h:

$$\widetilde{A}^h = \left(\widetilde{a}_{ij}^h\right)_{n\times n},$$

where $\widetilde{a}_{ij}^h = \left(l_{ij}^h, p_{ij}^h, q_{ij}^h\right)$, $h = 1,2,\ i,j = (1,2,\ldots,n)$. l_{ij}^h, p_{ij}^h, and q_{ij}^h are the pessimistic, probable, and optimistic values of the triangular fuzzy numbers, respectively.

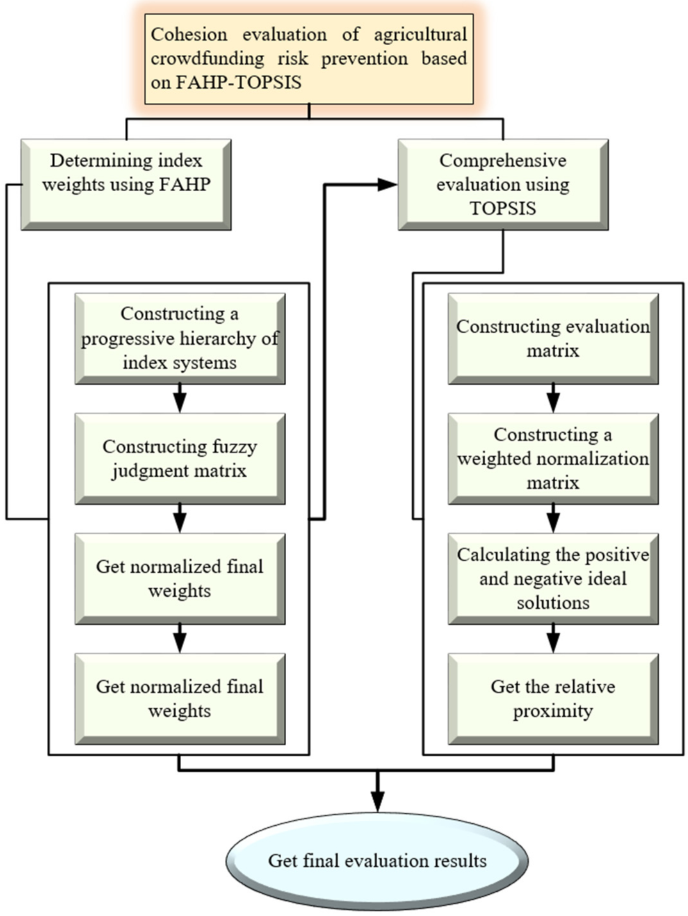

Figure 1. Flow chart of FAHP-TOPSIS model.

6. Calculate the total weight W

From $\widetilde{A}^h$, the initial weight $\widetilde{D}_i^h$ of the tier h indicator is obtained, as shown in Equation (9):

$$\widetilde{D}_i^h = \sum_{j=1}^{n} \widetilde{a}_{ij}^h \otimes \left[\sum_{i,j=1}^{n} \widetilde{a}_{ij}^h\right]^{-1},\ i = 1,2,\ldots,n, \tag{9}$$

where $\sum\limits_{j=1}^{n} \widetilde{a}_{ij}^h = \left(\sum\limits_{j=1}^{n} l_{ij}^h, \sum\limits_{j=1}^{n} p_{ij}^h, \sum\limits_{j=1}^{n} q_{ij}^h\right)$, $\left[\sum\limits_{i,j=1}^{n} \widetilde{a}_{ij}^h\right]^{-1} = \left(\frac{1}{\sum\limits_{i,j=1}^{n} q_{ij}^h}, \frac{1}{\sum\limits_{i,j=1}^{n} p_{ij}^h}, \frac{1}{\sum\limits_{i,j=1}^{n} l_{ij}^h}\right)$. $\widetilde{a}_{ij}^h$ denotes the elements of the triangular fuzzy judgment matrix.

Let $\widetilde{D}_i^h = \left(l_i^h, p_i^h, q_i^h\right)$ and $\widetilde{D}_j^h = \left(l_j^h, p_j^h, q_j^h\right)$ be the initial weights of the two trigonometric fuzzy number functions. The fuzzy sets represented by the integrated fuzzy values are compared with each other and the possible degree $V\left(\widetilde{D}_i^h \succ \widetilde{D}_j^h\right)$ is defined by the triangular fuzzy function, as shown in Equation (10):

$$V\left(\widetilde{D}_i^h \succ \widetilde{D}_j^h\right) = \begin{cases} 1, & p_i^h \geq p_j^h \\ \frac{l_j^h - q_i^h}{\left(p_i^h - q_i^h\right) - \left(p_j^h - l_j^h\right)}, & p_i^h \leq p_j^h, q_i^h \geq l_j^h, \\ 0, & otherwise \end{cases} \tag{10}$$

where l_{ij}^h, p_{ij}^h and q_{ij}^h are the pessimistic, probable, and optimistic values of the triangular fuzzy numbers, respectively.

The weights of the indicators in layer h are obtained by Equation (11).

$$d_i = \min V\left(\widetilde{D}_i^h \succ \widetilde{D}_j^h\right),\ j = 1, 2, \ldots, n,\ j \neq i, \tag{11}$$

Normalizing the weights, then W^h is the final weight that is normalized by processing the indicators in layer h, as shown in Equation (12):

$$\begin{gathered} W_i^h = \frac{d_i}{\sum\limits_{i=1}^{n} d_i}, \\ W^h = \left(W_1^h, W_2^h, \ldots, W_n^h\right), \end{gathered} \tag{12}$$

By the above method, the weight W^1 of the criterion-level indicators and the weight W^2 of the factor-level indicators can be obtained. Then the total weight W of the factor level indicators can be obtained, as shown in Equation (13):

$$\begin{gathered} W_{ik} = W_i^1 \times W_{ik}^2 (i = 1, 2, \ldots, n,\ k = 1, 2, \ldots, m) \\ W = (W_{11}, W_{12}, \ldots, W_{ik}, \ldots, W_{nm}), \end{gathered} \tag{13}$$

7. Build TOPSIS matrix

With r evaluation indicators, where $r = n \times m$, and z evaluation objects, the original data were collected, and an evaluation matrix was established as follows:

$$B = (b_{st})_{r \times z}$$

B is normalized as shown in Equation (14):

$$O_{st} = \frac{b_{st}}{\sqrt{\sum\limits_{s=1}^{r} b_{st}^2}}, O_{st} = \frac{\frac{1}{b_{st}}}{\sqrt{\sum\limits_{s=1}^{r} \left(\frac{1}{b_{st}}\right)^2}}, \tag{14}$$

The weighted standardization matrix Z is constructed by combining the standardization matrix $O = (O_{st})_{r \times z}$ with the total weights $W = (W_{11}, W_{12}, \ldots, W_{nm})$ of the indicators determined by the FAHP method, as shown in Equation (15):

$$Z = \begin{pmatrix} W_{11}O_{11} & W_{11}O_{12} & \ldots & W_{11}O_{1z} \\ W_{12}O_{21} & W_{12}O_{22} & \ldots & W_{12}O_{2z} \\ \vdots & \vdots & \vdots & \vdots \\ W_{nm}O_{r1} & W_{nm}O_{r2} & \ldots & W_{nm}O_{rz} \end{pmatrix} = \begin{pmatrix} Z_{11} & Z_{12} & \ldots & Z_{1z} \\ Z_{21} & Z_{22} & \ldots & Z_{2z} \\ \vdots & \vdots & \vdots & \vdots \\ Z_{r1} & Z_{r2} & \ldots & Z_{rz} \end{pmatrix}, \tag{15}$$

