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Study on Farmers' Satisfaction with the Supply of Public Goods for Disaster Reduction in Agriculture——Based on the Survey Data of Farmers in Two Counties and One District of Hubei Province

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Abstract According to actual features of public goods for disaster reduction in agriculture, an evaluation indicator system of farmers' satisfaction with the supply of public goods for disaster reduction in agriculture composed of five first-grade indicators containing 18 second-grade indicators was established firstly, and then a fuzzy comprehensive evaluation model of farmers' satisfaction was set up. Finally, farmers' satisfaction with the supply of public goods for disaster reduction in agriculture in two counties and one district of Hubei Province was evaluated by the model. The results show that farmers are satisfied with the supply of public goods for disaster reduction in agriculture on the whole, but farmers' satisfaction with openness about funds for disaster reduction, supply structure of public goods, work attitude and work efficiency is at a general level. Some suggestions about the four aspects were proposed, such as improving supervisory mechanisms to increase funding transparency, making information channels unblocked to improve the supply efficiency of public goods for disaster reduction, and improving the quality of government workers to increase their work efficiency.

Key words Public goods for disaster reduction in agriculture, Supply, Farmers' satisfaction, Fuzzy comprehensive evaluation

1 Introduction

In recent years, the frequent occurrence of agricultural natural disasters in China has brought great loss to rural economic construction and farmers' daily life, so local government increases the supply of public goods for disaster reduction in agriculture to improve farmers' ability to resist natural disasters and provide disaster relief. The supply of public goods for disaster reduction in agriculture, an important responsibility of the Chinese government in public services, can support and ensure the development of rural economy in China. The government has increased the input in the supply of public goods for disaster reduction in agriculture and has obtained great development, but all levels of government pay more attention to cities but less attention to rural areas, which has resulted in practical problems, such as unreasonable supply structure and low supply efficiency, big regional differences in the supply level of public goods for disaster reduction in agriculture, *etc.* Farmers' satisfaction with the supply of public goods for disaster reduction in agriculture is one of important indicators that are used to judge whether the government's public services are effective, so studying public goods for disaster reduction in agriculture from the aspect of farmer's satisfaction has important theoretical and realistic significance.

At present, public goods for disaster reduction in agriculture have been given an exact definition. For instance, Yan Fengxian *et al.* suggest that public goods for disaster reduction in agriculture are rural public goods or services provided for farmers to resist agricultural natural disasters and evade agricultural risk in rural

community^[1]. According to the research content of this paper, public goods for disaster reduction in agriculture are defined as all services and products among rural public goods that can be used to resist and relieve disasters to ensure farmers' daily life and support farmers' normal production. The supply of rural public goods in China is a "top-down" pattern led by the government presently. He Wenhua has pointed out that the current supply of rural public goods in China is inadequate in quantity and unbalanced in structure, the "top-down" pattern has led to low supply efficiency of rural public goods^[2]. Li Yanling *et al.* think that the supply efficiency of rural public goods can be divided into material and spirit efficiency, and paying more attention to farmers' satisfaction is the most efficient supply behavior^[3]. Han Pengyun *et al.* have proposed that farmers should have the right to demand expression and decision making, and farmers' dominant position should be paid more attention to^[4]. Public goods for disaster reduction in agriculture are mainly supplied to farmers, so studying the supply of public goods for disaster reduction in agriculture from the aspect of farmers' satisfaction and setting up a scientific and reasonable evaluation indicator system to assess farmers' satisfaction with the supply of public goods for disaster reduction in agriculture have important realistic significance to optimization of supply system of public goods for disaster reduction and improvement of their supply efficiency.

