Research on key stakeholder identification of agricultural development project based on fuzzy inference system

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Abstract - Project stakeholders are individuals or organizations that are closely related to the project. In agricultural development projects, there are multiple stakeholders that have complex interests. It is necessary to recognition the key stakeholders correctly and understand the role and power of the key stakeholders in agricultural development projects. This paper was firstly applied fuzzy inference system to identify the key stakeholders in agricultural development project, and put forward the appropriate management strategy to ensure the success of agricultural development project.

Index Terms - key stakeholders; fuzzy inference system; identification.

1. Introduction

As the basic industry and pillar industry, agriculture is an important part of the national economy. In recent years, agricultural project in China develops quickly, and many scholars have studied the development of agricultural projects [1].In 2013, the fifth revision of the knowledge system of project management, which is developed by the American Project Management Association, has been added to the management of the project management knowledge and expanded the knowledge of the past nine to ten areas of knowledge. This shows the importance of project stakeholder management.

At present, there are many literatures on the impact of stakeholders to agricultural projects. Carlos Llopis-Albert [2] analyzed the important effect of project stakeholders and decision maker to environmental projects, and established the groundwater management policy system based on public participation project which proved the importance of the project stakeholders to the successful implementation of the project. Nichola Geeson [3] explained the data of land degradation in Aare river valleys between 2004 and 2014 to show the significant prompt of land degradation problem by participating conferences and knowledge indoctrination of key stakeholders for 10 years. Olander [4] investigated and researched a residential project and a railway project, and found that the most important issue for a project is stakeholder, in the early stages of the project, it is a necessary and important step for planning, implementation and completion of any construction project to manage different needs by communicating and the evaluation stakeholder's needs.

The research of the project stakeholders in China mainly focuses on the enterprise which is engaged in the project oriented task, and less involved in the project related agriculture. This article mainly analyzes from three aspects: the Real Estate Company, the software enterprise as well as the construction company [5-7]. Ji jianyue [5] analyzes the internal mechanism of the influence of project stakeholders project on business performance by combining contract theory and expectation theory and based on theory of value chain to identify the key stakeholders of business performance. Besides it used panel data model for empirical analysis with Chinese Real Estate Company as a sample.Hu yun [6] used RAC6 model to illustrate the important base of software project, that is the identification, analysis and management of stakeholder. Stakeholder identification can greatly reduce the impact of needs omitting of the software project. Wang Jingyu [7] believes that in the construction project, the project stakeholders is an important factor to affect the success of the project and divided the stakeholders into key stakeholders, secondary stakeholders and stakeholder according to the important degree which can effectively promoted the construction of the project and develop different management strategies for different stakeholders.

There are two main problems of the existing research: First, the research on the method of stakeholder identification is not deep enough and there are few effective methods and empirical analysis. Second, it is relatively narrow in the area of identification for project stakeholders. Grace Paul, chairman of the American project management certification board, asserted: "in twenty-first Century, everything is a project, everything must also become a project"[8]. So it is necessary to identify the project stakeholders in several fields. Agricultural development project is an important factor to influence the development of agriculture and it can ensure the implementation of agricultural development project successfully to identify and analyze the stakeholders of the agricultural development project. This article introduced the theory of fuzzy reasoning and construct and apply fuzzy inference system and analyzed the actual case to find agricultural project stakeholders in every stage (preparation and declaration approved stage, the implementation stage and acceptance stage), which apply a requisite for the success of agricultural development project.

2. Fuzzy reasoning theory and the construction of fuzzy inference system

2.1 Basic theory of fuzzy reasoning

American control expert L.A.Zadeh proposed the fuzzy set theory in 1965[8], It opens a new research field of fuzzy mathematics, and also paved the way for the birth and development of fuzzy logic [9-11], in 1973, Zadeh firstly applied

the idea and method of fuzzy mathematics to fuzzy reasoning, and put forward the famous synthetic reasoning method, which is used to solve the problem of FMP and FMT [12].

Fuzzy reasoning a kind of uncertain reasoning that takes the fuzzy set theory as description tool, and extends mathematical logic which is based on general set theory. It is of great significance in the development of artificial intelligence technology. At present, fuzzy reasoning has been used successfully in many fields. Li guodong [13] proposed a voltage sag source identification method based on Mamdani type fuzzy inference, and analyzed different sag, extract the corresponding feature values. It used Mamdani type fuzzy inference technology of voltage sag disturbance sources to distinguish and can better the voltage sag source for accurate identification by simulating and validating the method. Luohaichi [14] proposed a 4 adaptive nerve fuzzy inference system and a post-block processing network, which is used in gray scale image filtering. Experimental results show that the proposed methods are more effective in the removal of images salt pepper impulse noise and can effectively keep edges and details of the original image as well. The filtering performance is better than that of the traditional filtering method. The decision of agricultural expert to stakeholder management are fuzzy and are common in imprecise, incomplete, fuzzy concept and linguistic ambiguity with expert system, so it is reasonable and applicable to apply fuzzy reasoning theory in agricultural development project stakeholder management.