8. Calculate the relative proximity of each evaluation object

The optimal and inferior solutions consisting of the maximum and minimum values of each row are calculated as shown in Equation (16):

$$Z^{+} = \left(\max_{t=1}^{z} Z_{1t}, \max_{t=1}^{z} Z_{2t}, \ldots, \max_{t=1}^{z} Z_{rt}\right)^{T} = \left(Z_{\max 1}, Z_{\max 2}, \ldots, Z_{\max r}\right)^{T}$$
$$Z^{-} = \left(\min_{t=1}^{z} Z_{1t}, \min_{t=1}^{z} Z_{2t}, \ldots, \min_{t=1}^{z} Z_{rt}\right)^{T} = \left(Z_{\min 1}, Z_{\min 2}, \ldots, Z_{\min r}\right)^{T} \quad (16)$$

Euler's formula is used to calculate the distance from each evaluation object to the positive and negative ideal solution. S_t^+ and S_t^- denote the positive ideal distance and negative ideal distance of the evaluation object, respectively, as shown in Equation (17):

$$S_t^+ = \sqrt{\sum_{s=1}^{r} \left(Z_{\max s} - Z_{st}\right)^2}$$
$$S_t^- = \sqrt{\sum_{s=1}^{r} \left(Z_{\min s} - Z_{st}\right)^2} \quad (17)$$

L_t is the relative proximity of the tth optimal solution, which in this paper is expressed as the cohesion level of the agricultural crowdfunding project, as shown in Equation (18):

$$L_t = \frac{S_t^-}{S_t^+ + S_t^-}, \quad (18)$$

L_t takes values between 0 and 1. The closer L_t is to 1, the higher the cohesion level of the project; conversely, the closer it is to 0, the lower the cohesion level of the project.

4. The Construction of a Cohesive Evaluation Index System for Agricultural Crowdfunding Risk Prevention Based on GCA-RS

4.1. Define Risk Prevention Cohesion in Agricultural Crowdfunding

The term "cohesion" originated in Western psychology and emphasizes the idea of unity and integration [49]. Cohesion refers to the degree to which members of a group work together to achieve the goals and objectives of the group. The concept of "group" refers to people or animals in general, including friends, family, a collective, unit, or nation, etc.

Agricultural crowdfunding risk prevention refers to a series of actions taken in advance to estimate some risks that may arise from various aspects of crowdfunding (e.g., product quality risks, operational risks, etc.). The various stakeholders involved in the whole process are promoters, investors, crowdfunding platforms, and governments [50]. Shi et al. [24] proposed that improving system cohesion can enhance integrated risk prevention, which leads to sustainable system development. Based on the basic connotation of agricultural crowdfunding risk prevention and the comprehensive risk prevention cohesion-related research results, the agricultural crowdfunding risk prevention cohesion is defined as: a synergistic internal driving force and synergy composed of various factors, such as agricultural crowdfunding project risk environment, risk prevention goals, risk management, and project benefits, etc. It is a multi-subject consensus research, involving subjects generally of four categories: initiators, investors, crowdfunding platforms, and government departments. They each carry out a single-subject synthesis in their own dimensions, and then the four categories of subjects are further integrated, cooperate, and influence each other, and reach a consensus, which enhances its own risk prevention ability. In turn, each subject is constantly optimized and adjusted for further synthesis, generating a convergence of forces and forming a stronger overall cohesion. Ultimately, it can have an effect on the risk prevention of agricultural crowdfunding and realize the sustainable development of agricultural crowdfunding. It can be expressed by the equation:

$$L = f(concentration, aggregation) = f\left(\langle N_1, N_2, \ldots, N_i \rangle, \langle J_1, J_2, \ldots, J_j \rangle\right),$$

where N_i represents the factor that affects the concentration and J_j represents the factor that affects the aggregation.

The level of cohesion in agricultural crowdfunding risk prevention has an important impact on the benefits and development of agricultural crowdfunding projects, as well as the growth and development of each participant. In an agricultural crowdfunding project, with a high level of risk prevention cohesion, all participants closely focus on the goal of risk prevention to cooperate, reach consensus, and generate synergy, forming a situation of cohesion and unity to minimize or eliminate risks and achieve the purpose of risk prevention, thereby promoting the development of agricultural crowdfunding projects. If the cohesion is lost in the process of agricultural crowdfunding risk prevention, people are distracted, blame each other, and internal friction continues.

4.2. Pre-Selected Indicators of Agricultural Crowdfunding Risk Prevention Cohesion

According to the principles and conditions of cohesion indicator selection and the reports and related research results on agricultural crowdfunding risks and risk prevention [51,52], the cohesion index system of agricultural crowdfunding risk prevention is constructed by combining the relevant characteristics of agricultural crowdfunding risk prevention cohesion. The evaluation index of agricultural crowdfunding risk prevention cohesion is divided into two levels. The first level examines concentration and aggregation, which mainly include organizational leadership, synergy, government support, solidarity, and agricultural product quantity and quality assurance. The second level considers the indicators proposed in the first level, and there are 26 principal indicators. The preliminary construction of the evaluation index system of agricultural crowdfunding risk prevention cohesion is shown in Table 3.

Table 3. Framework of the evaluation index system of agricultural crowdfunding risk prevention cohesion.

First-Level Indicator	Secondary Indicators	Third-Level Indicators	Indicator Screening
Agricultural crowdfunding risk prevention cohesion L	Organizational leadership N_1	Internal organizational capacity c_1, Agricultural crowdfunding risk prevention and decision-making ability c_2, Ability to obtain information c_3, Risk emergency execution c_4	Reduce c_3
	Synergy N_2	Responsive execution c_5, Work efficiency c_6, Project promotion efforts c_7, Social groups and public attention c_8	Reduce c_6
	Government support N_3	Policies that benefit farmers and farmers' satisfaction c_9, Effectiveness of risk response policies and measures c_{10}, The perfection of the agricultural crowdfunding supervision system c_{11}	Reserve
	Solidarity N_4	Risk sharing c_{12}, Risk prevention spontaneity c_{13}, Technical exchange and mutual assistance c_{14}, Risk prevention consensus c_{15}	Reduce c_{15}
	Quantity and quality assurance of agricultural products J_1	Quality of agricultural products c_{16}, Natural environment stability c_{17}, Safety of agricultural products c_{18}, Agricultural production efficiency c_{19}	Reduce c_{19}
	Technical support ability J_2	Agricultural production capacity c_{20}, Management level c_{21}, Platform service system capabilities c_{22}, Agronomic techniques c_{23}	Reduce c_{23}
	Timeliness of risk prevention strategies and measures J_3	Agricultural project adjustment c_{24}, Adjustment of suitability of measures c_{25}, Risk awareness timeliness c_{26}	Reserve

4.3. Determination of Cohesion Evaluation Index System Based on GCA-RS

There are many factors affecting the cohesion of agricultural crowdfunding risk prevention; the content is broad, and the relationship is complex. Some indicators in the cohesion evaluation index system may have cross-relationships, which may easily lead to data redundancy. Therefore, it is necessary to optimize the initially constructed index system. A clear risk prevention cohesion system framework is the basis and key to the case analysis in the following sections.