Farmers' satisfaction is derived from customers' satisfaction and can be used to measure the government's job performance. In recent years, Chinese scholars have studied farmers' satisfaction more and more deeply. For example, Yin Suang *et al.* established a fuzzy synthetic evaluation model of satisfaction with the government's public services by using the fuzzy synthetic evalua-

tion method and assessed the satisfaction with the government's public services^[5]. Based on a model of customers' satisfaction, Kong Rong *et al.* set up an evaluation model of farmers' satisfaction with rural microfinance and calculated farmers' satisfaction with various indicators by using fuzzy analytical hierarchy process and Likert scale^[6]. By using the factor analysis method, Fang Kai *et al.* designed an evaluation scale of farmers' satisfaction from the aspects of material and spirit and assessed farmers' satisfaction with rural public goods^[7]. Based on a linear regression model, Xiao Liang have analyzed factors influencing farmers' satisfaction with the supply of rural public goods and have proposed that social security is the most important factor influencing farmers' satisfaction^[8]. Zhu Yuchun *et al.* have pointed out that farmers' satisfaction with various species of public goods is different, and per capita income has obvious effects on farmers' satisfaction^[9]. Leng Junlei *et al.* have proposed that farmers' satisfaction with grain supplement is affected by farmers' educational level, species of disaster, actual situation of their village, and so forth^[10].

China's agriculture has suffered natural disasters frequently in recent years, so the government increases the supply of public goods for disaster reduction in agriculture, and then studies on China's agricultural disasters and supply of public goods for disaster reduction in agriculture have been started. For instance, based on the analysis of economics theory of disaster reduction, Yan Wen has classified products of disaster reduction and has proposed the concept of supply and demand of disaster reduction; the supply-demand equilibrium model was established from the aspect of various interest subjects' responsibility based on disaster prevention experience at home and abroad^[11]. Gu Jintu *et al.* have pointed out that the great impacts of natural disasters on China's rural areas are closely related to inadequate crisis awareness of farmers, opaque information of disasters, insufficient funds input by the government, and weak ability of restoration and reconstruction after the occurrence of a disaster^[12]. Yan Fengxian *et al.* have studied effects of governance mechanism of rural communities on the supply effect of public goods for disaster reduction in agriculture, and have proposed that the management ability of village cadres, policy support for disaster reduction, democratic decision-making, and collective action have positive effects on the supply effect of public goods for disaster reduction, while economic development level has adverse effects on the supply effect of public goods for disaster reduction^[13]. In this paper, a fuzzy synthetic evaluation model of farmers' satisfaction with the supply of public goods for disaster reduction in agriculture will be established to assess farmers' satisfaction with the supply of public goods for disaster reduction in agriculture in three counties of Hubei Province, and reasons for low efficiency of the supply and factors influencing farmers' satisfaction will be revealed.

2 Data sources and explanations for variables

2.1 Data sources

Data used in this paper were obtained from investigations of 27 villages in 10 towns of two counties and one

district in Hubei Province from September to December in 2013. In regions of Hubei Province where disasters are typical, three sample regions (Yiling District, Xishi County, and Sui County) were sampled randomly, from which 27 sample villages were chosen randomly then. The fuzzy assessment method was adopted in this paper, so 20 questionnaires were released to experts to determine the weight of each indicator, and all questionnaires released to experts were effective. Meanwhile, 500 questionnaires were released to farmers, of which 476 questionnaires were effective.

2.2 Establishment of an evaluation indicator system of farmers' satisfaction and explanations for variables

As shown in Fig. 1, an evaluation indicator system of farmers' satisfaction with the supply of public goods for disaster reduction in agriculture is composed of three layers, including five first-grade indicators containing 18 second-grade indicators. Farmers' expectation is their public goods or services for disaster reduction provided by the government. Farmers' expectation is a latent variable and should be transformed into a measurable variable through the establishment of second-grade indicators according to the principle of measurability. According to the actual situation of supply of public goods for disaster reduction in agriculture, its second-grade indicators include accuracy of published information about the situation of disasters, degree of openness about funds for disaster reduction, and reserve of materials for disaster reduction. In this paper, the disasters mainly refer to flood, drought, plant diseases and insect pests; the degree of openness about funds for disaster reduction means the degree of openness about funds for disaster reduction and resistance by the government; the reserve of materials for disaster relief refers to the degree of readiness of the government before the occurrence of a disaster. Perceived quality refers to the subjective feeling of customers during the process of consumption and service, and farmers' expectation is the psychological basis of perceived quality evaluation. The second-grade indicators of perceived quality contain timeliness of disaster resistance and relief, equity of releasing materials, quantity of supplied public goods, supply structure of public goods, and quality of supplied public goods. The timeliness of disaster resistance and relief refers to response speed of the government when natural disasters are injurious to farmers' production and living conditions; the equity of releasing materials means whether releasing materials for disaster relief follow the principles of equality, openness, and fairness; the quality of supplied public goods means whether each affected farmer receives enough quantities of public goods for disaster reduction; the supply structure of public goods means whether public goods supplied by the government can meet farmers' real demands to resist natural disasters; the quality of supplied public goods includes the practicality of agricultural extension training techniques and the quality of public goods for disaster reduction in use. Government image means farmers assess the behaviors and reflexes of the government. Systematicness of policies for disaster reduction means the government supports farmers to resist natural disasters by laws and regulations; clear division of departments for