2.2 The construction of fuzzy inference system

2.2.1 The architecture of fuzzy inference system and process of decision data transfer

Stakeholder management is important to ensure agricultural development project successfully, expert experience plays a important role in guiding the project stakeholder management. According to the experience and knowledge of experts, simulating expert thinking process to find key stakeholders by guiding relevant departments, and to put forward corresponding countermeasures and suggestions. However, the decision process of agricultural experts to stakeholder management is fuzzy and it is difficult to establish accurate model to simulate the reasoning process of expert. Fuzzy reasoning technology can overcome the ambiguity of the process of expert reasoning. So combining expert knowledge with fuzzy reasoning technology to find out the key stakeholders and ensure the progress of the agricultural project. The management expert system of this agricultural development project is mainly composed of man-machine interface, fuzzy inference, questionnaire and knowledge database. The flow of decision and management data of agricultural development project is shown in Figure 1.

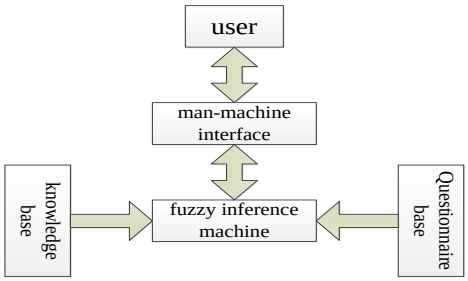

Fig. 1 The process of decision data transfer

Users input the questionnaire results of the agricultural development projects in human-computer interface, man-machine interface will transfer the data to a fuzzy inference machine and fuzzy inference engine will obtain the data to operate fuzzy reasoning and calculate the membership degree of questionnaire respondents.

2.2.2 The structure of knowledge base

Knowledge base is a part of expert system, which is based on the reasoning of the expert system. The expression of expert knowledge influence the accuracy of the decision of expert system directly, so it is the basis to design reasonable structure of knowledge base and express the expert knowledge correctly.

The decision rule is a rule that is used to decide the key stakeholders, which is the type of a stakeholder in a certain stage. The content structure of the decision rule is shown in Figure 2, it consists of the use of stage, the use of objects and a number of characteristics. The same nature of the problem constitutes a trait, and each trait contains information about whether or not to take the negative and the parameter values.

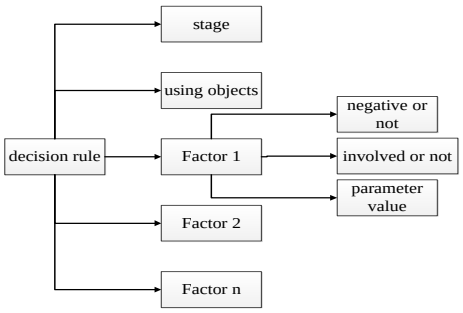

Fig. 2 Content structure of decision rules

2.2.3 Questionnaire database structure

Questionnaire is a key part to transfer the attitudes and perceptions of agricultural development project stakeholders to the membership degree of each trait, and it provides premise for the reasoning of the expert system to design the problem stem, options and their weights and the question number combined with decision rules for finding the weight of the problems. The construction of the questionnaire was carried out in accordance with the structure of the" phase, stakeholders, traits, and questions". The content of the questionnaire is shown in figure 3 for a particular phase of a particular stakeholder. It includes the use of stage, the use of

objects, the basic information of the respondents and traits of the rules.

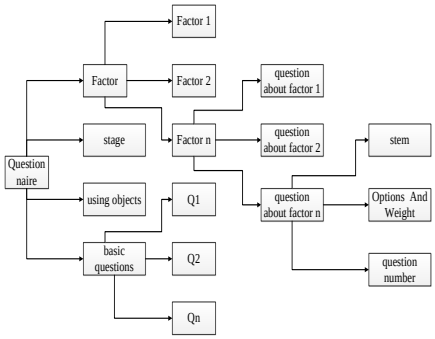

Fig. 3 The structure of questionnaire database

2.2.4 Fuzzy reasoning process

The fuzzy reasoning of decision rules is to calculate the membership degree of key stakeholders by using Hamacher-T model with the answers of any questionnaire respondents, which can provide data to support the decision of the key stakeholders. The fuzzy reasoning process of decision rules is shown in Figure 4.

