International Journal of Application or Innovation in Engineering & Management (IJAIEM)
Web Site: www.ijaiem.org Email: editor@ijaiem.org
Volume 9, Issue 10, October 2020 **ISSN 2319 - 4847**

Evaluation Model of Farmers' Training Willingness Based on AHP

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ABSTRACT

The "Thirteenth Five-Year Plan" National New-Occupational Farmer Cultivation and Development Plan, released in 2017, clarifies the development ideas, main tasks, key projects and specific measures for the cultivation of new-type farmers in my country during the "Thirteenth Five-Year Plan", and proposes new occupations nationwide by 2020 The total number of farmers will reach 20 million, becoming the leading force in the construction of modern agriculture. Based on the analytic hierarchy model, this paper analyzes the domestic research on the factors affecting the willingness of vocational farmers to train, and constructs an evaluation model of farmers' vocational training willingness based on the analytic hierarchy process to help the investigator evaluate the training willingness of the survey subjects, and select the key points Cultivate objects.
Keywords: Analytic Hierarchy Process, new professional farmers, training willingness assessment

1. BACKGROUND

With the development of industrialization and urbanization, a large number of young and middle-aged people have flowed from agriculture to non-agricultural industries, and from rural to urban areas. This has led to the intensification of rural households, the aging of agriculture, and the hollowing out of rural areas. The problem of the shortage of talents in modern agriculture and the shortage of manpower in agricultural production has become increasingly prominent[1], and "who will plant the land" and "how to plant the land" have become realistic and urgent issues. However, to accelerate the transformation and upgrading of traditional agriculture to modern agriculture, and to promote large-scale, intensive, and specialized production, it is necessary to accelerate the cultivation of new agricultural business entities and strengthen the new professional farmer team. In this context, various provinces and cities across the country have successively carried out research and practice of new-type professional farmers [2-4], and analyzed the training models of new-type professional farmers and how the training effects of different models are [5-8].

Hainan Province also issued the "Notice on Doing a Good Job in Farmer Cultivation in 2014", deploying relevant tasks such as the direction and requirements of new-type professional farmer training, and clearly explained the working ideas, key links and work requirements of new-type professional farmers . According to relevant statistics and training process feedback from the Department of Agriculture of Hainan Province, there are currently more than 300 new-type vocational farmer training institutions in Hainan. The training subjects include agricultural technology extension service agencies of municipal and county governments at all levels, agricultural secondary vocational schools, and farmers' science and technology education Training centers, agricultural research institutes, agricultural colleges, agricultural enterprises and farmer cooperatives, etc. Although some results have been achieved in the cultivation of new-type agriculture, there are also problems in various aspects. The more serious one is the lack of understanding of farmers' training willingness by training institutions. Even if a large number of farmers are given free training, the training effect is not satisfactory.

This paper uses the analytic hierarchy process to model and analyze farmers' vocational training willingness to help training institutions obtain farmers with strong training willingness among the survey subjects, improve training effects, and speed up the construction of national professional farmers.

2. DATA SOURCE

The research team produced and distributed electronic questionnaires from early February 2020 to mid-May 2020, and received a total of 127 questionnaires. The proportion of each option in the survey sample is shown in Table 1, Table 2, Table 3, and Table 4.

Table 1 Proportion of samples of gender indicator options

Options	Proportion of sample
male	0.54
Female	0.46

Table 2 Proportion of samples of age indicator options

Options	Proportion of sample
[0, 20)	0.22
[21, 30)	0.165
[31, 40)	0.27
[41, 50)	0.18
[51, -)	0.165

Table 3 Proportion of samples of academic indicators options

Options	Proportion of sample
Elementary school and below	0.11
junior high school	0.27
High school	0.13
Technical secondary school	0.20
Junior college	0.13
Bachelor degree and above	0.16

Table 4 Proportion of samples of identity type indicator options

Options	Proportion of sample
General farming farmers	0.23
Big farmer	0.12
Farmer (family farmer, farmer)	0.10
Leader of professional cooperatives	0.12
Heads of agricultural enterprises or managers of economic organizations	0.20
Modern agriculture (breeding/marketing/storage and transportation industries) service personnel	0.08
Other new agricultural business entities	0.15

It can be seen from these four tables that the individual characteristics of the sample are relatively evenly distributed, which is suitable for evaluating the willingness of vocational training.

