Efficiency of public goods provision in Wenchuan earthquake-stricken rural areas, Sichuan, China

A fuzzy comprehensive evaluation

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Abstract

Purpose – The purpose of this paper is to evaluate the efficiency of public goods provision in Wenchuan earthquake-stricken rural areas. The study was undertaken in August and September 2012 by the field survey of 24 villages.

Design/methodology/approach – This paper, by applying the methods of analytic hierarchy process and fuzzy comprehensive evaluation, aims to evaluate the efficiency by means of villagers' satisfaction, which is designed in the idea of combining overall goal-classifications and specific indicators, including 7 classifications and a total of 36 specific indicators.

Findings – Based on maximum membership principle by the fuzzy comprehensive evaluation, the calculation results in 0.4485862 as a "general" level of the evaluation membership of efficiency in the post-quake public goods provision, and 3.0634837 as overall comprehensive score, a level lower than 3.5.

Practical implications – The efficiency by means of villagers' evaluation is generally at a lower degree. Although the reconstruction has completed some high-quality infrastructure, schools, hospitals and houses, we still face more macroscopic and long-term problems of recovering and sustaining the post-quake communities in many fields.

Originality/value – It is more worthy to consider how to improve the efficiency of the reconstruction, especially in public goods and public services provision in the quake-stricken rural areas.

Keywords Risk management, Earthquakes, Restoration, Disaster response, Disaster cost, Infrastructure management

Paper type Research paper

1. Introduction

The Wenchuan earthquake, which struck Western Sichuan province, People's Republic of China on May 12, 2008, had a magnitude of 8.0, with a focal depth of 19 kilometers.

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The earthquake's name stems from the location of the epicenter in Wenchuan county, Ngawa Tibetan and Qiang Autonomous Prefecture of Sichuan province. The epicenter was 80 kilometers west-northwest of the provincial capital city of Chengdu, and total 51 counties were seriously affected (41 in Sichuan province, 6 in Gansu province and 4 in Shaanxi province), covering an area of 132,596 square kilometers populated by about 20 million people. The Wenchuan earthquake ranks among its kind the most destructive, the widest spreading and the most difficult in relief since the founding of new China. According to the Ministry of Civil Affairs report (as of September 25, 2008, 12:00 CST), 69,227 were confirmed dead, 374,643 injured and 17,923 listed as missing (2008). In the rural areas, there was extremely serious damage by the disaster[1]. The wide stricken areas were in urgent need of post-quake mass amendment. The Chinese Government assembled the national strength to carry out the post-earthquake reconstruction. The 26th meeting of the Earthquake Relief Headquarters of the State Council, held on October 14, 2008, mapped the blueprint that the nation should strive to complete the restoration and reconstruction of the earthquake-stricken areas, and improve the basic living conditions and economic development to meet or exceed their pre-quake levels in about three years.

As the rural areas and the rural population were most disastrously stricken by the Wenchuan earthquake, consequently, the post-quake rural reconstruction is highlighted as the most challenging task and the top priority throughout the restoration and reconstruction. Although Sichuan Provincial Government has announced that the reconstruction of its stricken areas has been fulfilled within three years, it is of significance to evaluate the efficiency of government-conducting public goods provision in quake-stricken rural areas. Thus, research on efficiency with reference to the provision of public goods in the quake-stricken rural areas is not only an economic issue but also a social one, not only a regional issue, but also a national one.

2. Public goods provision in the quake-stricken rural areas

In accordance with the Wenchuan Earthquake Restoration and Reconstruction Master Plan, which was announced by Chinese Central Government on September 19, 2008, a total of 1 trillion Y*uan* was to be invested in reconstructing the stricken areas in Sichuan, Gansu, Shaanxi and other provinces.

In the worst-stricken Sichuan province, the three-year reconstruction was successful in earthquake-stricken rural areas[2]. However, according to a research, the progress achieved in the first year of reconstruction in rural areas of Wenchuan earthquake and the challenges still remain. The research also shows that the speed and quality of state-led reconstruction is high, the efficiency of the reconstruction depended on a very clear plan of action and consistent and effective coordination and integration of the participation in its implementation (Dunforda and Li, 2011). Some experts emphasize that the non-government organizations (NGOs) are able to establish close relationships with rural schools, and gain the confidence of villages when they organized some education relief program (Menefee and Nordtveit, 2012). Whether the state-led or NGO participation, the reconstruction is in progress in various forms and has witnessed great achievements in recent years, but, there still exist some problems. A research pointed out that post-quake reconstruction was likely to suffer resource shortages and supply disruptions, so the Chinese policymakers and reconstruction group should face the problem how to deal with the issue such as price escalation and market inflation