9. Score Matrix X

Eight experts are invited, mainly researchers of the Institute of Agricultural Sciences, directors and researchers of government agricultural departments, and researchers of the Academy of Agricultural Sciences. The indicators c_1 to c_{26} in Table 1 were scored to obtain the original matrix. The original matrix was then substituted into Equation (1) to obtain X.

$$X = \begin{pmatrix}
0.8000 & 0.8200 & 1.0000 & 0.9375 & 0.7500 & 0.8750 & 0.8857 & 0.9649 \\
0.6667 & 0.6400 & 0.0588 & 0.6875 & 0.1786 & 0.1250 & 0.1143 & 0.0982 \\
0.6667 & 0.6000 & 0.1176 & 0.0625 & 0.0714 & 0.6250 & 0.0857 & 0.5614 \\
0.6667 & 0.7200 & 0.0000 & 0.5625 & 0.0357 & 0.0000 & 0.0000 & 0.0281 \\
0.9000 & 0.8800 & 0.9294 & 0.8125 & 1.0000 & 0.7500 & 0.8286 & 0.9474 \\
0.9333 & 0.9200 & 0.9118 & 0.8125 & 0.6071 & 0.9375 & 0.7714 & 0.9825 \\
0.6000 & 0.8640 & 0.8824 & 1.0000 & 0.8929 & 1.0000 & 0.7429 & 0.8947 \\
0.8000 & 0.7600 & 0.7059 & 0.6250 & 0.5714 & 0.6875 & 0.8857 & 0.8070 \\
0.5333 & 0.7800 & 0.7647 & 0.6875 & 0.8571 & 0.6250 & 0.7143 & 0.8772 \\
0.8000 & 0.9000 & 0.8235 & 0.8125 & 0.9286 & 0.7500 & 0.9143 & 1.0000 \\
0.8667 & 0.8600 & 0.8824 & 0.8125 & 0.6429 & 0.8063 & 0.8286 & 0.9298 \\
0.7333 & 0.8800 & 0.6765 & 0.8125 & 0.7143 & 0.8750 & 0.6857 & 0.9123 \\
0.9333 & 0.8200 & 0.7059 & 0.5313 & 0.4429 & 0.7500 & 0.8857 & 0.8772 \\
0.7333 & 0.9000 & 0.8235 & 0.6563 & 0.5714 & 0.9375 & 1.0000 & 0.9474 \\
1.0000 & 0.8400 & 0.8235 & 0.7500 & 0.6643 & 0.7875 & 1.0000 & 0.8947 \\
0.6667 & 0.7000 & 0.8824 & 0.8125 & 0.6071 & 0.6875 & 0.7714 & 0.8947 \\
0.0000 & 0.0000 & 0.0588 & 0.0000 & 0.0000 & 0.5000 & 0.0286 & 0.4912 \\
0.8667 & 0.8000 & 0.7941 & 0.6875 & 0.4643 & 0.7500 & 0.6571 & 0.9123 \\
0.4000 & 0.9600 & 0.7412 & 0.9875 & 0.6714 & 0.9688 & 0.8000 & 0.9825 \\
0.9000 & 0.8000 & 0.8235 & 0.6875 & 0.8214 & 0.6250 & 0.7143 & 0.8421 \\
0.6000 & 0.8200 & 0.7059 & 0.4688 & 0.3571 & 0.8125 & 0.8857 & 0.8772 \\
0.4000 & 0.3600 & 0.0000 & 0.5625 & 0.0357 & 0.0625 & 0.0857 & 0.0000 \\
1.0000 & 0.8800 & 0.6235 & 0.8625 & 0.5357 & 0.8438 & 0.5429 & 0.8772 \\
0.7333 & 0.7800 & 0.7647 & 0.8750 & 0.7857 & 0.8125 & 0.6286 & 0.8421 \\
0.6667 & 0.7800 & 0.7647 & 0.6875 & 0.7857 & 0.6250 & 0.7429 & 0.9298 \\
0.8667 & 1.0000 & 0.7353 & 0.6563 & 0.4643 & 0.6250 & 0.7143 & 0.8596
\end{pmatrix}$$

10. Correlation matrix E

Perform all gray clustering on X and calculate the gray correlation matrix according to Equations (2) to (4). When the resolution is $\rho = 0.5$, the gray correlation degree result is better and E is obtained.

$$E = \begin{pmatrix}
1 & 0.7877 & 0.6889 & 0.7011 & 0.6123 & 0.6708 & 0.6764 & 0.6673 \\
 & 1 & 0.7615 & 0.7496 & 0.6650 & 0.7740 & 0.7247 & 0.7732 \\
 & & 1 & 0.7276 & 0.7542 & 0.7595 & 0.8041 & 0.7747 \\
 & & & 1 & 0.6725 & 0.7264 & 0.6969 & 0.6315 \\
 & & & & 1 & 0.6514 & 0.7202 & 0.6496 \\
 & & & & & 1 & 0.7469 & 0.7866 \\
 & & & & & & 1 & 0.7318 \\
 & & & & & & & 1
\end{pmatrix}$$

According to E, the clustering situation under all indicators c_1 to c_{26} is obtained, as shown in Figure 2.

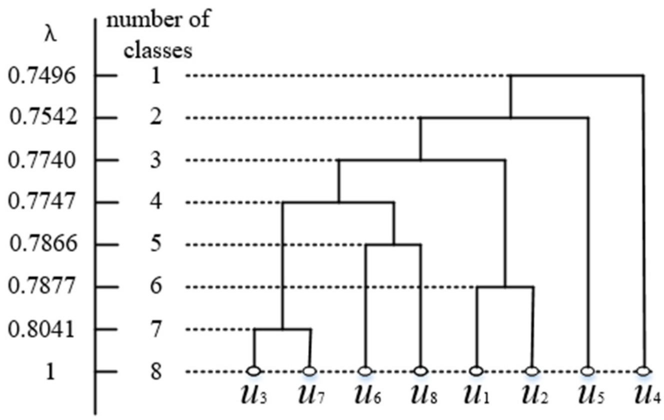

Figure 2. Clustering results under all indicators.

11. Best Threshold λ

Table 4 is obtained according to Equations (5) to (7), and the cases of classification numbers 1 and 8 are omitted. Since $\max\{(F - F_\alpha)/F\} = 0.7562$, so $\lambda = 0.7747$, so $r = 4$,$U/C = \{\{u_3, u_6, u_7, u_8\}, \{u_1, u_2\}, \{u_4\}, \{u_5\}\}$.

Table 4. Determination of threshold.