disaster reduction means whether government departments have clear responsibilities and orderly administration during the process of disaster prevention and relief; work attitude stands for government workers' attitude towards farmers at work; work efficiency refers to government workers' efficiency and quality at work. Farmers' complaint refers to the difference between farmers' psychological expectation and actual feeling after receiving public goods for disaster reduction. The second-grade indicators of farmers' complaint include handling of farmers' petitioning and adoption of farmers' suggestions. Handling of farmers' petitioning includes the handling period and ways; adoption of farmers' suggestions means whether the government gets suggestions from farmers actively and then adopts them. Farmers' trust means farmers' actual feeling exceeds their psychological expectation after receiving public goods for disaster reduction, so they have trust in the government. The second-grade indicators of farmers' trust include participation in village-level activities, initiative for disaster prevention and relief, rising of living standard, and restoration of production capacity. Participation in village-level activities means the frequency of farmers taking part in village-level activities from as-

pects of politics, economics, education and culture; initiative for disaster prevention and relief reflects whether farmers' physical and mental altitude are optimistic when facing disasters; rising of living standard means whether farmers' living standard improves after receiving public goods for disaster reduction; restoration of production capacity means whether farmers' agricultural loss is restored.

3 Establishment of a fuzzy evaluation model of farmers' satisfaction

3.1 Determination of weight of each indicator After the evaluation indicator system was established, it is needed to determine the weight of various indicator in the same layer. By using expert assignment method and Analytic Hierarchy Process (AHP), 20 experts engaging in disaster reduction in rural areas, leaders having rich experience of disaster relief, and doctors engaging in research on rural public goods were chosen to fill in a questionnaire, and then the results of all questionnaires were analyzed; finally, the weight of each indicator was determined by AHP (Table 1)^[13].

Table 1 The evaluation indicator system of farmers' satisfaction with the supply of public goods for disaster reduction in agriculture and weight of each indicator

Overall indicator	First-grade indicator (Weight)	Second-grade indicator	Weight
Farmers' satisfaction	Farmers' expectation (0.30)	Accuracy of published information	0.10
	Perceived quality (0.41)	Degree of openness about funds for disaster reduction	0.65
	Government image (0.18)	Reserve of materials for disaster reduction	0.25
	Farmers' complaint (0.07)	Timeliness of disaster resistance and relief	0.25
	Farmers' trust (0.04)	Equity of releasing materials	0.48
		Quantity of supplied public goods	0.07
		Supply structure of public goods	0.15
		Quality of supplied public goods	0.04
		Systematicness of policies for disaster reduction	0.07
		Clear division of departments for disaster reduction	0.10
		Work attitude	0.19
		Work efficiency	0.63
		Handling of farmers' petitioning	0.25
		Adoption of farmers' suggestions	0.75
		Participation in village-level activities	0.07
		Initiative for disaster prevention and relief	0.11
		Restoration of production capacity	0.27
		Rising of living standard	0.56

3.2 Establishment of a fuzzy comprehensive evaluation model

3.2.1 Basic ideas of fuzzy comprehensive evaluation. Fuzzy comprehensive evaluation was proposed by the cybernetician Zadeh in 1965, meaning that based on set theory, synthesis of fuzzy relations in fuzzy mathematics is used to quantify fuzzy and uncertain objective things that are difficult to determine their values. Farmers' satisfaction is fuzzy and uncertain, so it is scientific and feasible to use fuzzy comprehensive evaluation to assess farmers' satisfaction.