(Chang *et al.*, 2010). It fails to produce significant effect to restore the lives of the rural residents by government subsidies metastatic revenue (Wang, 2011). A survey suggests that governments should support income-generating activities and improve living conditions as well as public health (Kun *et al.*, 2010). Survivors after the earthquake tend to experience problem-avoidance, fantasy, self-blame and seek assistance, especially women (Xu and He, 2012), and it is urgent to pay more attention to the post-quake living quality of the old in some rural areas, who live a lower-quality life (Zhang, 2012). In the field of social protection, the effectiveness of reconstruction may be affected by the alarming rate of burnout, and the capability of degradation in several months after the calamity (Hu *et al.*, 2010). The landless farmers in the stricken areas are lack of employment security, and vocational education mechanisms and old-age insurance system need to be improved (Li, 2011). The efficiency of the primary and secondary education in the stricken areas is not high, and there is waste of education resource (Zhang, 2012). So the efficiency of public goods provision in the Wenchuan earthquake-stricken rural areas still remains as a problem.

3. Model of efficiency evaluation

As early as the beginning of the twentieth century, Wichsell and Lindahl's approach to public goods provision is based on the benefit principle of taxation which states that people should pay taxes in relation to the benefits they receive from the consumption of public goods (Michael, 2001). In Pigou's (1928) equilibrium model, the provision of public goods is most effective when the marginal utility of public goods is equal to the marginal disutility of everyone's tax. Samuelson (1954) points out that there is no free-riding behavior when the sum of public goods demand is equal to the sum of the individual needs with the established assumption of the consumer preferences, income and the prices of public goods. He further theorizes the general equilibrium analysis that the efficiency of public goods provision is that the sum of the marginal rate of substitution must be equal to the marginal transfer rate.

It is necessary to say that the models of public goods provision by Wichsell, Lindahl, Pigou and Samuelson need to obtain the true expression referred to consumers' demands in complete information condition whether it is who provide the public goods. So it is inefficient when the public goods, even if in more quantity, do not meet the consumers demand. Only when consumers agree with the provision of public goods will the efficiency be high.

According to the methods of expert consultation and analytic hierarchy process (AHP), the paper will build the efficiency evaluation index system, determine the weights of public goods provision in the Wenchuan earthquake-stricken rural areas, and then take advantage of the villagers' satisfaction to evaluate the efficiency by fuzzy comprehensive evaluation (FCE).

3.1 Determination of the evaluation index and weights

Based on the domestic and overseas researches on public goods index system, with the help of experts' opinions, and in line with scientific, oriented, common, representative, specific and feasible principle, the efficiency of public goods provision in Wenchuan earthquake-stricken rural areas is designed in the idea of combining overall goal-classifications and specific indicators.

Efficiency evaluation classifications are composed of infrastructure and environmental construction, agricultural production services, social administration, medical & health services, social security, public education and cultural & sports services. The seven classifications and a total of 36 specific indicators are as follows (Table I). The specific indicators contain both the general character of public goods

The index system and weights (U)		
Classifications	Specific indicators	Weights
Infrastructure and environmental construction (U_1) (0.2169)	Construction of rural roads (U_{11})	0.2458
	Construction of water, electricity, gas, telecommunications, Internet (U_{12})	0.3646
	Garbage and sewage treatment (U_{13})	0.1593
	Rural passenger transport (U_{14})	0.0582
	Rural postal (U_{15})	0.0492
	Landscaping in the village (U_{16})	0.1228
Agricultural production services (U_2) (0.1128)	Rural poverty alleviation (U_{21})	0.3333
	Agricultural disaster prevention (U_{22})	0.3333
	Agricultural technology promotion and training (U_{23})	0.1111
	Agricultural material provision (U_{24})	0.1111
	Agricultural market information services (U_{25})	0.1111
Social administration (U_3) (0.1769)	Village police and legal aid (U_{31})	0.0752
	Rural social security (U_{32})	0.1635
	Natural disaster rescue (U_{33})	0.4652
	Villagers affairs agency (U_{34})	0.0963
	Mediation service (U_{35})	0.1998
Medical & health services (U_4) (0.1492)	Basic medical insurance (U_{41})	0.3889
	Basic medical services (U_{42})	0.3889
	medical assistance (U_{43})	0.0687
	Health epidemic prevention, maternity and child care (U_{44})	0.1535
Social security (U_5) (0.1893)	Social old-age insurance (U_{51})	0.0611
	Rural minimum living security (U_{52})	0.0499
	Disaster affected people assistance (U_{53})	0.2505
	Disability services (U_{54})	0.1882
	Aging services (U_{55})	0.0631
	Employment services (U_{56})	0.0761
	Housing security (U_{57})	0.3111
Public education (U_6) (0.1124)	Educational infrastructure (U_{61})	0.2445
	Preschool education (U_{62})	0.1360
	Nine-year compulsory education (U_{63})	0.5430
	Villagers training and education (U_{64})	0.0765
Cultural & sports services (U_7) (0.0424)	Radio and television coverage (U_{71})	0.4566
	Rural film show (U_{72})	0.0743
	Rural newspapers and books service (U_{73})	0.2450
	Art performances and exhibitions (U_{74})	0.1339
	Farmer fitness services (U_{75})	0.0903