Number of Categories	2	3	4
λ value	0.7542	0.7740	0.7747
F value	9.2560	12.3328	27.0344
F_α	5.9874	5.7861	6.5914
$(F - F_\alpha)/F$	0.3531	0.5308	0.7562
Number of Categories	**5**	**6**	**7**
λ value	0.7866	0.7877	0.8041
F value	34.5080	29.9184	41.1352
F_α	9.1172	19.2964	233.986
$(F - F_\alpha)/F$	0.7358	0.3550	—

12. Rough set index reduction

In order to judge whether the influence of each index on the sample classification is significant, according to the rough set reduction theory, the gray clusters after removing one index c_j are calculated in turn, as shown in Table 5.

Table 5. Dynamic clustering results.

Indicator Situation	Best Classification
All indicators C	$\{\{u_3, u_6, u_7, u_8\}, \{u_1, u_2\}, \{u_4\}, \{u_5\}\}$
$U/(C - c_1)$	$\{\{u_1, u_2\}, \{u_3, u_7\}, \{u_6, u_8\}, \{u_4\}, \{u_5\}\}$
$U/(C - c_2)$	$\{\{u_2, u_3, u_4, u_6, u_7, u_8\}, \{u_1\}, \{u_5\}\}$
$U/(C - c_3)$	$\{\{u_3, u_6, u_7, u_8\}, \{u_1, u_2\}, \{u_4\}, \{u_5\}\}$
$U/(C - c_4)$	$\{\{u_1, u_2, u_3, u_4, u_6, u_7, u_8\}, \{u_5\}\}$
$U/(C - c_5)$	$\{\{u_1, u_2\}, \{u_3, u_7\}, \{u_6, u_8\}, \{u_4\}, \{u_5\}\}$
$U/(C - c_6)$	$\{\{u_3, u_6, u_7, u_8\}, \{u_1, u_2\}, \{u_4\}, \{u_5\}\}$
$U/(C - c_7)$	$\{\{u_1, u_2, u_6, u_8\}, \{u_3, u_7\}, \{u_4\}, \{u_5\}\}$
$U/(C - c_8)$	$\{\{u_1, u_2\}, \{u_3, u_7\}, \{u_6, u_8\}, \{u_4\}, \{u_5\}\}$
$U/(C - c_9)$	$\{\{u_1, u_2\}, \{u_3, u_7\}, \{u_6, u_8\}, \{u_4\}, \{u_5\}\}$

Table 5. *Cont.*

Indicator Situation	Best Classification
$U/(C-c_{10})$	$\{\{u_1,u_2\},\{u_3,u_7\},\{u_6,u_8\},\{u_4\},\{u_5\}\}$
$U/(C-c_{11})$	$\{\{u_1,u_2,u_6,u_8\},\{u_3,u_7\},\{u_4\},\{u_5\}\}$
$U/(C-c_{12})$	$\{\{u_1,u_2\},\{u_3,u_7\},\{u_6,u_8\},\{u_4\},\{u_5\}\}$
$U/(C-c_{13})$	$\{\{u_1,u_2\},\{u_3,u_7\},\{u_6,u_8\},\{u_4\},\{u_5\}\}$
$U/(C-c_{14})$	$\{\{u_1,u_2\},\{u_3,u_7\},\{u_6,u_8\},\{u_4\},\{u_5\}\}$
$U/(C-c_{15})$	$\{\{u_3,u_6,u_7,u_8\},\{u_1,u_2\},\{u_4\},\{u_5\}\}$
$U/(C-c_{16})$	$\{\{u_1,u_2\},\{u_3,u_7\},\{u_6,u_8\},\{u_4\},\{u_5\}\}$
$U/(C-c_{17})$	$\{\{u_2,u_3,u_6,u_7,u_8\},\{u_1\},\{u_4\},\{u_5\}\}$
$U/(C-c_{18})$	$\{\{u_1,u_2\},\{u_3,u_7\},\{u_6,u_8\},\{u_4\},\{u_5\}\}$
$U/(C-c_{19})$	$\{\{u_3,u_6,u_7,u_8\},\{u_1,u_2\},\{u_4\},\{u_5\}\}$
$U/(C-c_{20})$	$\{\{u_1,u_2,u_3,u_4,u_6,u_7,u_8\},\{u_5\}\}$
$U/(C-c_{21})$	$\{\{u_1,u_2\},\{u_3,u_7\},\{u_6,u_8\},\{u_4\},\{u_5\}\}$
$U/(C-c_{22})$	$\{\{u_1,u_2,u_3,u_4,u_6,u_7,u_8\},\{u_5\}\}$
$U/(C-c_{23})$	$\{\{u_3,u_6,u_7,u_8\},\{u_1,u_2\},\{u_4\},\{u_5\}\}$
$U/(C-c_{24})$	$\{\{u_1,u_2,u_3,u_4,u_6,u_7,u_8\},\{u_5\}\}$
$U/(C-c_{25})$	$\{\{u_1,u_2,u_3,u_4,u_6,u_7,u_8\},\{u_5\}\}$
$U/(C-c_{26})$	$\{\{u_1,u_2,u_3,u_4,u_6,u_7,u_8\},\{u_5\}\}$

According to Table 5, it can be seen that the clustering results after the reduction of indicators c_3, c_6, c_{15}, c_{19}, and c_{23} are the same as the clustering results under all indicators, which indicates that there is no impact on the classification of the evaluation object, and so these five indicators are reduced. However, the clustering results after the reduction of the remaining indicators are different from the clustering results under all indicators, and the corresponding indicators are retained.

Based on the above reduction results, the optimized evaluation index system of agricultural crowdfunding risk prevention cohesion is determined, as shown in Figure 3.

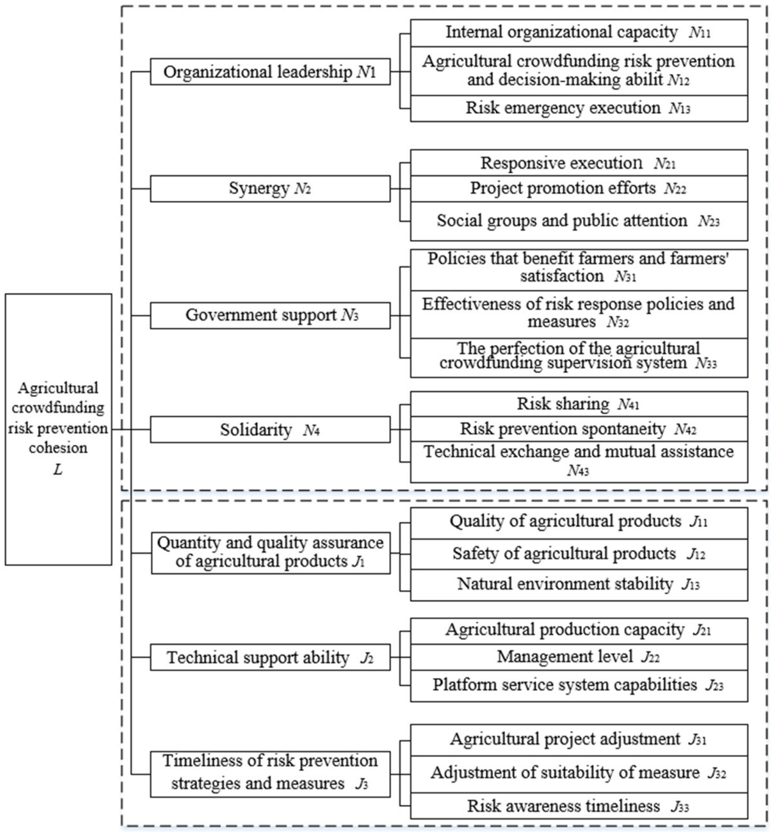

Figure 3. The evaluation index system of agricultural crowdfunding risk prevention cohesion.

