

THE APPLICATION OF AHP IN SRID EVALUATION FRAMEWORK OF CHINESE AGRICULTURAL ENTERPRISE

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Abstract

The Analytic Hierarchy Process (AHP) has been invented by SAAS, and has been applied in many fields [1]. It is very helpful in complex problem for the decision makers. And the AHP divides the decision goal into many factors, and each factor contains various decision choices. Through the comparison of the elements (factors and choices) in the AHP, the decision makers can build the comparison matrix. And through computing the Eigen vector and Eigen value, the decision makers can get the weights of all the elements and make the decision which best suits the problem.

This paper wants to apply this AHP to the SRID evaluation framework¹ of agricultural enterprises which is constructed by Maohua Li (2016) [2]. Though Maohua Li (2016) builds the SRID evaluation framework of agricultural enterprises, how to apply this framework to the real agricultural enterprises is a problem. This paper attempts to use the analytic hierarchy process to solve this problem, and tries to give the corresponding weights to each item (factor and choice) in this framework, so as to ensure the consistency of the weighting process and the integrity of the framework. Through this study, the SRID framework of agricultural enterprise can be used smoothly in various agricultural enterprises. It can help to understand the quality of SRID of agricultural enterprises better.

Keywords

AHP, CSR, information disclosure, evaluation framework.

Introduction

The corporate social responsibility (CSR) refers to the responsibility that the enterprise should take as a kind of social organization [3]. It is the responsibility in the process of production and operation of the enterprise. It includes the economic and social responsibility of business to consumers, employees, shareholders, the community, the government and the environment. The purpose of corporate social responsibility is to “give humanism to the market economy”, and to stress that enterprises should bear the responsibility for the environment and stakeholders while making profits [4].

CSR means that corporate is not only responsible to the stockholders, but also takes responsibility to the other stakeholders [5, 6]. It contains social responsibility and social obligation, and the content contains business ethics, production safety, occupational health, protection of legitimate rights and interests of workers, protection of the environment, the charity support, the community donation, the protection of vulnerable groups, etc [7].

In the market economy, the competitiveness of enterprises is the outstanding performance of the ability to pursue profits [8]. Profit is the reason for the existence of enterprises and the fundamental driving force of the development. However, CSR is the foundation of sustainable development and the tool for the long-term profit.

In Hungary, Nagypál N. C. (2014) uses Hungarian SME as research sample and he finds that corporate social responsibility plays a very important role in the sustained development [9]. Radacsi G. and Hardi P. (2014) point out that CSR is a voluntary add-on to the

¹The model is constructed by Maohua Li in the paper “Study on the SRID Evaluation Framework of Agricultural Enterprise in China” which is published by the journal “Visegrad Journal on Bioeconomy and Sustainable Development” in 2016, vol.5, issue 1, pp.36-40.

regular market activities and legal compliances of companies [10]. Metaxas T. and Tsavdaridou M. (2010) make a detailed research on the dimensions and benefits of CSR in Greece, Denmark and Hungary, and they get the conclusion that the effective implementation of CSR strategy cannot follow strict rules and should be adjusted to the culture, needs and particularities of each country [11].

However, enterprises will interact with other social organizations and individuals frequently in this social system [12]. In the process of interaction, many ethic risks will occur due to externality and asymmetric information. And there are many conflicts between profit of corporate and interest of society which may have impact on the staff and society [13]. For the prosperity and harmony of the society, we have the reason to promote the enterprise to strengthen the social responsibility, and to increase the disclosure of social responsibility information (SRID).

There are many problems on SRID, such as information disclosure is incomplete; the form of information disclosure is single [14]; the comparability of information disclosure is not strong; the carrier of information disclosure is less. How to evaluate SRID is a problem, in this case, Maohua Li (2016) proposes a SRID evaluation framework. This framework includes four elements: content quality, total quality, expression and utility quality. However, he does not study on how to apply this framework. This paper attempts to use the Analytic Hierarchy Process (AHP) to solve this problem, and tries to give the corresponding weight to each item in this framework, so as to ensure the consistency of the weighting process and the integrity of the framework. Through this study, the SRID framework of agricultural enterprise can be used smoothly in various agricultural enterprises. It can help to understand the quality of SRID of agricultural enterprises better.