Table I.
The index system and weights of the efficiency of the post-quake rural public goods provision

efficiency evaluation index, and the specific character of the post-quake reconstruction, and involve the most urgent, concerned and demanded basic public goods in the post-quake rural areas.

The specific content of the efficiency evaluation index system of public goods provision in the Wenchuan earthquake rural areas meets the following basic public welfare standards (UNDP, 2008):

- the basic central role in human feasible capacity, self-esteem and dignity, such as compulsory education, social security and public health;
- the extensive role in meeting the public demand of the earthquake-stricken rural families and villagers;
- the basic urgent protection in solving the current survival, life and development; and
- the feasible role in adapting to the current policy and being implemented effectively in many rural areas.

Designing weights on indicators is an important step upon the assignment of efficiency evaluation index system. There are still some problems in the weight-designing of the index system. For instance, some evaluation index systems ignore the weights, while others take into account simple man-made weights, which ultimately affect the efficiency evaluation result. So this paper takes advantage of the AHP, which was developed by Thomas L. Saaty in the 1970s (Saaty, 1980), and has been extensively studied and refined since then (Vaidya and Kumar, 2006), to determine the weights of the efficiency evaluation index system of the public goods provision in the rural areas.

The efficiency evaluation index system forms a disjoint hierarchy which determines the affiliation between the upper and lower factors. By applying AHP, the weights are given from the judgment matrix A by experts' pairwise comparisons. The relative importance of the two factors is set as 1, 3, 5, 7, 9 and their reciprocal as the scale. The comparative scale a_{ij} expresses the relative importance of the i-th factor in next layer compared with the j-th factor in previous layer as a comparison criterion. The judgment matrix $A = (a_{ij})$ is composed of a_{ij}. So the scale of the relative importance can be calculated by the judgment matrix A, and the ranking value that is the lowest layer factors relative to the highest layer conclude the hierarchy sort through the consistency examination (Li, 2007).

Taking the judgment matrix of the infrastructure and environmental construction, for example, which include six specific indicators. The judgment matrix A_1 is as follows:

$$A_1 = \begin{pmatrix} 1 & 1 & 1 & 3 & 5 & 3 \\ 1 & 1 & 3 & 5 & 7 & 5 \\ 1 & 1/3 & 1 & 3 & 3 & 1 \\ 1/3 & 1/5 & 1/3 & 1 & 1 & 1/3 \\ 1/5 & 1/7 & 1/3 & 1 & 1 & 1/3 \\ 1/3 & 1/5 & 1 & 3 & 3 & 1 \end{pmatrix}$$

So the weights can be obtained by calculation. Due to paper length, the detailed calculating process is skipped here. Thus, the index system and its weights of the efficiency of the post-quake rural public goods provision are gained (Table I).

3.2 Model of FCE

FCE, as a fuzzy mathematics-based method, can solve the fuzzy and uncertain problems. This paper introduces the satisfaction theory and puts forward the concept of "villagers' satisfaction", which refers to the quake-stricken villagers' feeling in consuming public goods as compared with their expectation. From the microscopic angle, it is efficient only when the villagers are provided with needy and useful public goods, so the villagers' satisfaction can represent the efficiency of public goods provision in the rural areas. According to the FCE method (Du *et al.*, 2008), the steps of model construction are as follows.