5. Cohesion Evaluation of Agricultural Crowdfunding Risk Prevention and Comparative Analysis of Models

5.1. Cohesion Evaluation of Agricultural Crowdfunding Risk Prevention Based on FAHP-TOPSIS

The FAHP-TOPSIS method is comprehensively considered to evaluate the cohesion of agricultural crowdfunding risk prevention and four actual agricultural crowdfunding projects are selected for case analysis.

13. Comprehensive triangular fuzzy judgment matrix $\widetilde{A}^1$ and $\widetilde{A}_i^2$

According to Figure 3 and the relevant expert judgment information, construct $\widetilde{A}^1$ and $\widetilde{A}_i^2(i = 1, 2, \ldots, 7)$, $\widetilde{A}_i^2$ is shown in Table 6.

$$\widetilde{A}^1 = \begin{bmatrix} (1,1,1) & (0.84,1.58,2.11) & (1.67,2.67,3.67) & (2,3,4) & (1.18,1.58,2.11) & (2,3,4) & (1.53,2.28,2.83) \\ (1.4,2.08,2.83) & (1,1,1) & (2.42,3.11,4.33) & (2.44,3.17,4) & (1.11,1.83,2.67) & (2.33,3.33,4.33) & (1.42,2.11,2.83) \\ (0.28,0.39,0.67) & (0.45,1.17,1.57) & (1,1,1) & (0.78,1.5,2.33) & (0.8,1.17,1.56) & (1.44,2.17,3.33) & (1.5,1.9,2.42) \\ (0.26,0.36,0.61) & (0.49,0.88,1.39) & (0.56,1,1.67) & (1,1,1) & (0.47,0.84,1.58) & (0.86,1.28,1.83) & (1.13,1.5,1.9) \\ (1.4,2.08,2.78) & (0.53,0.94,1.5) & (2.08,2.78,3.5) & (2.08,2.83,3.67) & (1,1,1) & (2.33,3.33,4.33) & (1.44,2.17,3) \\ (0.28,0.4,0.75) & (0.25,0.34,0.58) & (0.48,0.92,1.44) & (1.08,1.78,2.5) & (0.25,0.34,0.58) & (1,1,1) & (0.51,0.92,1.44) \\ (1.05,1.72,2.42) & (0.84,1.25,1.78) & (1.72,2.4,3.08) & (2.4,3.08,3.78) & (0.5,0.89,1.33) & (1.44,2.17,3) & (1,1,1) \end{bmatrix}$$

Table 6. Triangular fuzzy judgment matrix of third-level indicators.

Third-Level Indicators	Triangular Fuzzy Judgment Matrix
$\widetilde{A}_1^2$	$\widetilde{A}_1^2 = \begin{bmatrix} (1,1,1) & (0.72,1.73,2.42) & (1.75,2.78,3.50) \\ (1.53,1.94,2.67) & (1,1,1) & (2.33,3.67,4.67) \\ (0.81,1.18,1.61) & (0.23,0.32,0.58) & (1,1,1) \end{bmatrix}$
$\widetilde{A}_2^2$	$\widetilde{A}_2^2 = \begin{bmatrix} (1,1,1) & (1.42,2.11,2.83) & (2.67,3.67,4.67) \\ (0.83,1.22,1.67) & (1,1,1) & (1.42,1.28,1.36) \\ (0.22,0.28,0.39) & (0.47,0.84,1.67) & (1,1,1) \end{bmatrix}$
$\widetilde{A}_3^2$	$\widetilde{A}_3^2 = \begin{bmatrix} (1,1,1) & (2.06,2.73,3.42) & (1.42,2.11,3.17) \\ (1.47,1.84,2.25) & (1,1,1) & (0.80,1.19,1.61) \\ (0.82,1.22,1.67) & (1.75,2.44,3.50) & (1,1,1) \end{bmatrix}$
$\widetilde{A}_4^2$	$\widetilde{A}_4^2 = \begin{bmatrix} (1,1,1) & (0.80,1.18,1.61) & (1.73,2.42,3.17) \\ (1.75,2.78,3.83) & (1,1,1) & (2.33,3.33,4.33) \\ (0.83,1.53,1.94) & (0.25,0.34,0.58) & (1,1,1) \end{bmatrix}$
$\widetilde{A}_5^2$	$\widetilde{A}_5^2 = \begin{bmatrix} (1,1,1) & (1.45,1.81,2.19) & (1.40,2.08,2.78) \\ (2.39,3.40,4.08) & (1,1,1) & (1.75,2.78,3.50) \\ (1.17,1.56,2.00) & (0.81,1.18,1.61) & (1,1,1) \end{bmatrix}$
$\widetilde{A}_6^2$	$\widetilde{A}_6^2 = \begin{bmatrix} (1,1,1) & (1.40,2.08,2.78) & (2.11,3.17,4.00) \\ (1.17,1.56,2.00) & (1,1,1) & (1.33,2.33,3.33) \\ (0.46,0.82,1.25) & (0.31,0.44,0.83) & (1,1,1) \end{bmatrix}$
$\widetilde{A}_7^2$	$\widetilde{A}_7^2 = \begin{bmatrix} (1,1,1) & (1.42,2.11,2.83) & (1.48,1.86,2.28) \\ (0.83,1.22,1.67) & (1,1,1) & (0.82,1.19,1.67) \\ (1.72,2.40,3.08) & (1.42,2.44,3.17) & (1,1,1) \end{bmatrix}$

14. Total Weight W

Substitute $\widetilde{A}^1$ and $\widetilde{A}_i^2$ into Equations (9) to (12) to obtain W^1 and W^2, and then obtain W from Equation (13), as shown in Table 7.

Table 7. Total weight of indicators.