3.2.2 Determination of factor sets. A factor set is a set composed of factors in the evaluation indicator system, and a factor set of a

layer is composed of factors in the layer. The factor set of the criteria layer is $U = \{u_1, u_2, \dots, u_n\}$, which should meet the follow-up three conditions: firstly, $U_i \neq \emptyset$, $\forall i \in \{1, 2, \dots, N\}$; secondly, $U_i \cap U_j = \emptyset$, $i \neq j$; thirdly, $U = \bigcup_{i=1}^N U_i$. The factor set of the objective layer is $U_{ij} = \{U_{i1}, U_{i2}, \dots, U_{im}\}$, where U_{ij} is the j th factor in the indicator layer affecting the i th factor in the criteria layer.

3.2.3 Determination of fuzzy remark sets. A fuzzy remark set is a fuzzy concept set used by evaluators during the process of evaluation. In this study, the remark set of farmers' satisfaction is a set composed of all possible evaluation results of farmers' satisfaction, and it can be expressed as $V = \{v_1, v_2, \dots, v_p\}$, where p is the

number of remark grades, and $3 \leq p \leq 9$. If $p < 3$, indicator grade can not be described in detail; if p is too large, it is difficult to judge indicator grade. Therefore, five assessment grades were chosen, including very not satisfied, not satisfied, general, satisfied, and very satisfied. Afterwards, a score scale set $H = \{h_1, h_2, \dots, h_p\}$ was established, and the scores corresponding to the five grades are $[0, 20], [20, 40], [40, 60], [60, 80]$ and $[80, 100]$ respectively.

3.2.4 Establishment of a fuzzy evaluation matrix. A fuzzy evaluation matrix is a complete matrix obtained after the fuzzy evaluation of indicators in each layer is conducted. Firstly, factor u_i is assessed, and then its membership is calculated, thereby obtain its evaluation vector $\gamma_i = \{\gamma_{i1}, \gamma_{i2}, \dots, \gamma_{im}\}$. For instance, if farmers assess the supply equity of public goods, 5% of them are very not satisfied; 15% of them are not satisfied; 25% of them are general; 35% of them are satisfied; 20% of them are very satisfied. Then the fuzzy evaluation set of supply equity of public goods can be obtained as follows: $\gamma_1 = \{0.05, 0.15, 0.25, 0.35, 0.20\}$. After the fuzzy evaluation vector of each factor $\gamma_i = \{\gamma_{i1}, \gamma_{i2}, \dots, \gamma_{im}\}$ is calculated by using the above methods, a fuzzy evaluation matrix R is obtained finally as follows:

$$R = \begin{bmatrix} \gamma_{11} & \gamma_{12} & \cdots & \gamma_{1n} \\ \gamma_{21} & \gamma_{22} & \cdots & \gamma_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ \gamma_{m1} & \gamma_{m2} & \cdots & \gamma_{mn} \end{bmatrix} \quad (3)$$

In the above formula, n is the number of assessment grades;

Table 2 Results of questionnaires about farmers' satisfaction

Overall indicator	First-grade indicator	Second-grade indicator	Very bad	Worse	General	Better	Very good
Farmers' satisfaction	Farmers' expectation	Degree of openness about funds for disaster reduction	15	223	173	65	0
		Accuracy of published information	0	15	175	210	76
		Reserve of materials for disaster reduction	37	54	320	60	5
		Perceived quality	Timeliness of disaster resistance and relief	1	45	65	300
		Equity of releasing materials	11	78	120	264	3
	Government image	Quality of supplied public goods	1	12	150	283	60
		Supply structure of public goods	0	262	102	100	12
		Quantity of supplied public goods	0	90	136	227	23
		Systematicness of policies for disaster reduction	2	60	139	245	30
		Clear division of departments for disaster reduction	3	171	187	90	25
Farmers' trust	Farmers' complaint	Work attitude	25	189	150	86	26
		Work efficiency	16	157	200	61	42
	Farmers' trust	Handling of farmers' petitioning	5	54	110	268	39
		Adoption of farmers' suggestions	15	211	96	84	70
	Farmers' trust	Initiative for disaster prevention and relief	3	78	135	170	90
		Restoration of production capacity	2	30	179	190	75
		Rising of living standard	11	50	135	260	20
		Participation in village-level activities	4	90	258	107	17