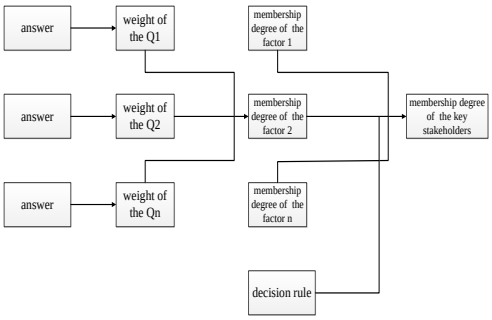

Fig. 4 Fuzzy reasoning process of decision rules

3. Analysis of key stakeholders in Liuzhou Guangxi agricultural development project

This paper takes an agricultural development project in Sanjiang of Liuzhou, Guangxi as an example to determine the key stakeholders of the project area residents in the preparation stage. The objects of questionnaire are the villagers in Gaoji village. The village has about 60 households with about 300 people. we provided 60 questionnaires and recovered 51 questionnaires, the recovery rate reached 85%.In the setting of the questionnaire, there are ten traits of the residents in preparation stage: high degree of response to cover an area(X_1), low quality(X_2), low level of economy(X_3), less social security(X_4), high land dependence(X_5),low awareness of agricultural development projects(X_6), low expected value(X_7), low government trust(X_8), less collective property and lack of compensation(X_9) and low social status(X_{10}). The questionnaire structure of the residents is 6 basic questions and 18 traits questions. The answer of 51 questionnaires are input to fuzzy inference system. The decision rule for the residents of the project area is set to eight rules, as is showed in table1.

TABLE I Eight decision rules for the residents of the project area in preparation stage

	X1	*X2*	*X3*	*X4*	*X5*	*X6*	*X7*	*X8*	*X9*	*X10*
R*1*	√		√		√					
R*2*		√	√		√					
…				…						
R8			√		√	√				

It reflects the reasoning process of the rule of figure 4 from table 2 to table 5.

TABLE 2 The answers to the questions of the traits of the 51 sample

Answers	Sample1	Sample2	Sample3	…	Sample 50	Sample 51
Q7	D	C	C	…	C	C
Q8	B	B	B	…	D	C
…	…	…	…	…	…	…
Q18	D	B	B	…	C	C

The corresponding membership degrees of the answers are shown in Table 3.

TABLE 3 Membership degree of each question

Answers	sample*1*	sample *2*	sample *3*	…	sample *50*	sample *51*
Q*7*	0.7	0.3	0.3	…	0.2	0.6
Q *8*	0.3	0.1	0.3	…	0.3	0.5
…	…	…	…	…	…	…
Q *18*	0.9	0.7	0.3	…	0.2	0.4

Among them, the traits of the 1-8 were respectively corresponding to the two traits of the problem, the traits of 9 and 10 corresponding to three traits. The membership degree of all traits is obtained by the use of the membership degree of the corresponding traits question. The results are showed in table 4.

TABLE 4 Membership degree of each trait

Membership degree	sample *1*	sample *2*	sample *3*	…	sample *50*	sample *51*
Trait *1*	0.7	0.3	0.3	…	0.3	0.6
Trait *2*	0.9	0.6	0.4	…	0.8	0.8
…	…	…	…	…	…	…
Trait *10*	1	0.9	1	…	0.9	0.9

The corresponding traits of the rules can be obtained by querying the decision rules. The membership degree of all rules is obtained by using the Hamacher-t model with the parameters of the membership degree corresponding to the 1. The results are showed in table 5.

TABLE 5 Membership degree of the rules of all the objects

Membership degree	sample *1*	sample *2*	sample *3*	…	sample *50*	sample *51*
Rule *1*	0.33	0.06	0.17	…	0.10	0.48
Rule *2*	0.43	0.12	0.22	…	0.29	0.64
…	…	…	…	…	…	…
Rule *8*	0.48	0.18	0.56	…	0.32	0.72
Comprehensive decision	0.48	0.2	0.56		0.36	0.8

The maximum membership degree given by each decision rule is obtained as a comprehensive evaluation and make 0.9 as the threshold. Membership degree that are more than 0.9 can be listed as key stakeholders. From the above table, sample 5, sample 10, sample 13, sample 15, sample18, sample 19, sample26 and sample 34 can be listed as key stakeholders. The overall membership of the comprehensive decision is 1,1,1,0.9,1, 1, 1, 0.9.

Aimed to the traits of the key stakeholders and the degree of membership, the following countermeasures are given: sample 5, sample 10 and sample26 have low level of economic income. To those villagers, the government should increase the investment in agriculture, improve the level of agricultural modernization and encourage to develop characteristic agriculture to increase their income. Sample 13 and sample 19 have high degree of response to cover an area. To those villagers, we can implement emotional management, improve their emotional control ability and strengthen emotional transfer training. In addition, information communication method, discussion method, model demonstration method and object oriented method are also useful to transfer negative attitude to positive attitude. Sample 15, sample18 and sample 34 are the villagers who have less social security. To those villagers, government departments should further improve the rural social security and agricultural insurance system to remove the worries of farmers. Besides, the government should improve the security policy and earnestly safeguard the interests of landless farmers.

4. Conclusion

The implementation of agricultural development projects is often involved in many fields and many departments, the stakeholders involved in the project have different understanding and expectations. Active participation and communication of project stakeholders are key factors for the success of the project. This paper find the key stakeholders of an agricultural development project in Sanjiang of Liuzhou, Guangxi based on fuzzy inference system. It is helpful to the agricultural development project smoothly, and also illustrates that the fuzzy inference system has higher application value and can be extended to other fields of stakeholder identification.

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