AHP FOR RURAL ECONOMIC DEVELOPING STRATEGIES

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ABSTRACT

AHP is a new decisive method in which quantative analysis is combined with qualitative analysis. There are merits that decisive processes are systematized and quantized for complicated objects. In this paper, AHP is used and modified on studies of rural economic developing strategies that have been realized since 1986.

AHP was presented by T. L. Saaty early in the 1970s. It is a decisive method which is analysed for sequence of elements of the system by hierarchy.

By analysis of rural economic developing strategies, the optimun way and tactics in which the original system is changed to High-function system are drawn up. It is a very complicated and synthetical decisive problem with multi-levels, and AHP is used properly. But there are many relative factors in the rural economy, and it is difficult to make use of AHP. Therefore, AHP must be modified accordingly.

I. The Modification and Simplification of AHP

The rural economic system is very complex in levels and factors generally. The method of constructed decision matrix, leads to the fact that AHP can not be used. It is well known that AHP need comparative values of $n(n-1)/2$ factors for a n order of decision matrix. Here 190 comparative values for 20 factors are given, to different levels and combination of factors, to make up comparative valies of factors are about 1000.

By experimental information in the brain, we find that the more accurate comparison isn't obtained in ones. Therefore, AHP must be modified and simplified.

To consider the process of calculated W_i in normalizing a 3 order decision matrix (Table 1), it is sumed with noralizing values of every column by a row, then W_i is obtained by normalizing sumed values. In order to the process of calculat W_i, the equations are presented. Then simplified, it is shown that W_i will be obtained by normalizing the element value of first column, for example:

Table 1

M	a_1	a_2	a_3	w_i
a_1	1	a_1/a_2	a_1/a_3	w_1
a_2	a_2/a_1	1	a_2/a_3	w_2
a_3	a_3/a_1	a_3/a_2	1	w_3

let

$$A_{ij}=\frac{a_i/a_j}{a_1/a_j+a_2/a_j+a_3/a_j}$$

Then

$$w_1=\frac{A_{11}+A_{12}+A_{13}}{P}$$

where

$$P = A_{11}+A_{12}+\cdots+A_{33}$$

Therefore we have

$$w_1=\frac{1}{1+a_2/a_1+a_3/a_1}$$

Similarly, we have

$$w_2=\frac{a_2/a_1}{1+a_2/a_1+a_3/a_1}$$

$$w_3=\frac{a_3/a_1}{1+a_2/a_1+a_3/a_1}$$

This process proves that the normalizing of every element of first column may be expressed as a single sequence of this level of the decision matrix. Thus, the workload of constructed decision matrix may be reduced greatly, and the accumulative error effect will be avoided.

II. AHP of the Developing Strategy of Xiangshui County Agricultural Economy

Xiangshui county is a developing county which is located in the north of Jiangsu province, it is at the downstream of the Huai River and the seashore of the Yellow Sea, thus it's rich in seashore resouces. The area of the seashore is about 4 times of the cultivable land, which remains to be exploited. The fresh water resource is also abundant; there are some wasteland that can be brought under cultivation. In the county, the sufficient sunshine and medium rainfall provide the county with a suitable condition for

multi-reclaim, cultivation and development. However, its economical base is weak, the commodity economy is less developed and the level of scientific and technologic management is pretty low. The process of determining the economic developing strategy of the county is as follows.

1. The program of developing strategy is shown in figure 1.

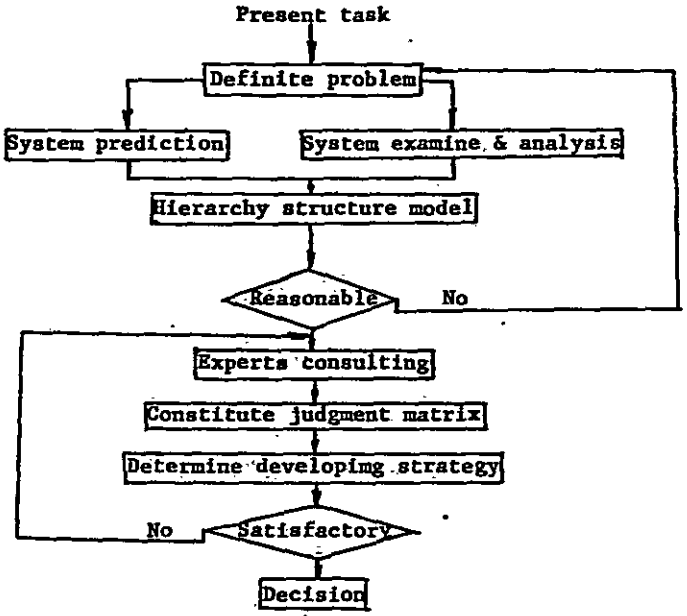

Figure 1.

2. The hierarchy structure model of the analysis on economic developing strategy this county is shown figure 2.

3. Delphi consulting, constitute judgment matrix and calculation

(1) M--A judgment matrix, using the normal single sequencing method.

Table 2

M	A_1	A_2	A_3	W_i	λ_{max}=3.009
A_1	1	3	2	0.5390	CI=0.045
A_2	1/3	1	1/2	0.1638	RI=0.58
A_3	1/2	2	1	0.2972	CR=0.0076<0.1

(2) Apply the improved method to the single sequencing of the matrixes A_1--B, A_2--b, A_3--B and normalizing the first column of each judgment matrix we obtain W_1. The result is shown in table 3.

