

An Empirical Research of the Performance Evaluation Index of Synergic Supply for the Rural Public Goods

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Abstract Synergic supply of the rural public goods is an effective way to improve the performance of the supply of rural public goods, so the purpose of this paper is to try to mobilize the enthusiasm of the multiple operators involved in the supply and to raise the performance of the synergic supply. Based on the synergic supply of rural product and the theory of the stakeholders to construct the indicator system, and through expert scoring and processing of index membership and also making the further amendments by expert's scoring and membership processing to build the performance evaluation indicator system of synergic supply of rural public goods, then taking the construction of village A's road in Heilongjiang Province for example, it uses the analysis of fuzzy and synergic evaluation methods, the evaluation results show that the indicator system can reflect the performance level of the synergic supply of rural public goods truly.

Key words Rural public goods; Synergic supply; Performance evaluation; Indicator system; Fuzzy and synergic evaluation

1 Introduction

Building a socialist new countryside is a breakthrough in the present China to break the "three rural" issue, if it can make the of initiative achieve to largely depend on the effective supply of public goods in rural areas. However, the following factors affect the progress: the dual economic structure of city-biased strategy, the idea of single-supply, lagged changes in government's functions, the financial difficulties of primary that comes from the reform, there are many problems such as insufficient total size, structure imbalances and inefficiency and a series of questions in the supply of public goods in rural areas^[1]. Thus, to improve the supply performance of rural public goods has become an urgent need for our economy to solve the major theoretical and practical issues. For this reason, the domestic academic institutions study the theory of rural public goods' supply problem mainly from the perspectives of the system^[2], the mechanisms^[3], the main supplier^[3], the supply method^[5] and other different perspectives deeply. The Cooperation supply mode of Multiple Perspective in the current supply view is a very hot issue. Based on the coordination theory, this paper starts from the systemic and defines the co-operation of the main body as the way of synergic supply. Synergic supply is different from the cooperative supply, although both stress the interactive cooperation and close coordination, cooperation simply emphasizes the cooperation of multiple subjects, and it could not reflect the systematic of the diverse subjects, and the synergic effect is not apparent in the function even from " $2+2>4$ ". It is still extremely rare of the study for the performance and the evaluation of synergic supply of multiple subject. There has been too much performance study focusing on the efficiency and equity of the way that the government provides, the concerned main subjects tend to reflect the interests of the government and the farmers and the other subjects are excluded, so it is not conducive to the mobilize the enthusiasm of the other main subjects for supplying the public goods in rural areas. The performance evaluation of rural public goods' synergic supply is a process to determine and confirm the efficiency and the effectiveness of the provision of public products by the government-led multi-subjects in the rural areas, its aim is to solve the coordination problems in supply through synergic, integrated, scientific and fair assessment of the collaboration supply of public goods in rural areas between the government and other suppliers so that it can draw some experience and have some findings^[6], in this way, we can form the positive interaction between the government and other subjects in order to provide public goods for the farmers in a better way. Therefore, the study of this paper on the performance and evaluation of synergic supply of rural public goods plays an important role in the theoretical innovation and the practical application.

2 The Construction of the Performance Evaluation Indicator System of the Synergic Supplies in the Rural Public Goods

(1) Construction of the initial theory. Based on the existing research results, the tool values of the performance evaluation of the supply of the rural public goods embrace economy, efficiency, effectiveness, equity and democracy and so on. Therefore, when building the performance evaluation indicator system of synergic supply, this paper selects the indicator system respectively and constructs the indicator system based on the value orientation from five facets and also considering the interests of stakeholders.

Table 1 Guideline System of Performance Evaluation for Synergic Supply of Rural Public Goods

