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Research on Evaluation Index System and Empirical of Agricultural Products' Unsalable Risk Level

Yichao Wan

School of Economics and Management, Jiangxi Tourism & Commerce Vocational College, Nanchang 330100, China.

Abstract: Taking the unsalable risk level of agricultural products as the research object, this paper redesigns an evaluation index system based on BSC, which includes five dimensions: finance, customer, internal process, technology and innovation, and environment. Then, with the combination of AHP and fuzzy comprehensive evaluation method as the basic model, a practical and feasible evaluation model of unsalable risk grade of agricultural products is obtained. Finally, a case study was conducted to verify the rationality of the evaluation model for the unsalable risk level of agricultural products, providing a theoretical basis and practical method for further research on the unsalable risk level of agricultural products in the future.

Keywords*:* Unsalable Risks of Agricultural Products; Fuzzy Comprehensive Evaluation; Analytic Hierarchy Process; Balanced scorecard; Index System

1. Introduction

In recent years, affected by the epidemic situation, agricultural products are unsalable all over the country, which has greatly affected the local economic development and farmers' income. In order to effectively warn and reduce the harm caused by unsalable events of agricultural products, it is of great significance to propose an evaluation method for the level of unsalable risks of agricultural products.

2. System of Evaluation Indicators

This paper combines the research results of domestic and foreign scholars in recent years and expert suggestions, and designs a new agricultural product unsalable risk evaluation index system based on the balanced scorecard to increase the environmental dimension. The index system includes 5 first level indicators, 10 second level indicators and 22 third level indicators. (as shown in Table 1)

Table 1 Evaluation index data of unsalable risk grade of agricultural products

First indicators	Weights	Second indicators	Weights	Third indicators	Weights
Finance u_1	0.0986	Capital flow	1.00	Inflow of consumer funds	0.20
				Balance of benefit distribution	0.40
				Government subsidized input	0.40
Internal processe u_2	0.3134	Planting process	0.40	Current market supply and demand	0.75
				Farmer planting planning	0.25
		Circulation process	0.40	Circulation efficiency of agricultural products	0.50
				Transportation capacity	0.50
		Sales process	0.20	Marketing strategy	0.54
				Symmetry of production and marketing information	0.16
				Sales convenience	0.30

learning and growth u_3	0.1760	Innovation	0.50	Characteristics of agricultural products	0.33
				Deep processing of agricultural products	0.67
		Technical support	0.50	Tracking technology of agricultural product safety information	0.11
				Safety logistics construction and guarantee	0.18
				Agricultural product storage technology	0.71
Customer u_4	0.0986	consumer	1.00	Consumer demand	0.50
				Consumer satisfaction	0.50
Environmental u_5	0.3134	Policy environment	0.30	Supporting policies of the government	0.50
				Implementation of the "Three Rural" Policy	0.50
		natural environment	0.54	Local natural resources	0.67
				Local natural disasters	0.33
		Economic situation	0.16	Current economic situation	1.00

3. Evaluation Model and Empirical Analysis

3.1 Evaluation Model Selection

Considering that there are many influencing factors and fuzziness in the agricultural products unsalable risk grade evaluation index, and fuzzy comprehensive evaluation has great advantages in the evaluation of multi index system, this paper proposes a fuzzy comprehensive evaluation method based on the analytic hierarchy process.

3.2 Data Collection

This paper selects the unsalable risk of Xinjiang grapes as the evaluation object. The research objects of this paper are mainly government departments, farmers and consumers. The qualitative indicators in the evaluation indicator system are determined through survey, and the data are obtained through online questionnaire. For quantitative indicators, based on the data obtained, they are judged by consulting experts and borrowing existing standards.

3.3 Determination of evaluation factor set

According to the previous analysis, the evaluation index system is divided into three levels, and the first level evaluation factor set is U = （u_1，u_2，u_3，u_4，u_5），The evaluation factor set of the second and third layers is shown in Table 1.

3.4 Determination of weight of evaluation index

In this paper, according to the characteristics of the index system, AHP is selected to determine the weight.（as shown in Table 1）

3.5 Fuzzy Comprehensive Evaluation

According to the data obtained, this paper uses the fuzzy statistics method to calculate the membership of all indicators, and the result is：

$$R_{11}=\begin{bmatrix}0.04 & 0.89 & 0.07 & 0 & 0\\ 0.06 & 0.91 & 0.03 & 0 & 0\\ 0.60 & 0.24 & 0.16 & 0 & 0\end{bmatrix} \quad R_{21}=\begin{bmatrix}0.96 & 0.04 & 0 & 0 & 0\\ 0.06 & 0.94 & 0 & 0 & 0\end{bmatrix} \quad R_{22}=\begin{bmatrix}0 & 0.05 & 0.95 & 0 & 0\\ 0 & 0.05 & 0.95 & 0 & 0\end{bmatrix}$$