Criterion Layer		Criterion Layer Weights	Criterion Layer Weight Ranking	Factor Layer	Factor Layer Weights	Total Weight	Factor Layer Total Weight Ranking
Concentration N	W_1^1	0.198	2	W_{11}^2	0.425	0.084	3
				W_{12}^2	0.500	0.099	2
				W_{13}^2	0.075	0.015	10
	W_2^1	0.207	1	W_{21}^2	0.553	0.114	1
				W_{22}^2	0.403	0.083	4
				W_{23}^2	0.044	0.009	11
	W_3^1	0.110	3	W_{31}^2	0.417	0.046	5
				W_{32}^2	0.254	0.028	8
				W_{33}^2	0.329	0.036	7
	W_4^1	0.076	4	W_{41}^2	0.343	0.026	9
				W_{42}^2	0.571	0.043	6
				W_{43}^2	0.086	0.007	12
Aggregation J	W_5^1	0.198	1	W_{51}^2	0.075	0.015	8
				W_{52}^2	0.680	0.135	1
				W_{53}^2	0.245	0.049	4
	W_6^1	0.050	3	W_{61}^2	0.521	0.026	6
				W_{62}^2	0.406	0.020	7
				W_{63}^2	0.073	0.004	9
	W_7^1	0.161	2	W_{71}^2	0.360	0.058	3
				W_{72}^2	0.216	0.035	5
				W_{73}^2	0.424	0.068	2

15. TOPSIS Matrix Z

In this paper, four specific projects, the Yonghe Walnut Crowdfunding Project M_1, Qinglingzhilu's Walnut Crowdfunding Project M_2, Jinjinshang-Yangcheng Lake Hairy Crab Crowdfunding Project M_3, and Bao'an Chicken Crowdfunding Project M_4, were selected for evaluation, and the basic information of the projects is shown in Table 8.

Table 8. Basic information of projects.

Crowdfunding Projects	Target Amount (RMB)	Expected Duration (d)	Completion Time (d)	Amount Raised (RMB)	Number of Participants (per)
M_1	150,000	30	180	566,670	1364
M_2	100,000	30	19	121,810	3850
M_3	100,000	30	27	682,986	4501
M_4	800,000	30	17	836,000	6445

Using the defer method, experts are invited to judge each item from 21 aspects of the factor layer to obtain B. Substitute B into Equation (14) to obtain O. Z is calculated by substituting the weights of each index obtained in Table 7 into Equation (15). Among them, the rows O and Z represent the 21 indicators of the factor layer, respectively, and the columns represent the four items of M_1, M_2, M_3 and M_4, respectively.

$$B=\begin{pmatrix} 7.75 & 8.00 & 7.75 & 7.50 \\ 5.00 & 6.50 & 6.50 & 7.25 \\ 5.25 & 6.00 & 6.25 & 7.00 \\ 8.00 & 7.50 & 7.75 & 8.50 \\ 8.50 & 7.75 & 8.00 & 7.75 \\ 8.75 & 7.75 & 8.50 & 7.50 \\ 9.00 & 8.50 & 7.50 & 7.50 \\ 6.25 & 6.50 & 6.50 & 6.25 \\ 6.25 & 6.75 & 6.50 & 5.25 \\ 6.00 & 6.25 & 6.00 & 6.00 \\ 6.00 & 6.75 & 6.00 & 5.75 \\ 6.25 & 6.50 & 7.00 & 6.50 \\ 8.50 & 8.50 & 8.50 & 8.00 \\ 8.50 & 8.75 & 8.50 & 8.00 \\ 8.00 & 8.00 & 7.25 & 7.25 \\ 8.00 & 8.50 & 8.00 & 7.75 \\ 7.25 & 7.75 & 8.00 & 7.50 \\ 7.00 & 7.75 & 8.50 & 7.75 \\ 7.00 & 6.25 & 6.75 & 8.25 \\ 6.75 & 5.75 & 6.25 & 7.75 \\ 6.50 & 5.75 & 6.25 & 7.25 \end{pmatrix} O=\begin{pmatrix} 0.500 & 0.516 & 0.500 & 0.484 \\ 0.393 & 0.511 & 0.511 & 0.570 \\ 0.426 & 0.487 & 0.508 & 0.568 \\ 0.503 & 0.472 & 0.488 & 0.535 \\ 0.531 & 0.484 & 0.500 & 0.484 \\ 0.537 & 0.476 & 0.522 & 0.461 \\ 0.552 & 0.521 & 0.460 & 0.460 \\ 0.490 & 0.510 & 0.510 & 0.490 \\ 0.503 & 0.543 & 0.523 & 0.422 \\ 0.495 & 0.515 & 0.495 & 0.795 \\ 0.511 & 0.489 & 0.511 & 0.489 \\ 0.476 & 0.495 & 0.533 & 0.495 \\ 0.507 & 0.507 & 0.507 & 0.477 \\ 0.503 & 0.518 & 0.503 & 0.474 \\ 0.524 & 0.524 & 0.475 & 0.475 \\ 0.496 & 0.527 & 0.496 & 0.480 \\ 0.475 & 0.508 & 0.524 & 0.491 \\ 0.451 & 0.499 & 0.547 & 0.499 \\ 0.493 & 0.440 & 0.475 & 0.581 \\ 0.506 & 0.431 & 0.469 & 0.581 \\ 0.503 & 0.445 & 0.484 & 0.561 \end{pmatrix} Z=\begin{pmatrix} 0.042 & 0.043 & 0.042 & 0.041 \\ 0.039 & 0.051 & 0.051 & 0.056 \\ 0.006 & 0.007 & 0.008 & 0.009 \\ 0.058 & 0.054 & 0.056 & 0.061 \\ 0.044 & 0.040 & 0.042 & 0.040 \\ 0.005 & 0.004 & 0.005 & 0.004 \\ 0.025 & 0.024 & 0.021 & 0.021 \\ 0.014 & 0.014 & 0.014 & 0.014 \\ 0.018 & 0.020 & 0.019 & 0.015 \\ 0.013 & 0.013 & 0.013 & 0.013 \\ 0.022 & 0.021 & 0.022 & 0.021 \\ 0.003 & 0.003 & 0.004 & 0.003 \\ 0.008 & 0.008 & 0.008 & 0.007 \\ 0.068 & 0.070 & 0.068 & 0.064 \\ 0.025 & 0.026 & 0.023 & 0.023 \\ 0.013 & 0.014 & 0.013 & 0.012 \\ 0.010 & 0.010 & 0.010 & 0.010 \\ 0.002 & 0.002 & 0.002 & 0.002 \\ 0.029 & 0.026 & 0.028 & 0.034 \\ 0.018 & 0.015 & 0.016 & 0.020 \\ 0.034 & 0.030 & 0.033 & 0.038 \end{pmatrix}$$

16. The relative proximity of each evaluation object L_{M_t}

Z^+ and Z^- are calculated from Equation (16).

Z^+ = (0.043 0.056 0.009 0.061 0.044 0.005 0.025 0.014 0.020 0.013 0.022 0.004 0.008 0.070 0.026 0.014 0.010 0.002 0.034 0.020 0.038)

Z^- = (0.041 0.039 0.006 0.054 0.040 0.004 0.021 0.014 0.015 0.013 0.021 0.003 0.007 0.064 0.023 0.012 0.010 0.002 0.026 0.015 0.030)

From Equations (17) and (18), M_4, $S^-_{M_t}$ and L_{M_t} of the four schemes M_1, M_2, M_3, and M_4 are obtained, as shown in Table 9.

Table 9. Calculation results of $S^+_{M_t}$, $S^-_{M_t}$, and L_{M_t}.