First-level indicators (U_i)	Second-level indicators (U_{ij})	Third-level indicators (U_{ijr})	
Economy (U_1)	U_{11} cost-input ratio	U_{111} Input costs every unit	
	U_{12} resource-waste ratio	U_{121} The amount of waste of resources per unit of output	
Efficiency (U_2)	U_{21} Input-output ratio	U_{211} Input supply every Unit	
	U_{22} Labor productivity	U_{221} Supply of every unit time	
Benefit (U_3)	U_{31} The quality of public goods in rural areas	U_{311} The functionality of public goods in rural areas	
		U_{312} The reliability of public goods in rural areas	
		U_{313} Timing of public goods in rural areas	
		U_{314} The applicability of public goods in rural areas	
		U_{315} The economics of public goods in rural areas	
		U_{316} Farmer's satisfaction	
	U_{32} The degree of achievement of objectives	U_{321} The achievement degrees of the government's aims t	
		U_{322} The objectives degree of self-realization of villagers	
		U_{323} The achievement degrees of the Farmers' aim	
		U_{324} The achievement degrees of the profit organization's aim	
		U_{325} The achievement degrees of the non-profit organization's aim	
		U_{33} The degree of synergy between multiple subjects	U_{331} The coordination degree of the government and autonomous organization
			U_{332} Collaborative degree between the Government and farmers
U_{333} The coordination degree of government and for-profit organization			
U_{334} The coordination degree of government and non-profit organization			
Fairness (U_4)	U_{41} Enjoy the fair	U_{411} The degree of enjoying fair	
		U_{421} The extent of fair of compensation for damaged farmers	
	U_{42} Fair compensation	U_{422} The extent of fair of compensation for the disadvantaged farmers	
		U_{511} The participation of the needs' expression	
		U_{512} Participation in decision-making	
		U_{513} Participation in financing	
Democracy (U_5)	U_{51} Stakeholders' participation and supply situation	U_{514} Participation in production	
		U_{515} Participation in encouragement	
		U_{516} Participation in regulation	
		U_{527} Satisfaction of participation in the villager organizations	
	U_{52} Stakeholders' satisfaction of participation	U_{523} Satisfaction of participation in the profit organizations	
		U_{524} Satisfaction of participation in the non-profit organizations	

(2) The revisionment of evaluation indicators. In order to filter the performance Indicators of the

synergic supply of rural public goods further, the paper has adopted the way of the consulting experts. These experts come from the main leaders of universities, research institutions, government agencies. For this problem, the author made a field survey from July to September in Harbin in 2008, a total of 148 questionnaires were issued, involving 20 scientific research institutes, and also involving 20 County Farm Bureau cadres of 10 counties (cities) and 54 townships in Harbin and 108 Farm Bureau cadres, 142 valid questionnaires, the effective rate is 95.95%. By compiling the experts' advice, and doing some analysis for the degree of membership according to the formula $R_i = M_i/N$, we keep the membership degree $R_i \geq 0.6$ down, which strengthens the scientific nature and the feasibility of the achievements appraisal indicator system enormously.

(3) The determination of indicator system. After the above two stages, this article has determined the following contents of the performance evaluation indicator system of synergic supply in the synergic supplies of the rural public goods: 5 first-level targets, 11 second-level targets and 38 third-level targets (see Table 1).

3 Empirical Analysis of the Performance Evaluation of the Synergic Supply of Rural Public Goods

The main purpose of establishing the indicator system is to practice. It is meaningless if the indicator system has no any practical value. Therefore, the purpose of establishing the indicator system of the performance evaluation of synergic supply of rural public goods is to make the synergic supplies practice in the rural public goods applied and promoted. However, the application and the promotion of this indicator system based on this indicator system's scientific and reasonable design, and this needs to use the fact to confirm. Therefore, in order to verify the scientific and applicability of the index system, this article takes the Village A rural road case in Qinggang in Heilongjiang as example to make an empirical analysis. The reason why this village-level projects are selected to make an empirical analysis is that the construction of village road is typical, and it also involves the participation of the plural subjects, they are the government and farmers fund jointly, autonomous organization is responsible for organizing, business is responsible for the construction, those can reflect the synergic supply situation of diverse subjects better. We put the following as the emphases: the indicator system constructed in this paper is a theoretical framework from the general sense. We can make some minor adjustments this indicator system according to different collaborative modes. Because village A built the road only relating the four following subjects: the government, autonomous organization, businesses and farmers, so in the specific empirical analysis, the indicator system in a project related to non-profit organizations is not included, which is in line with the theoretical requirements of the stakeholders.

3.1 Data collection

(1) Questionnaire

In line with the study of this part, the author carried out the field investigation of the synergic supply situation in rural public goods. The survey questionnaire was mainly designed about this performance evaluation indicator system in synergic supply in rural public goods. The questionnaire includes two parts: one questionnaire is for the experts aiming at conducting AHP to determine the weights by experts' scoring; the other questionnaire is for the supplied subjects of the rural public goods, the purpose is to obtain the corresponding data in each indicator system.