3. MODEL CONSTRUCTION AND CALCULATION

3.1 Hierarchical model construction

The analytic hierarchy process generally divides the constructed model into three levels: target level, criterion level, and program level. The target layer represents the purpose of model construction and the problems to be solved; the criterion layer is also called the indicator layer, which is the factors that affect the target, the indicators in decision-making, etc.; the scheme layer represents multiple alternative solutions.

The problem that this article aims to solve is to analyze the intensity of farmers' willingness to vocational training. Therefore, the program level is determined as the farmers participating in the survey, and the farmers are ranked through the analytic hierarchy model, and it is analyzed that those farmers have a stronger willingness to vocational training relative to other farmers.

For the selection of criteria-level indicators, this article mainly considers the influence of various factors on the willingness of vocational training from the following aspects, and then selects the indicators:

1. In terms of self-interest [9]. Farmers' participation in vocational training is actually a process of human capital accumulation. Therefore, combining the rational smallholder hypothesis and human capital theory, the farmer is willing to pay for vocational training only when he can maximize his benefits after participating in vocational training. and time. According to the cost-benefit analysis method, it can be assumed that the mathematical expression of farmers participating in vocational training decision-making is: E represents the expected income of farmers participating in

vocational training, C is the investment cost of farmers participating in vocational training, and R represents the current income of the farmer Situation, D(R) represents the decision function of farmers participating in vocational training. According to this model, it can be seen that farmers will choose to participate in vocational training when their expected income minus investment costs is greater than the current income. Therefore, we can identify three influencing factors: expected benefits, training costs, and current benefits.

2. Individual characteristics. From a theoretical and logical point of view, individual characteristics may also affect farmers' demand for vocational training. Individuals also generally refer to gender, age, education level, and identity type. The type of identity is mainly divided according to the type of work the farmers are engaged in. There are three main types: "production and management", "professional skills", and "social service". Therefore, four indicators were determined: age, gender, education level, and identity type.

3. Environmental factors. This aspect is mainly reflected in the farmers' cognition of vocational training, whether the policy is supported, and whether the training institution is legal. Farmers' cognition of vocational training mainly depends on propaganda work. If the propaganda work is not done well, and there is no government policy support, farmers do not know the benefits of vocational training, or even the concept of vocational training. Most of them instinctively refuse to let them participate in vocational training in a training institution with no prestige. On the contrary, the publicity work is in place, with the support and explanation of government policies, and the training institutions are also recommended by the government. Farmers are still optimistic about such credible and beneficial work. Therefore, in this aspect, this article selects three indicators: awareness of vocational training, government policy support, and the credibility of training institutions.

In summary, this article constructs the hierarchy analysis model structure shown in Figure 1.

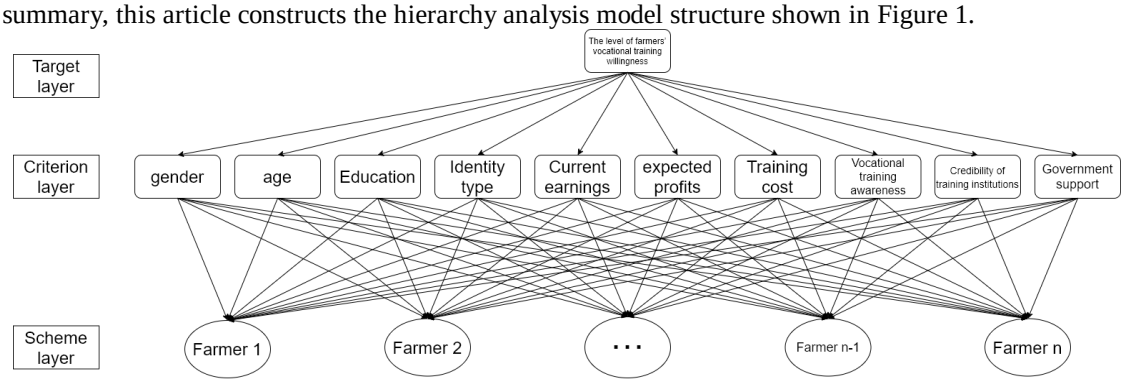

Figure 1 Hierarchical structure model

3.2 Sample processing

There are a total of 38 questions in the questionnaire and the criterion level of this article's hierarchical model has only 10 indicators. Therefore, this article regards several questions in the questionnaire as indicators approximately. The specific correspondence is shown in Table 5.