2. Literature review

In 1953, Howard R. Bowen first proposes that business owners have the responsibility to meet all of the mainstream values and public needs, so he is called the father of corporate social responsibility. In his book, "Social Responsibilities of the Businessman", he points out that shareholders, employees, consumers, government, community, etc. are stakeholders of enterprises, and enterprises should not only attain the goal of stockholder, but also should make some contributions to the other stakeholders [15].

Scholars also make some achievements in the social responsibility information disclosure (SRID). Andrew Crane, in his book "Corporate Social Responsibility",

talks about SRID based on the use of value-added sheet [16]. Toni, in his book "Social Responsibility Accounting", mainly discusses the background of the social responsibility accounting, expounds the connotation of social responsibility accounting and has a profound discussion on SRID [17].

On the evaluation of CSR, Li Yongchen and Cao Xi (2013) researches on the social responsibility evaluation index system of power supply enterprises [18]. Hu Junnan Meng Dandan (2015) uses AHP to do a research of industrial projects investment evaluation based on the social responsibility [19]. Huang Yifang and Sun Yongbo (2015) uses AHP method to do research on the social responsibility evaluation index system of retail enterprise [20].

In Hungary, as we mentioned above, there only a few scholars make research on CSR in English, such as Nagypál N. C., Radacsi G., Hardi P., Metaxas T., and Tsavdaridou M. They get some research results from different perspectives. Nagypál N. C. (2014) makes some research on CSR from the point of SME [8]. Radacsi G. and Hardi P. (2014) point out the function of CSR in market activities. Metaxas T. and Tsavdaridou M. (2010) make research on the CSR in Europe with the samples of Greece, Demark and Hungary [11]. However, No Hungarian scholar makes any research on the evaluation of SRID as we search.

Although many scholars make a great progress on the research of CSR and SRID, nobody focuses on how to evaluate SRID. Maohua Li (2016) use oral theme encoding method to construct the SRID evaluation framework of agricultural enterprises for the first time, and he uses the expert opinion method and factor analysis method to verify the framework.

3. SRID evaluation framework

Table 1. SRID evaluation framework

| First-Level | Second-Level | Third-Level |
|--------------------------------------|--------------------------------------|---------------------------------|
| SRID Evaluation Framework A | Content quality B ₁ | Objectivity C ₁₁ |
| | | Correctness C ₁₂ |
| | | Credibility C ₁₃ |
| | Total quality B ₂ | Relevance C ₂₁ |
| | | Completeness C ₂₂ |
| | | Sufficiency C ₂₃ |
| | Expression quality B ₃ | Definition C ₃₁ |
| | | Intelligibility C ₃₂ |
| | | Conciseness C ₃₃ |
| | Effectiveness quality B ₄ | Timeliness C ₄₁ |
| | | Adaptability C ₄₂ |
| | | Testability C ₄₃ |

Maohua Li (2016) establishes the SRID evaluation framework of agricultural enterprises through the method of the oral theme encoding technology, the frequency analysis, the reliability test and so on. And the expert opinion method, exploratory factor analysis and confirmatory factor analysis are used to verify the evaluation framework. According to Maohua Li (2016), the SRID evaluation framework of agricultural enterprises consists of four elements and 12 specific indicators. Details are shown in the following Table 1.

4. About AHP

The analytic hierarchy process (AHP) treats the complex multi-objective decision as a system, and divides the purpose of it into several targets or factors which can be divided into multiple objectives or choices. AHP can help decision maker get a rational and comprehensive solution to the complex decision problem. Instead of providing a “correct” answer to the problem, the AHP will help the decision makers to get the solution which is the most suitable to the complex problem and help the decision makers to understand the problem better.

Just like the Figure 1, AHP will divide the goal of decision into several factors which contain various choices. The factors and choices are related to every aspect of the decision that contains tangible and intangible problems. All the factors will be well understood and carefully measured and they are divided into various choices that apply to the decision at hand.

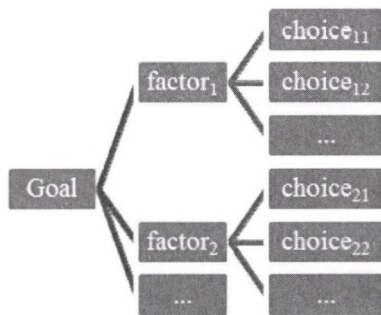


Figure 1. Structure of AHP

Once the structure of AHP is fixed, the decision makers only have to consider the impact of choices to factors or the impact of factors to the goal, and then evaluate all the choices and factors systematically by comparing them to each other. For instance, in the process of comparing choices, the decision makers can consider the importance of choices to its own factor and evaluate them. And the same method can be used in comparing the factors according to the impact of them to the goal.