(3) Applying the improved methods to the single ordering of 12 judgment matrixes. The result is shown in table 4.

Table 3

A_1	B_1	W_i	A_2	B_1	W_i	A_3	B_1	W_i
B_1	1	0.2007	B_1	1	0.1371	B_1	1	0.1511
B_2	1/3	0.0669	B_2	1/2	0.0686	B_2	1/3	0.0504
B_3	1/5	0.0401	B_3	1/8	0.0172	B_3	1/3	0.0504
B_4	1/3	0.0669	B_4	1/3	0.0457	B_4	1/3	0.0504
B_5	1	0.2007	B_5	2	0.2743	B_5	2	0.3022
B_6	1/2	0.1003	B_6	1	0.1371	B_6	1/4	0.0378
B_7	1/4	0.0501	B_7	1/3	0.0457	B_7	1/4	0.0378
B_8	1/5	0.0401	B_8	0	0	B_8	1/5	0.0302
B_9	1/2	0.1003	B_9	1	0.1371	B_9	1/4	0.0378
B_{10}	1/6	0.0335	B_{10}	1/3	0.0457	B_{10}	1/6	0.0252
B_{11}	1/3	0.0669	B_{11}	1/6	0.0229	B_{11}	1	0.1551
B_{12}	1/6	0.0335	B_{12}	1/2	0.0686	B_{12}	1/2	0.0756

* Adopting the variation coefficient of coordinative degree of experts opinion, $V_j=T_i/E_j$, to juge the consistency.

Table 4

	B_1		B_2		B_3		B_4		B_5		B_6	
B_1	C_i	W_i	C_i	W_i	C_i	W_i	C_i	W_i	C_i	W_i	C_i	W_i
C_1	1	0.7273	1	0.25	1	0.125	1	0.5	1	0.6522	1	0.4
C_2	1/4	0.1818	2	0.50	1	0.125	1/2	0.25	1/3	0.2174	1	0.4
C_3	1/8	0.0909	1	0.025	6	0.75	1/2	0.25	1/5	0.1304	1/2	0

	B_7		B_8		B_9		B_{10}		B_{11}		B_{12}	
B_i	C_1	W_i	C_1	W_i	C_1	W_i	C_1	W_i	C_1	W_i	C_1	W_i
C_1	1	0.222	1	0.4	1	0.445	1	0.4	1	0.588	1	0.333
C_2	3	0.667	1	0.4	1	0.444	1	0.4	1/5	0.118	2	0.667
C_3	1/2	0.111	1/2	0.2	1/4	0.111	1/2	0.2	1/2	0.294	0	0

(4) The general sequencing of the level B, according to the normal way of AHP shown in table 5. The result is shown in table 6.

Table 5

level A / level B	A_1	A_2	A_3	General sequencing
	0.5390	0.1638	0.2972	of the level B
B_1	0.2007	0.1372	0.1511	0.1755
B_2	0.0669	0.0686	0.0504	0.0623
B_3	0.0401	0.0172	0.0504	0.0394
B_5	0.2007	0.2743	0.3022	0.2429
B_6	0.1003	0.1371	0.0378	0.0878
B_7	0.0501	0.0457	0.0378	0.0457
B_8	0.0401	0	0.0302	0.0306
B_9	0.1003	0.1371	0.0378	0.0878
B_{10}	0.0335	0.0457	0.0252	0.0330
B_{11}	0.0335	0.0686	0.0756	0.0518

(5) Using the same method as table 5 , the result of general sequencing of the levelc is shown in table.6.

Table 6

level B / levelc	B_1	B_2	B_3	B_4	B_5	B_6	B_7
	0.1755	0.0623	0.0394	0.0585	0.2429	0.0878	0.0457
C_1	0.7273	0.25	0.125	0.50	0.6522	0.40	0.222
C_2	0.1818	0.50	0.125	0.25	0.2174	0.40	0.667
C_3	0.0909	0.25	0.75	0.25	0.1304	0.20	0.111

B_8	B_9	B_{10}	B_{11}	B_{12}	General sequencing
0.0306	0.0878	0.0330	0.0847	0.0518	of level C
0.40	0.445	0.40	0.588	0.333	0.5125
0.40	0.444	0.40	0.118	0.667	0.3100
0.20	0.111	0.20	0.294	0	0.1775

4. The determination of economic developing strategy. According to result of general sequencing, it is easy to sum up the economic developing strategy: in order to realise the general objective of optimal economic development of the county, the chiet method is to improve the industrial structure. We need to put stress on aquatic products industry B_1 and herbivore raising B_5, take appropriate development of agricultural products processing B_6 trade B_9 and

reclaim of the seashore wasteland B_{11}. We also need to consider other industry, that is, to take the optimal developing moder of multipurpose production with a main industry of aquatic prodcts and herbivore raising. Since the developing strategy was put into effect from in the county two years ago the gross product has increased by a fact of 15-17% for each year.

Conclusion

The improved AHP obtains an extensive use for the decision analysis of economic developing strategy . It can be applied to economic levels similar to county level which are complicated or more complicated systems so that the amount of computer work can be significantly reduced. For the problem of consistence check, the variation coefficient V_j can be used to juge the coordinate degree of the experts opinion.