Table 5 Correspondence between questionnaire questions and analytic hierarchy model indicators

Question (single choice)	index
Your gender	gender
your age	age
Your education	Education
Your current status or occupation	Identity type
Annual operating income of your family	Current earnings
I participate in training to improve the status quo of the family and increase family income	expected profits
Before registering for training, I agree with the cost of training	Training cost
I participated in the training because I understand that the government provides training-related policies to benefit the people	Vocational training awareness
Before registering for training, I recognize the training strength of the training organization	Credibility of training institutions
The local government actively encourages me to participate in the training	Government support

3.3 Constructing the judgment matrix

After obtaining the hierarchical structure model, the next work is to determine the weights between the various factors at each level, but it is often not convincing if the weights are determined qualitatively. Therefore, the analytic hierarchy

process compares two factors and uses relative scales to obtain a consistent matrix, that is, a judgment matrix, so as to reduce as much as possible the difficult problems caused by the different nature of each factor to improve the accuracy of the model. Table 6 is a scale table.

Table 6 Proportion scale table

Factor i compared to factor j	Quantized value
Equally important	1
Slightly important	3
Stronger important	5
Strongly important	7
Extremely important	9
The middle value of two adjacent judgments	2, 4, 6, 8

At the same time, the judgment matrix also has the following properties,

$$a_{ij} = \frac{1}{a_{ij}}$$

a_{ij} represents the importance of factor i compared with factor j.

The criterion-level factor judgment matrix A is shown in Table 7.

Table 7 Judgment matrix for criterion layer to satisfy consistency test

factor	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10
a1	1	1	1	1/5	1/7	1/2	1/4	1/6	1/4	1/4
a2	1	1	1	1/5	1/7	1/2	1/4	1/6	1/4	1/4
a3	1	1	1	1/5	1/7	1/2	1/4	1/6	1/4	1/4
a4	5	5	5	1	5	1/6	1/2	1/3	1/6	1/5
a5	7	7	7	2	1	1/9	1/3	1/3	1/6	1/5
a6	2	2	2	1/3	9	1	5	5	3	3
a7	4	4	4	2	3	1/5	1	1/3	1/5	1/5
a8	6	6	6	3	3	1/5	3	1	1/3	1/3
a9	4	4	4	6	6	1/3	5	3	1	3
a10	4	4	4	5	5	1/3	5	3	1/3	1

Each farmer in the scheme level scores each indicator. The more important options have higher scores. Therefore, in the electronic questionnaire, the greater the selection value, the higher the importance. The judgment matrix of the scheme layer can be constructed

$$B1, B2, B3, B4, B5, B6, B7, B8, B9, B10 \in R^{127*127}$$

3.4 Hierarchical list sorting and consistency check

Hierarchical single sorting refers to normalizing the eigenvector of the largest eigenvalue of the judgment matrix as W. W represents the weight ranking of the relative importance of the factors of the same level relative to the factors of the previous level.

$$\lambda_{\max} = \frac{1}{n}\sum_{i=1}^{n}\frac{(AW)_i}{W_i}$$

If you want to confirm the ranking of the level list, you should first check the consistency of the model, that is, determine the allowable range of inconsistency for the index factors in the judgment matrix. The consistency index is expressed as:

$$CI = \frac{\lambda_{\max}(\mathrm{A}) - n}{n-1}$$

In $CI = 0$, there is complete consistency; when CI is close to 0, there is satisfactory consistency; the larger the CI, the more serious the inconsistency.