Crowdfunding Project	$S^+_{M_t}$	$S^-_{M_t}$	L_{M_t}	Ranking
M_1	0.0191	0.0108	0.3612	4
M_2	0.0153	0.0153	0.5000	3
M_3	0.0128	0.0144	0.5294	2
M_4	0.0107	0.0224	0.6767	1

According to the relative proximity rankings shown in Table 9, the level of risk prevention cohesion from high to low is: Bao'an Chicken Crowdfunding Project $L_{M_4} = 0.6767$, Jinshang-Yangcheng Lake Hairy Crab Crowdfunding Project $L_{M_3} = 0.5294$, Qinglingzhilu's Walnut crowdfunding project $L_{M_2} = 0.5000$, Yonghe walnut crowdfunding project $L_{M_1} = 0.3612$; the evaluation results are consistent with the actual risk prevention cohesion level of these four agricultural crowdfunding projects.

As can be seen from Table 8, M_4 had the highest completion and number of participants, and took the shortest time to complete. M_4 was divided into three main periods within the 17 days of successfully completing the crowdfunding goal. In the first phase (days 1–7), the project leader worked with the crowdfunding platform to implement the first crowdfunding plan for the project, but only 156 people participated, and only 138,000 RMB were raised at this time. In the second stage (days 8–11), the project leader realized the risks of the project and actively contacted the government agricultural department and the platform leader to jointly discuss and propose improvement measures. In the third phase (days 12–17), the project plan was adjusted and re-launched, raising 698,000 RMB and adding 6289 participants in less than a week.

By analyzing the crowdfunding process of M_4, we can determine that the second and third stages are the main stages for risk prevention and cohesiveness, so we mainly focus on the basic situation of the project in the second and third stages. In the second stage, the initiator has a high-risk prevention decision-making ability (N_{12}) to recognize the risks of the project in time (J_{33}), cooperate with the government and platform (N_2), and adjust and develop measures with high timeliness and appropriateness (J_3, J_{33}). In the third phase, the implementation of various risk-prevention programs (N_{21}) began in response. The promoter adjusted the agricultural projects(J_{31}) in a timely manner to produce native eggs in the farm, supplemented by fruits such as lychees and dragon fruit, and expanded the scale of farming, which improved the production capacity of agricultural products (J_{21}) and made agricultural products meet the safety and supply requirements (J_{12}). The platforms vigorously promoted the project(N_{22}), publicizing the project on Aika Forum, WeChat Moments, and crowdfunding platforms to increase the attention of social groups and the public(N_{23}). The government has increased its support (N_3) and introduced various policies to benefit farmers and improve their satisfaction (N_{31}). These specific examples in the process of M_4 fully demonstrate that the participants of the project have a high level of cohesion in preventing risks. From the perspective of sustainable development, this crowdfunding has attracted widespread attention from the community and has opened up the market for the sale of agricultural products to the outside world.

5.2. Comparative Analysis of Model Evaluation Results

To verify the validity and superiority of the FAHP-TOPSIS model in this paper. The FAHP-TOPSIS model was compared and analyzed with the commonly used models for cohesion evaluation, which are Entropy-TOPSIS and FCE. Three indicators, Mean-Square Error (MSE), Root Mean Squared Error (RMSE), and Mean Absolute Percentage Error (MAPE), were selected for the evaluation [53]. The final results are shown in Table 10 and Figure 4, and the model evaluation results are shown in Figure 5 below.

Table 10. Cohesion evaluation results of modes.

	FAHP-TOPSIS	Entropy-TOPSIS	FCE
M_1	0.3612	0.3300	0.4734
M_2	0.5000	0.5337	0.3600
M_3	0.5294	0.5200	0.5600
M_4	0.6767	0.6000	0.5700

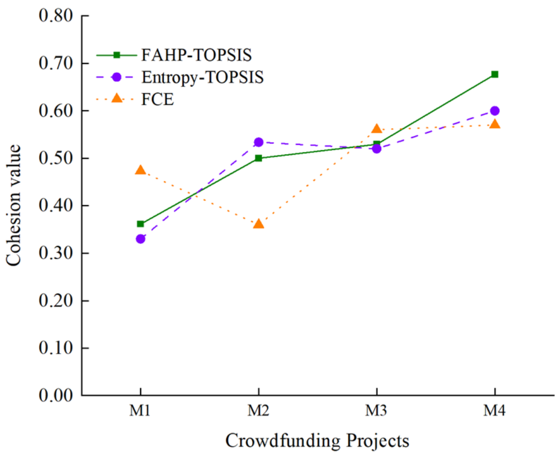

Figure 4. Comparison of the models' cohesion evaluation results.

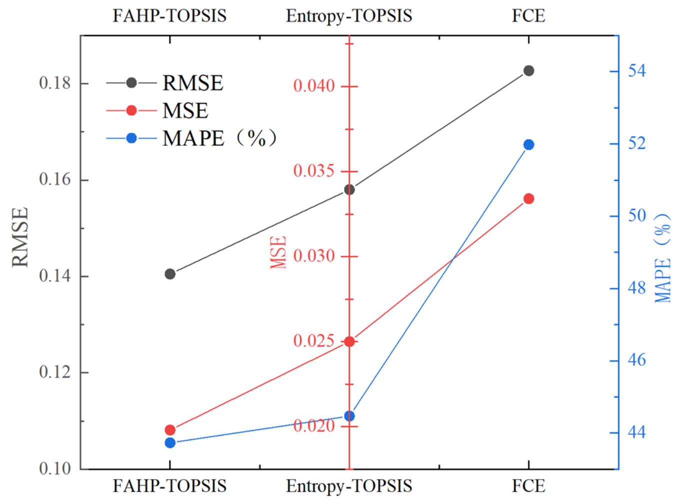

Figure 5. Evaluation chart of the models.

As can be seen in Figure 4, the FAHP-TOPSIS model yields M_4 as the item with the highest level of risk prevention cohesion compared with other methods, except for minor changes in the ranking of M_1, M_2, and M_3. However, as shown in Figure 5, the FAHP-TOPSIS model can obtain a more accurate ranking, which can effectively solve the problem of risk prevention cohesiveness evaluation. To further determine the ranking results obtained by different models, the fit of the three models was calculated separately, and it can be seen that the FAHP-TOPSIS model has the highest fit, greater than 80%, showing a better fitting accuracy. Therefore, FAHP and TOPSIS can combine the advantages of each other and make up for the shortcomings of both. This model is superior and can be effectively applied to cohesion evaluation.

6. Analysis of Influencing Factors of Agricultural Crowdfunding Risk Prevention Cohesion

According to the screening results of the evaluation indicators in Section 4 and the cohesion evaluation results of actual crowdfunding projects in Section 5, the influencing factors of agricultural crowdfunding risk prevention cohesion are analyzed.

6.1. Analysis of Influencing Factors of Concentration

According to the weight ranking shown in Table 7, synergy $W_2^1 = 0.207$ ranks first, which should be regarded as a key control factor. Synergy reflects the centripetal force and cohesiveness of the participating subjects. Through coordination and cooperation, the organization can operate efficiently and ensure the realization of the organization's goals. Among them, the response execution strength $W_{21} = 0.114$ is the first indicator, which means that it has the most significant effect on improving the cohesion of agricultural crowdfunding risk prevention. Strengthening the response execution strength ill improves the ability of each participant to deal with the event, directly impacting the cohesion among them, strengthening the risk prevention ability, and promoting the completion of the goal.