5. Weights of SRID evaluation framework based on AHP

In the actual weighting process of SRID evaluation framework, we can use the relatively simple method to weight, and the main steps are as follows:

To form the comparison matrix A according to the scores of different estimators.

$$A = \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{pmatrix}$$

The product B_i of each-row elements of the comparison matrix A is calculated.

$$B_i = \prod_{j=1}^n a_{ij}$$

$$i=1, 2, \dots, n$$

To compute the n -th root C_i of B_i

$$C_i = \sqrt[n]{B_i}$$

$$i=1, 2, \dots, n$$

To normalize the vector $C=(C_1, C_2, \dots, C_n)$

$$W_i = \frac{C_i}{\sum_{i=1}^n C_i}$$

$$i=1, 2, \dots, n$$

$W=(W_1, W_2, \dots, W_n)^T$ is the Eigen vector that we need, and the Eigen values W_1, W_2, \dots, W_n are the weights of every row.

In order to ensure the correctness of the results, the consistency test is carried out. In the process of constructing the comparison matrix, the subjective consciousness of the estimators is very strong. Therefore, it is necessary to use consistency test and consistency ratio to determine the compatibility of the weight, and to evaluate the reliability of comparison matrix. The calculation steps are as follows:

To calculate the consistency index CI

$$\lambda_{\max} = \frac{1}{n} \sum_{i=1}^n \frac{\sum_{j=1}^n a_{ij} W_j}{W_i}$$

and

$$CI = \frac{\lambda_{\max} - n}{n - 1}$$

The largest Eigen value is called the principal Eigen value, and λ_{\max} is the largest Eigen value of comparison matrix, and n is orders of the comparison matrix $A=(a_{ij})_{n \times n}$.

To calculate the consistency ratio CR

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

In the formula above, RI is the average random consistency index, and its value can be obtained by looking up the related Table 2. If $CR < 0.1$, we can accept the consistency, that is to say, the consistency

test of comparison matrix is passed. If $CR \geq 0.1$, we should make appropriate adjustments to comparison matrix A.

Table 2. Random Consistency Index (RI)

| | | | | | | | | | | |
|----|---|---|------|-----|------|------|------|------|------|------|
| n | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| RI | 0 | 0 | 0.58 | 0.9 | 1.12 | 1.24 | 1.32 | 1.41 | 1.45 | 1.49 |

Source: [21]

Now we set an illustrative example about how to weight the SRID evaluation framework of agricultural enterprise based on the AHP.

There are four estimators such as market supervisor, competitor, supplier, purchaser, and they will estimate the SRID framework separately and form a comparison matrix A.

$$A = \begin{pmatrix} 1 & 4 & 3 & 1 \\ 1/4 & 1 & 2 & 1/4 \\ 1/3 & 1/2 & 1 & 1/3 \\ 1 & 4 & 3 & 1 \end{pmatrix}$$

According to matrix A, we can calculate $B_1=12$. $B_2=1/8$. $B_3=1/18$. $B_4=12$

To calculate the n -th root C_i of B_i

$$C_1=1.8612. C_2=0.5946. C_3=0.4855. C_4=1.8912$$

To normalize the vector $C=(1.8612, 0.5946, 0.4855, 1.8912)$, we can get that

$$W_1=0.3875. W_2=0.1238. W_3=0.1012. W_4=0.3875$$

And then to calculate the consistency index CI:

$$\lambda_{\max} = \frac{1}{n} \sum_{i=1}^n \frac{\sum_{j=1}^n a_{ij} W_j}{W_i} = 4.089;$$

$$CI = \frac{\lambda_{\max} - n}{n - 1} = \frac{4.089 - 4}{4 - 1} = 0.0297$$

Due to $N=4$, the value of $RI=0.9$ which can be obtained by looking up the related Table 2.

So

$$CR = \frac{CI}{RI} = \frac{0.0297}{0.9} = 0.033 < 0.1,$$

The CR of comparison matrix can be accepted.