In order to measure the size of CI, the random consistency index RI is introduced. By randomly generating m pairs of comparison matrix $A_1, A_2, ..., A_m$, the consistency index is obtained, then

$$RI = \frac{CI_1 + CI_2 + ... + CI_m}{m}$$

Due to the large number of scheme layers designed in this paper, high-order random consistency indexes are required [10], and the results are shown in Table 8.

Table 8 Random consistency index table

n	1	2	3	4	5	6	7	8	9	10	127
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	.1.49	1.71

Finally, considering that the deviation of consistency may be caused by random reasons, the test coefficient CR is constructed,

$$CR = \frac{CI}{RI}$$

If $CR < 0.1$, the consistency is met.

The calculated CR value of each judgment matrix is shown in Table 9

Table 9 CR value of each judgment matrix

Matrix	A	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
CR	0	0	0	0	0	0	0	0	0	.0	0

It can be seen from Table 5 that each judgment matrix has passed the consistency test.

3.5 Willingness assessment

The goal of this article is to find out those farmers who have a strong desire for vocational training, so farmers need to be ranked in the end. Therefore, after the criterion level and the scheme level have passed the consistency check, the total order of the scheme level is calculated by using the single ordering results of the criterion level and the scheme level.

After calculation, the hierarchical order of matrix A is

$$w_A = [0.155,\ 0.155,\ 0.155,\ 0.069,\ 0.034,\ 0.121,\ 0.086,\ 0.053,\ 0.086,\ 0.086]$$

By calculating $B_1, B_2, B_3, B_4, B_5, B_6, B_7, B_8, B_9, B_{10}$, 10 normalized feature vectors $\lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5, \lambda_6, \lambda_7, \lambda_8, \lambda_9, \lambda_{10} \in R^{1*127}$ are obtained.

Get:

$$W_A = [0.1552\ 0.1552\ 0.1552\ ...\ 0.0861\ 0.0861] \in \mathbb{R}^{1*10}$$

$$W_B = [\lambda_1^T, \lambda_2^T, \lambda_3^T, \lambda_4^T, \lambda_5^T, \lambda_6^T, \lambda_7^T, \lambda_8^T, \lambda_9^T, \lambda_{10}^T] \in \mathbb{R}^{127*10}$$

$$= \begin{bmatrix} 0.0054 & 0.0137 & 0.0146 & ... & 0.0103 & 0.1552 \\ 0.0108 & 0.0091 & 0.0062 & ... & 0.0052 & 0.1552 \\ ... & ... & ... & ... & ... & ... \\ 0.0054 & 0.0137 & 0.0104 & ... & 0.0026 & 0.0862 \end{bmatrix}$$

The overall order of the scheme layer is:

$$score = W_B * W_A^T \in \mathbb{R}^{1*127} \quad (mean(score) = 1/127)$$

$$= [0.0093\ 0.0078\ 0.0077\ ...\ 0.0059\ 0.0071]$$

$score_i$ represents the proportion of the i-th farmer among all surveyed farmers. The larger the ratio, the greater the willingness of the farmer to participate in vocational training in the data brought in by this model.

4. RESULT ANALYSIS

This paper obtained 127 valid questionnaire results through questionnaire surveys, and obtained the scores of each farmer's relative willingness to vocational training through the use of analytic hierarchy model for these 127 questionnaires. Rough statistical indicators are shown in Table 10.

Table 10 Basic statistical indicators of score

	Min	Mean	Max

score	0.005323	0.007874	0.010548

Through calculation, a total of 59 survey respondents scored higher than the average. Because of, it can be considered that farmers with a score greater than the average are more suitable for vocational training and are more willing to vocational training.

5. CONCLUSION

This article mainly elaborates on the four aspects of criterion-level indicator screening, judgment matrix construction, consistency test and willingness evaluation, and builds an analytic hierarchy model. After all the matrices pass the consistency test, the willingness evaluation step can get all The ranking results of farmers participating in the survey on their willingness to vocational training can help the investigator to screen out key cultivation targets.

Acknowledgements

This article is one of the research results of the Hainan Provincial Natural Science Foundation project "New-type professional farmer cultivation mode and related model construction research-taking Hainan Province as an example" (project number: 618MS025). The Fund of Lab of Security Insurance of Cyberspace, Sichuan Province (szjj2016-091)

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