Organizational leadership $W_1^1 = 0.198$ ranks second as an important factor influencing the improvement of agricultural crowdfunding risk prevention cohesion. Organizational leadership refers to the leadership of a collective ability, which is the sum of the capabilities of the whole system [54]. It is an important condition for enhancing organizational effectiveness, achieving organizational goals, and enhancing cohesion. Among them, agricultural crowdfunding risk prevention and decision-making ability $W_{12} = 0.099$ is in the first place. Risk prevention should not only prevent possible risks, but also control the risks that have occurred. In this process, each subject needs to participate in various decision-making activities, such as making the choice of relevant programs, all of which determine the success or failure of risk prevention.

Government support $W_3^1 = 0.110$ ranks third. The policies of government departments regarding all aspects of agricultural crowdfunding affect the corresponding decision making and actions of each participant on risks. When risk events occur, policies to encourage self-rescue and recovery issued by government departments are all conducive to improving the effectiveness of risk prevention. Among them, policies that benefit farmers and farmers' satisfaction $W_{31} = 0.046$ ranked first. The government's policy inclination and preferential treatment to support the development of agriculture affects the decision-making ability and behavior of each subject on risk prevention.

The fourth ranking of solidarity $W_4^1 = 0.076$ refers to the cohesion of consensus among the participating subjects. The effectiveness degree of solidarity affects the development of risk prevention actions of each entity and its results. Among them, risk prevention spontaneity $W_{42} = 0.043$ ranks first, which mainly refers to the active participation of each subject in preventing possible risks in advance and controlling the risks that have already occurred. A sense of solidarity affects the effectiveness of risk prevention to a certain extent.

6.2. Analysis of Factors Affecting Aggregation

From the ranking of weights shown in Table 7, it can be seen that the agricultural product quantity and quality assurance degree $W_5^1 = 0.198$ ranks first, which is extremely important to the improvement of agricultural crowdfunding risk prevention cohesion. The quantity and quality assurance of agricultural products is the key to the success of agricultural crowdfunding projects, and it is also the bottom line. The quantity and quality should be given equal importance to build a scientific and efficient guarantee system. Among them, the safety of agricultural products $W_{52} = 0.135$ is the first indicator, which is an important factor to improve the cohesion of risk prevention and to strengthen the ability of risk prevention. The safety of agricultural products mainly refers to the quality and safety of agricultural products, that is, the reliability and usability of agricultural products, whether they can meet food standards, and the level of harm to people and the environment.

The timeliness of risk prevention strategies and measures $W_7^1 = 0.161$ ranks second. All participants should accurately grasp the actual situation and ensure the timeliness of strategies and measures. Among them, the timeliness of risk awareness $W_{73} = 0.068$ ranks first. Timely awareness of the risks that have occurred determines whether the decision makers can adjust the direction and strategy within an effective timeframe to minimize the loss caused by the risks.

The technical support ability $W_6^1 = 0.050$ ranks third. Technical support means organizing and implementing a series of maintenance, optimization, and construction work to ensure stable support for each process in agricultural crowdfunding. The greater the technical support ability, the more conducive to improving the ability of risk prevention. Among them, the agricultural production capacity $W_{61} = 0.026$ ranks first. It is expressed as the output level in the agricultural production process in a certain period of time, and it also includes the potential of increasing production of agricultural products. The poor harvest of agricultural products affects crowdfunding income. Therefore, it is necessary to protect the production capacity of agricultural products and increase the input to build the agricultural production capacity steadily.

7. Conclusions and Discussion

With the rise of financial technology, agricultural crowdfunding has brought new opportunities for the sustainable development of the agricultural economy. However, a series of risks has greatly hindered the development process of agricultural crowdfunding, and enhancing the cohesive level of risk prevention determines the healthy development of agricultural crowdfunding at this stage. Therefore, preventing crowdfunding risks is the driving force and direction to promote development. This paper introduces the concept of cohesion into the study of agricultural crowdfunding risk prevention for the first time, proposes an evaluation index system of agricultural crowdfunding risk prevention cohesion, and combines FAHP and TOPSIS to establish an evaluation model. Four crowdfunding projects are selected, and the corresponding project risk prevention cohesion levels and rankings are obtained. The comparison and analysis show that the model is more accurate. Finally, we analyze the factors influencing the level of risk prevention cohesion in agricultural crowdfunding. The results show that responsive execution and safety of agricultural products have the most significant effect on enhancing cohesion.

On this basis, the following insights and suggestions were drawn:

1. Strengthen coordination and cooperation capacity and solidify the working basis of consensus building. First, it is clear that the goal of improving internal organizational capabilities is to enhance risk prevention and decision-making capacity. Improve the quality inspection and certification system for agricultural products, credit evaluation systems, and other related systems to improve the success rate of risk prevention. The department should increase the publicity and promotion of agricultural crowdfunding projects, improve the public's understanding and participation in agricultural crowdfunding, and effectively use agricultural crowdfunding to provide agricultural financing and marketing services for farmers and agricultural enterprises. Finally, agricultural insurance can be taken out to provide protection against capital losses caused by natural disasters and market risks. For example, in 2018, the Internet agricultural insurance platform "Yimi Agricultural Insurance" was launched, which has greatly promoted the development of agricultural crowdfunding.
2. Promulgate relevant support policies, improve relevant laws and regulations, and provide institutional guarantees. In recent years, the government has been regulating rural financial operations, including agricultural crowdfunding. It is also necessary to strengthen the supervision of crowdfunding platforms. On the one hand, the government continues to improve the agricultural crowdfunding policy support system, improve the agricultural crowdfunding supervision system, clarify the supervisory body and division of labor, strengthen the review, improve the access conditions, reduce the legal risks of the agricultural crowdfunding industry, and enhance the overall quality of agricultural crowdfunding; on the other hand, the government establishes a fund supervision system to enhance the trust of the three parties and improve the information sharing of the platform to create a good investment and financing environment for the initiators and investors of agricultural crowdfunding projects.
3. Integrate existing resources, develop special advantageous industries, and promote technological innovation. First, the promoters should continuously innovate management methods, develop characteristic advantageous industries, and improve operational efficiency. In addition, crowdfunding platforms should accelerate the development of system service informatization and intelligence, such as the introduction of blockchain technology. Cultivate new industries and models of modern agricultural crowdfunding, and absorb professional talent to provide support for the development of agricultural crowdfunding-related technologies.

There are limitations in the research of this paper. First, the agricultural crowdfunding in this paper only considers agricultural products in crowdfunded agriculture, while in fact, agricultural crowdfunding can cover almost all agricultural fields, such as agricultural technology, farms, and equity. Secondly, the cohesion evaluation model in this paper cannot solve more complex situations more accurately and quickly. Finally, in the context of the digital intelligence era, this paper does not consider the application of emerging financial technology tools to agricultural crowdfunding risk prevention. Therefore, the subsequent research directions are: (1) We will identify and analyze the risks in different areas of agricultural crowdfunding and construct a more effective evaluation index system. (2) We will improve the evaluation model and consider combining with BWM, SWAR, VIKOR, and other methods to improve the feasibility of the evaluation model. (3) We will integrate with emerging technology tools such as blockchain to mitigate risks such as information asymmetry in the crowdfunding process.

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