(2) The investigation scope and the sample selection

The study of this part is trying to do some empirical studies using the example of village A's road construction, since the government and farmers fund jointly for this project, autonomous organization is responsible for organizing, business is responsible for the construction, the scope of the investigation only concerned the government, the villagers' self-government organizations, enterprises and farmers of the village. As there are a total of 119 households in village A, the total sample of the design of this study is 147, of which there are 119 farmers, 10 governments, 8 village self-government organizations, and 10 enterprises. Questionnaire is issued by the author himself, 147 questionnaires were returned, of which 130 questionnaires are valid, the effective rate is 88.44%. Total and sub-questionnaires' Cronbach's α values are greater than 0.8, which indicate that the questionnaire has high reliability. In addition, the design of the questionnaire is mainly completed by referring to the constructed indicator system the guiding of the experts, this can ensure the validity and construct validity of the questionnaire's contents.

3.2 Fuzzy and synergic evaluation method

The specific steps of the fuzzy synergic evaluation are as follows^[7]:

(1) Establish the factor set. The factor set is a set of factors impacting the evaluation object, namely $U = (u_1, u_2, \dots, u_n)$, and the factor set itself is a general collection.

(2) The establishment of the alternative set. The alternative set is also called evaluation set, it is a set of evaluation results from the objects' evaluation on possible evaluators, that is $V = (v_1, v_2, \dots, v_m)$, v_i is representative of all possible results of the overall evaluation. Fuzzy synergic evaluation is aimed at taking all factors into account, and drawn the best evaluation result from the alternative evaluation result.

(3) The establishment of the weight set. This part use AHP to determine.

(4) Single factor fuzzy evaluation. That is to make a fuzzy mapping from U to $F(V)$.

$$f : U \rightarrow F(V), \forall u_i \in U, u_i \rightarrow f(u_i) = \frac{r_{i1}}{v_1} + \frac{r_{i2}}{v_2} + \dots + \frac{r_{im}}{v_m} \tag{1}$$

In this formula, r_{ij} indicates that u_i belongs to v_j , from $f(u_i)$ we can get set of single-factor evaluation: $R_i = (r_{i1}, r_{i2}, \dots, r_{im})$, the matrix uses the single factor evaluation set as the line is called a single factor evaluation matrix. The matrix is a fuzzy matrix.

$$R = \begin{bmatrix} r_{11} & r_{12} & \dots & r_{1m} \\ r_{21} & r_{22} & \dots & r_{2m} \\ \vdots & \vdots & \dots & \vdots \\ r_{n1} & r_{n2} & \dots & r_{nm} \end{bmatrix}$$

Fuzzy and synergic evaluation. According to the fuzzy matrix R , the role of each factor is assigned to the corresponding weight k_i , so that the combined effect of all factors can be reasonably reflected. Therefore, synergic evaluation can be expressed as:

$$B = K \bullet R = (k_1, k_2, \dots, k_n) \begin{bmatrix} r_{11} & r_{12} & \dots & r_{1m} \\ r_{21} & r_{22} & \dots & r_{2m} \\ \vdots & \vdots & \dots & \vdots \\ r_{n1} & r_{n2} & \dots & r_{nm} \end{bmatrix} = (b_1, b_2, \dots, b_m) \tag{2}$$

The treatment of evaluation indicators. After obtaining the evaluation indicator, we can determine the results of evaluations according to the principle of maximum membership.