4.2 Analysis of results According to Table 3, the score of farmers' satisfaction with the supply of public goods for disaster reduction in agriculture in the three regions is 65.65, showing that farmers are satisfied with the supply of public goods for disaster reduction in agriculture on the whole. The scores of farmers' expectation, government image, farmers' complaint, perceived quality, and farmers' trust are 56.76, 57.98, 62.43, 66.96 and 70.06 re-

m is the quantity of evaluation indicators.

3.2.5 Fuzzy comprehensive evaluation. Based on the weight set A and fuzzy evaluation matrix R , the result vector of fuzzy comprehensive evaluation B can be obtained as follows:

$$B = A * R = \begin{bmatrix} \gamma_{11} & \gamma_{12} & \cdots & \gamma_{1n} \\ \gamma_{21} & \gamma_{22} & \cdots & \gamma_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ \gamma_{m1} & \gamma_{m2} & \cdots & \gamma_{mn} \end{bmatrix} = \{b_1, b_2, \dots, b_n\} \quad (4)$$

3.2.6 Calculation of final assessment results. Calculation of final assessment results means analyzing the result vector of fuzzy comprehensive evaluation B to obtain the score of satisfaction by using weighted average method, and the formula of the score is shown as follows:

$$S = \frac{\sum_{k=1}^p b_k h_k}{\sum_{k=1}^p h_k} \quad (5)$$

4 Data preparation and analysis

4.1 Data preparation After the questionnaires were collected and the results were averaged, experts' suggestions and farmers' satisfaction were obtained (Table 2). By using the above methods, the result vector of comprehensive evaluation B was calculated, and the comprehensive score H_i and the comprehensive score of the overall indicator H were calculated (Table 3).

spectively, so the scores of farmers' expectation and government image are at a general level and need to be improved further; the scores of farmers' complaint, perceived quality, and farmers' trust are at a satisfied level but are low. Among the second-grade indicators, the scores of timeliness of disaster resistance and relief (76.09), accuracy of published information (74.58) and restoration of production capacity (72.86) are very high; the scores of

degree of openness about funds for disaster reduction (52.10), supply structure of public goods (54.20), work attitude (55.76) and work efficiency (58.15) are very low.

Table 3 Results of fuzzy comprehensive evaluation of farmers' satisfaction

First-grade indicator	Second-grade indicator	Very bad	Worse	General	Better	Very good	Score
Farmers' expectation	Degree of openness about funds for disaster reduction	0.03	0.47	0.36	0.14	0.00	52.10
	Accuracy of published information	0.00	0.03	0.37	0.44	0.34	74.58
	Reserve of materials for disaster reduction	0.08	0.11	0.46	0.13	0.01	61.76
	B_1	0.03	0.37	0.39	0.19	0.03	56.76
Perceived quality	Timeliness of disaster resistance and relief	0.00	0.09	0.14	0.63	0.14	76.09
	Equity of releasing materials	0.02	0.16	0.25	0.55	0.01	67.14
	Quality of supplied public goods	0.00	0.03	0.53	0.38	0.06	69.62
	Supply structure of public goods	0.00	0.55	0.21	0.21	0.03	54.20
	Quantity of supplied public goods	0.00	0.19	0.29	0.48	0.05	67.69
	B_2	0.01	0.19	0.24	0.50	0.05	66.96
Government image	Systematicness of policies for disaster reduction	0.00	0.13	0.29	0.51	0.06	70.13
	Clear division of departments for disaster reduction	0.01	0.36	0.39	0.19	0.05	58.45
	Work attitude	0.05	0.40	0.32	0.18	0.05	55.76
	Work efficiency	0.03	0.33	0.42	0.13	0.09	58.15
	B_3	0.03	0.33	0.38	0.17	0.08	57.98
Farmers' complaint	Handling of farmers' petitioning	0.01	0.11	0.23	0.56	0.08	71.85
	Adoption of farmers' suggestions	0.03	0.44	0.20	0.18	0.15	59.29
	B_4	0.02	0.28	0.22	0.37	0.11	62.43
Farmers' trust	Initiative for disaster prevention and relief	0.03	0.36	0.21	0.27	0.13	71.18
	Restoration of production capacity	0.00	0.06	0.38	0.40	0.16	72.86
	Rising of living standard	0.02	0.11	0.28	0.55	0.04	69.58
	Participation in village-level activities	0.01	0.19	0.54	0.22	0.04	61.81
	B_5	0.01	0.19	0.54	0.22	0.04	70.06
	B	0.03	0.01	0.04	0.02	0.02	65.65