That is to say that the weights of them are as follows in Table 3:

Table 3. Sample of weighting

| valuator | Market supervisor | competitor | supplier | purchaser |
|----------|-------------------|------------|----------|-----------|
| weight | 0.3875 | 0.1238 | 0.1012 | 0.3875 |

Table 4. The weighting results of SRID evaluation framework

| First-Level | Second-Level | Weight | Third-Level | Weight |
|-----------------------------|--------------------------------------|--------|---------------------------------|--------|
| SRID Evaluation Framework A | Content quality B ₁ | 0.2968 | Objectivity C ₁₁ | 0.3122 |
| | | | Correctness C ₁₂ | 0.5124 |
| | | | Credibility C ₁₃ | 0.1754 |
| | Total quality B ₂ | 0.2437 | Relevance C ₂₁ | 0.3862 |
| | | | Completeness C ₂₂ | 0.3227 |
| | | | Sufficiency C ₂₃ | 0.2911 |
| | Expression quality B ₃ | 0.1962 | Definition C ₃₁ | 0.3124 |
| | | | Intelligibility C ₃₂ | 0.3472 |
| | | | Conciseness C ₃₃ | 0.3404 |
| | Effectiveness quality B ₄ | 0.2633 | Timeliness C ₄₁ | 0.2532 |
| | | | Adaptability C ₄₂ | 0.4201 |
| | | | Testability C ₄₃ | 0.3267 |

According to the similar method above, we can calculate the weights of the four elements such as content quality, total quality, expression quality and effectiveness quality. And then we can calculate the weights of the indicators. The weighting results are shown in the Table 4.

According to Table 4, we can make the weight calculation table (Table 5) of the SRID evaluation framework.

Table 5. Weight calculation table of the SRID evaluation framework

| B ₁ (0.2968) | | Proportion of C ₁ among A | | B ₂ (0.2437) | | Proportion of C ₂ among A | |
|-------------------------|--------|--------------------------------------|--|-------------------------|-----------------|--------------------------------------|--|
| C ₁₁ | 0.3122 | 0.0927 | | C ₂₁ | 0.3862 | 0.0941 | |
| C ₁₂ | 0.5124 | 0.1521 | | C ₂₂ | 0.3227 | 0.0786 | |
| C ₁₃ | 0.1754 | 0.0521 | | C ₂₃ | 0.2911 | 0.0709 | |
| B ₃ (0.1962) | | Proportion of C ₃ among A | | B ₄ (0.2633) | | Proportion of C ₄ among A | |
| C ₃₁ | 0.3124 | 0.0613 | | C ₄₁ | C ₃₁ | 0.3124 | |
| C ₃₂ | 0.3472 | 0.0681 | | C ₄₂ | C ₃₂ | 0.3472 | |
| C ₃₃ | 0.3404 | 0.0668 | | C ₄₃ | C ₃₃ | 0.3404 | |

Through the analysis above, we can construct the SRID evaluation framework as follows:

$$Y_{ji} = \sum_{i=1}^{i=3} X_{ji} \cdot w_{ji}$$

$$F = \sum_{k=1}^{k=n} (\sum_{j=1}^{j=4} Y_j \cdot W_j) P_k$$

$i=123$
 $j=1234$
 $k=12 \dots n$

F is the score of SRID evaluation framework (from 1 to 5)

X_{ji} is the score of third-level (from 1 to 5)

Y_{ji} is the score of second-level (from 1 to 5)

w_i is the weight of third-level

W_j is the weight of second-level

P_k is the score by the grader k (from 1 to 5)

By the total score of SRID evaluation framework of the agricultural enterprise, we can tell the grade of its SRID and can tell the quality of its SRID (Table 6.).

Table 6. Grade standard of the scoring

| Range of score | 5 | 4 | 3 | 2 | 1 |
|----------------|-----------|------|--------------|------------|--------------|
| Grade | excellent | good | satisfactory | sufficient | insufficient |

6. Conclusion

By trying to use the AHP method, this paper gives the weight of each evaluation item in the SRID evaluation framework of agricultural enterprise, so as

to ensure the application of the SRID evaluation framework in agricultural enterprises and the integrity of the framework. Through the application of the evaluation framework based on the AHP method, we can get more accurate, objective and convincing results from the evaluation of social responsibility information disclosure.

And the evaluation framework mixes the advantages of expert opinion method, fuzzy comprehensive evaluation method and AHP method, so we get a more objective and comprehensive result than the previous single evaluation methods. On the basis of the comprehensive evaluation framework to evaluate the SRID, we can find their own problems, and find technique to solve them. So through the evaluation framework based on AHP method, we can evaluate the SRID correctly and tell the quality of SRID of agricultural enterprises.

In Hungary, this paper only focuses on related research of CSR, SRID and the evaluation of SRID in English. In the future research, we will extend our research in Hungarian with local scholars.

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