3.3 Fuzzy and synergic evaluation

(1) Establish the factor set. The main factors of the performance evaluation of the synergic supply of rural public goods includes the following five areas: economic, efficiency, effectiveness, fairness and democracy, so we can established factor set $U = (U_1, U_2, U_3, U_4, U_5)$. Meanwhile, the above five factors can also include their own secondary indicators, the factor set can be broken down, that is $U_1 = (U_{11}, U_{12})$, $U_2 = (U_{21}, U_{22})$, $U_3 = (U_{31}, U_{32})$, $U_4 = (U_{41}, U_{42})$, $U_5 = (U_{51}, U_{52})$. Similarly, the secondary indicators also includes their third indicators, so the factor set can be further broken down, that is $U_{11} = (U_{111}, U_{112})$, $U_{12} = (U_{121}, U_{122})$, $U_{21} = (U_{211}, U_{212})$, $U_{22} = (U_{221}, U_{222})$, $U_{31} = (U_{311}, U_{312}, U_{313}, U_{314}, U_{315}, U_{316})$, $U_{32} = (U_{321}, U_{322}, U_{323}, U_{324})$, $U_{33} = (U_{331}, U_{332}, U_{333}, U_{334}, U_{335}, U_{336})$, $U_{41} = (U_{411}, U_{412}, U_{413}, U_{414}, U_{415}, U_{416})$, $U_{42} = (U_{421}, U_{422}, U_{423}, U_{424}, U_{425}, U_{426})$, $U_{51} = (U_{511}, U_{512}, U_{513}, U_{514}, U_{515}, U_{516})$, $U_{52} = (U_{521}, U_{522}, U_{523}, U_{524}, U_{525}, U_{526})$.

(2) Establish an evaluation set. Synergic evaluation of performance status of the synergic supply of the rural public goods is the evaluation of the performance status, that is the worse, bad, common, better, good. So the evaluation set is $V = (\text{worse, bad, common, better, good}) = (V_1, V_2, V_3, V_4, V_5)$.

(3) Establishment of the weight set. We have calculated the index weight using AHP to give a score to the expert, the weight of each index is as follows: $K = (K_1, K_2, K_3, K_4, K_5) = (0.064, 0.264, 0.510, 0.130, 0.032)$; $K_1 = (K_{11}, K_{12}) = (0.750, 0.250)$, $K_2 = (K_{21}, K_{22}) = (0.750, 0.250)$, $K_3 = (K_{31}, K_{32}, K_{33}) = (0.286, 0.571, 0.143)$, $K_4 = (K_{41}, K_{42}) = (0.750, 0.250)$, $K_5 = (K_{51}, K_{52}) = (0.333, 0.667)$; $K_{11} = (K_{111}, K_{112}) = (1.000, 1.000)$, $K_{12} = (K_{121}, K_{122}) = (1.000, 1.000)$, $K_{21} = (K_{211}, K_{212}) = (1.000, 1.000)$, $K_{22} = (K_{221}, K_{222}) = (1.000, 1.000)$, $K_{31} = (K_{311}, K_{312}, K_{313}, K_{314}, K_{315}, K_{316}) = (0.042, 0.160, 0.064, 0.252, 0.101, 0.381)$, $K_{32} = (K_{321}, K_{322}, K_{323}, K_{324}) = (0.055, 0.118, 0.564, 0.263)$, $K_{33} = (K_{331}, K_{332}, K_{333}, K_{334}, K_{335}, K_{336}) = (0.381, 0.101, 0.160, 0.252, 0.064, 0.042)$, $K_{41} = (K_{411}, K_{412}, K_{413}, K_{414}, K_{415}, K_{416}) = (1.000, 1.000, 1.000, 1.000, 1.000, 1.000)$, $K_{42} = (K_{421}, K_{422}) = (0.333, 0.667)$, $K_{51} = (K_{511}, K_{512}, K_{513}, K_{514}, K_{515}, K_{516}) = (0.252, 0.381, 0.101, 0.064, 0.042, 0.160)$, $K_{52} = (K_{521}, K_{522}, K_{523}, K_{524}, K_{525}, K_{526}) = (0.163, 0.540, 0.297)$.

(4) Single-factor fuzzy evaluation. According to the results of the questionnaire (an indicator of the investigating officers' ratio on the different options), We can establish the single-factor evaluation matrix R .