5 Conclusions and suggestions

5.1 Conclusions In respect of supply of public goods for disaster reduction, the government should pay more attention to equity, benefit, efficiency and effect. Meanwhile, it is seen that farmers give more attention to their living standard, which can provide certain references for the establishment of supply policies according to farmers' will. In addition, farmers are care about the work altitude of government workers, so the quality of government workers should be improved. According to the investigation results of farmers' satisfaction, some suggestions about openness about funds for disaster reduction, supply structure of public goods, work attitude and work efficiency are shown as follows.

5.2 Suggestions Firstly, it is needed to improve supervisory mechanisms to increase funding transparency. Participation of farmers in supervision can enhance farmers' consciousness as a protagonist and satisfaction, so it is needed to develop diversified subjects of supervision, such as governments, enterprises and farmers. At the same time, information of public goods for disaster reduction should be open in time to increase information transparency. Secondly, it is necessary to make information channels unblocked to improve the supply efficiency of public goods for disaster reduction. It is needed to set up opinion expression channels to listen to farmers' suggestions actively, so as to correct problems faced by the government during the process of supplying public goods for disaster reduction to farmers, reasonably optimize the supply structure of public goods for dis-

aster reduction, and improve the supply efficiency of public goods for disaster reduction. Thirdly, it is needed to improve the quality of government workers to increase their work efficiency. Construction of ideological and moral level of government workers should be strengthened, and they should pay more attention to farmers' benefit. Meanwhile, construction of civil servants' ability should be enhanced to improve their work efficiency through training, and they should communicate with farmers.

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clauses of agricultural insurance contract should be clear and simple, to make farmers understand and accept easily, so as to raise their enthusiasm for buying the agricultural insurance.

Integrating the information technology into the operation activities of agricultural insurance can reduce the difficulty of the operation. In modern society with wide use of smart cell phones and tablet PC, it is recommended to actively expand functions of mobile devices as insurance service platform, which will play a great role in popularizing the insurance knowledge, simplifying the service procedures, conveying the disaster warning, and disaster prevention information.

4.3 Expanding the coverage scope and increasing the financial subsidy of both central and provincial level finance

Compared with staple grain crops, characteristic agricultural products such as vegetable, fruit and aquatic products have higher level of specialization and intensification, more input of production elements, so they have more urgent demands for risk security, accordingly it is required to provide premium subsidy for those high efficient agricultural product industries. Besides, agricultural production also needs insurance, and transport, processing and circulation of agricultural products also need risk security. Therefore, agricultural insurance operators should closely follow demands of millions of farmers, and gradually expand the security scope from general disaster accident risk, meteorological disaster risk and plant disease and insect pest risks to market and social risk fields. Specifically, it is recommended to develop agricultural product transport insurance to decentralize risks in the transport of agricultural products, undertake agricultural product liability insurance, cover products not up to standard or having defects due to reasons

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of processing party or selling party and causing personal injury or property losses to consumers or users, and assume compensation liability in accordance with laws; develop commercial credit insurance, insure economic losses due to delay in payment of purchasers or unilateral default of the insurance contract.

The production security for agriculture, especially for grain crops, involves national grain security. Agricultural insurance has distinctive characteristics of public goods, so central government should provide great support at the level of state policy. According to experience of countries with developed agricultural insurance, government provides the premium subsidy as high as 50% – 80%, basically covering all main grain crops, and it also provides subsidy for insurance companies. Therefore, it is recommended to further increase central finance subsidy for primary agricultural products, and reasonably reduce the pressure of local finance, especially the financial pressure of large counties of grain production.

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