$$R_{23}=\begin{bmatrix}0.04 & 0.89 & 0.07 & 0 & 0\\ 0.06 & 0.03 & 0.91 & 0 & 0\\ 0 & 0.16 & 0.84 & 0 & 0\end{bmatrix} \quad R_{31}=\begin{bmatrix}0 & 0.13 & 0.87 & 0 & 0\\ 0 & 0.14 & 0.86 & 0 & 0\end{bmatrix} \quad R_{32}=\begin{bmatrix}0.05 & 0.06 & 0.89 & 0 & 0\\ 0.06 & 0.91 & 0.03 & 0 & 0\\ 0 & 0.07 & 0.93 & 0 & 0\end{bmatrix}$$

$$R_{41}=\begin{bmatrix}0.88 & 0.12 & 0 & 0 & 0\\ 0.08 & 0.92 & 0 & 0 & 0\end{bmatrix} \quad R_{51}=\begin{bmatrix}0.86 & 0.14 & 0 & 0 & 0\\ 0.06 & 0.94 & 0 & 0 & 0\end{bmatrix} \quad R_{52}=\begin{bmatrix}1 & 0 & 0 & 0 & 0\\ 0.91 & 0.09 & 0 & 0 & 0\end{bmatrix}$$

$$R_{53}=\begin{bmatrix}0.8 & 0.2 & 0 & 0 & 0\end{bmatrix}$$

The secondary fuzzy evaluation results are:

$$B_{11}=w_{11}\bullet R_{11}=\begin{bmatrix}0.2 & 0.4 & 0.4\end{bmatrix}\bullet\begin{bmatrix}0.04 & 0.89 & 0.07 & 0 & 0\\ 0.06 & 0.91 & 0.03 & 0 & 0\\ 0.60 & 0.24 & 0.16 & 0 & 0\end{bmatrix}=\begin{bmatrix}0.272 & 0.638 & 0.090 & 0 & 0\end{bmatrix}$$

$$B_{21}=w_{21}\bullet R_{21}=\begin{bmatrix}0.735 & 0.265 & 0 & 0 & 0\end{bmatrix} \quad B_{22}=w_{22}\bullet R_{22}=\begin{bmatrix}0 & 0.05 & 0.95 & 0 & 0\end{bmatrix}$$

$$B_{23}=w_{23}\bullet R_{23}=\begin{bmatrix}0.031 & 0.533 & 0.436 & 0 & 0\end{bmatrix} \quad B_{31}=w_{31}\bullet R_{31}=\begin{bmatrix}0 & 0.137 & 0.863 & 0 & 0\end{bmatrix}$$

$$B_{32}=w_{32}\bullet R_{32}=\begin{bmatrix}0.016 & 0.220 & 0.764 & 0 & 0\end{bmatrix} \quad B_{41}=w_{41}\bullet R_{41}=\begin{bmatrix}0.48 & 0.52 & 0 & 0 & 0\end{bmatrix}$$

$$B_{51}=w_{51}\bullet R_{51}=\begin{bmatrix}0.46 & 0.54 & 0 & 0 & 0\end{bmatrix} \quad B_{52}=w_{52}\bullet R_{52}=\begin{bmatrix}0.97 & 0.03 & 0 & 0 & 0\end{bmatrix}$$

$$B_{53}=w_{53}\bullet R_{53}=\begin{bmatrix}0.8 & 0.2 & 0 & 0 & 0\end{bmatrix}$$

The first level fuzzy evaluation results are:

$$B_1=w_1\bullet R_1=\begin{bmatrix}1\end{bmatrix}\bullet\begin{bmatrix}0.272 & 0.638 & 0.090 & 0 & 0\end{bmatrix}=\begin{bmatrix}0.272 & 0.638 & 0.090 & 0 & 0\end{bmatrix}$$

$$B_2=w_2\bullet R_2=\begin{bmatrix}0.300 & 0.233 & 0.467 & 0 & 0\end{bmatrix} \quad B_3=w_3\bullet R_3=\begin{bmatrix}0.008 & 0.178 & 0.814 & 0 & 0\end{bmatrix}$$

$$B_4=w_4\bullet R_4=\begin{bmatrix}0.48 & 0.52 & 0 & 0 & 0\end{bmatrix} \quad B_5=w_5\bullet R_5=\begin{bmatrix}0.79 & 0.21 & 0 & 0 & 0\end{bmatrix}$$

The final evaluation result is

$$R=\begin{bmatrix}B_1B_2B_3B_4B_5\end{bmatrix}^{\mathrm{T}}$$

$$B=w\bullet R=\begin{bmatrix}0.4172 & 0.2843 & 0.2985 & 0 & 0\end{bmatrix}$$

This paper uses the weighted average method to calculate the comprehensive evaluation effect of indicators at all levels.According to the evaluation results, the evaluation score of unsalable risk of agricultural products is 4.1187, indicating that the unsalable risk level is "low".

Table 2 Evaluation results of unsalable risk grade of agricultural products

	Evaluation results
Evaluation results of unsalable risk grade of agricultural products	4.1187

4. Conclusion

In order for farmers to fully understand their own situation so as to make the best decision on sustainable development of agricultural products, it is important to evaluate the unsalable risk level of agricultural products. The new agricultural products unsalable risk evaluation index system proposed in this paper is effective and can be used in practice.

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