(5) Fuzzy and synergic evaluation

①The first-level fuzzy and synergic evaluation. According to the formula (2), by the previously determined single-factor evaluation matrix multiplying the corresponding set of weights, we can get the corresponding fuzzy synergic evaluation value.

$$B_{11} = K_{11} \times R_{11} = (1.000) \cdot [0.14 \ 0.18 \ 0.52 \ 0.11 \ 0.05] = (0.14, 0.18, 0.52, 0.11, 0.05)$$

$$B_{12} = K_{12} \times R_{12} = (1.000) \cdot [0.06 \ 0.09 \ 0.32 \ 0.38 \ 0.15] = (0.06, 0.09, 0.32, 0.38, 0.15)$$

Similarly:

$$B_{21}=(0.03,0.21,0.49,0.23,0.04) \quad B_{22}=(0.05,0.24,0.45,0.22,0.04) \quad B_{31}=(0.06,0.14,0.28,0.36,0.16)$$

$$B_{32}=(0.03,0.13,0.27,0.33,0.23) \quad B_{33}=(0.07,0.18,0.28,0.33,0.14) \quad B_{41}=(0.06,0.20,0.34,0.25,0.15)$$

$$B_{42}=(0.16,0.43,0.23,0.13,0.05) \quad B_{51}=(0.22,0.37,0.22,0.15,0.04) \quad B_{52}=(0.09,0.34,0.32,0.19,0.06)$$

②Second-level fuzzy and synergic evaluation. See the first-level evaluation results as its single-factor evaluation set, we can get the single-factor evaluation matrix of second-level fuzzy and synergic evaluation, and according to the formula (2), multiply this evaluation set with its corresponding weights. we can get the second-level fuzzy and synergic evaluation value.

$$B_1 = K_1 \times R_1 = (0.750, 0.250) \begin{bmatrix} 0.14 & 0.18 & 0.52 & 0.11 & 0.05 \\ 0.06 & 0.09 & 0.32 & 0.38 & 0.15 \end{bmatrix} = (0.12, 0.16, 0.47, 0.19, 0.08)$$

Similarly:

$$B_2=(0.04,0.22,0.48,0.23,0.03) \quad B_3=(0.04,0.14,0.27,0.34,0.21)$$

$$B_4=(0.09,0.26,0.31,0.22,0.12) \quad B_5=(0.13,0.35,0.29,0.18,0.05)$$

③Third-level fuzzy and synergic evaluation. See the second evaluation results as the single factor evaluation sets, and compose the single-factor evaluation matrix of the third fuzzy and synergic evaluation, and according to the formula (2), by multiplying the evaluation set with the corresponding weights we can obtain the final fuzzy evaluation value.

$$B = K \times R = (0.064, 0.264, 0.510, 0.130, 0.032) \begin{bmatrix} 0.12 & 0.16 & 0.47 & 0.19 & 0.08 \\ 0.04 & 0.22 & 0.48 & 0.23 & 0.03 \\ 0.04 & 0.14 & 0.27 & 0.34 & 0.21 \\ 0.09 & 0.26 & 0.31 & 0.22 & 0.12 \\ 0.13 & 0.35 & 0.29 & 0.18 & 0.05 \end{bmatrix}$$

$$= (0.05, 0.18, 0.34, 0.28, 0.15)$$

(6) Evaluation processing. According to the principle of maximum membership we can know that the performance evaluation results is "common."

3.4 Analysis of results

From the evaluation results above, we can see that the overall performance of building village road in village A in Qinggang is common and even tend to better. This is consistent with the results of our field interviews. The reason for this is that the two indicators—economy and efficiency of the construction of village road in Village A are both common and the level of performance of the two indicators—democracy and fair is worse, although the effectiveness level of the performance indicators is better, this indicator is not enough to change the overall level of performance. This result has proved that the multiple subjects of the rural public goods should not only pay attention to effectiveness, efficiency and economy, but also pay attention to equity and democracy in the synergic supply process. In order to improve the overall performance level of the synergic supply, we must put all the things into a balanced and synergic way.

4 Conclusion

This article builds the indicator system initially based on the value orientation and the theory of stakeholder of the performance evaluation of the synergic supply in rural public goods, and to make further amendments through expert scoring and processing of index membership, at last it establishes the performance evaluation indicator system of the synergic supply of the rural public goods which contains 5 first-level indicators, 11 second-level indicators and 38 third-level indicators. It proves the feasibility of the indicator system, take building the village road in village A in Heilongjiang as an example, the paper uses the fuzzy integrated evaluation method to do some empirical analysis, the results show that the indicator system can truly reflect the performance level of the synergic supply of the rural public

goods. Thus, indicator system not only makes up the theoretical defects of supply in rural public goods, but also has some practical value.

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