3.2.1 Evaluated objects and sets. The sets of evaluated objects U = efficiency of public goods provision in the stricken villages, and the evaluated factor sets are as follows. The first-level evaluated sets are the U = $\{u_1, u_2, \ldots, u_7\}$ = {Infrastructure and environmental construction, agricultural production services, social administration, medical and health services, social security, public education, cultural and sports services}. The second-level evaluated sets are the $u_1 = \{u_{i1}, u_{i1}, \ldots, u_{ij}, \}, u_{ij}$, which means the j-th specific indicator of the i-th classification of the first-level evaluated sets U as follows.

u_1 = Infrastructure and environmental construction = {construction of rural roads, construction of water, electricity, gas, telecommunications, Internet, garbage and sewage treatment, rural passenger transport, rural postal, landscaping in the village}; u_2 = Agricultural production services = {rural poverty alleviation, agricultural disaster prevention, agricultural technology promotion and training, agricultural material provision, agricultural market information services}; u_3 = Social administration = {village police and legal aid, rural social security, natural disaster rescue, villagers affairs agency, mediation service}; u_4 = Medical & health services = {basic medical insurance, basic medical services, medical assistance, health epidemic prevention, maternity and child care}; u_5 = Social security = {social old-age insurance, rural minimum living security, disaster affected people assistance, disability services, aging services, employment services, housing security}; u_6 = Public education = {educational infrastructure, preschool education, nine-year compulsory education, villagers training and education}; u_7 = Cultural & sports services = {radio and television coverage, rural film show, rural newspapers and books service, art performances and exhibitions, farmer fitness services}.

The evaluated sets of efficiency of rural public goods provision are thus determined. $V = \{v_1, v2, \ldots, v5\}$ = {very satisfied, satisfied, general, dissatisfied, very dissatisfied}. According to the evaluation rank of the classifications of the object U, a judgment matrix R is established:

$$R = \begin{pmatrix} R_1 \\ R_2 \\ \vdots \\ R_7 \end{pmatrix} = (r_{ij})7 \times 5 = \begin{pmatrix} r_{11} & r_{12} & \cdots & r_{15} \\ r_{21} & r_{22} & \cdots & r_{25} \\ \vdots & \vdots & \ddots & \vdots \\ r_7 & r_{72} & \cdots & r_{75} \end{pmatrix}$$

The r_{ij} of the judgment matrix is membership function of any classification u_i corresponding to any rank v_j, ($i = 1, 2, \ldots, 7; j = 1, 2, \ldots, 5$), the values of which are generally calculated to meet the $\Sigma r_{ij} = 1$ through the normalization. So the matrix R is not dimensionless, not necessary for specialized treatment.

Similarly, for the secondary evaluated objects u_i, a corresponding judgment matrix can also be established. In the matrix R_i, m is the number of the specific indicators about the secondary evaluated object U_i, $(i = 1, 2, \ldots, 7)$.

$$R_i = \begin{pmatrix} R_{i1} \\ R_{i2} \\ \vdots \\ R_{im} \end{pmatrix} = \begin{pmatrix} r_{i11} & r_{i12} & \ldots & r_{i15} \\ r_{i21} & r_{i22} & \ldots & r_{i25} \\ \vdots & \vdots & \ddots & \vdots \\ r_{im1} & r_{im2} & \ldots & r_{im5} \end{pmatrix}$$

3.2.2 Fuzzy operation. It is necessary to consider that every evaluated factor has different status and role for the evaluated objects U and U_i, which means the weights of evaluated factors occupy a different proportion of the comprehensive evaluation. So the fuzzy subsets, in the name of A and A_i, should be introduced to the evaluated objects U and U_i, which stand for the weights of every evaluated factors, $A = (a1, a2, \ldots, a7)$, $Ai = (ai1, ai2, \ldots, aim)$ where $ai > 0$, $aim > 0$, $(i = 1, 2, \ldots, 7)$, and $\Sigma a_i = 1$, $\Sigma a_{im} = 1$.

The row of the judgment matrix R or R_i reflects the degree of membership in the evaluated rank of a single factor in a different evaluated object. So the degree of ranked membership of the evaluated objects can be comprehensively operated by synthesizing the different rows and its weights. It forms the result vector of FCE, $B = (b1, b2, \ldots, b5)$. The vector can be calculated by the matrix A and R ("$\circ$" is the symbol of the operator).

$$B = A \circ R = (a_1, a_2, \cdots, a_7) \circ \begin{pmatrix} r_{11} & r_{12} & \ldots & r_{15} \\ r_{21} & r_{22} & \ldots & r_{25} \\ \vdots & \vdots & \ddots & \vdots \\ r_{71} & r_{72} & \ldots & r_{75} \end{pmatrix}$$

Similarly, $Bi = Ai \times Ri$. It will obtain the final evaluation about $B = (b1, b2, \ldots, b5)$ and $Bi = (bi1, bi2, \ldots, bi5)$ to meet $b'j = bj / \Sigma_{j=1}^{5}(bj)$, which represents the degree of the ranked evaluation about the object, through the normalization. B and Bi, usually processed by the maximum membership degree rule, describe the degree of hierarchical evaluation object status.

4. Empirical analysis

In August and September 2012, the research group of the post-quake rural public goods provision visited 24 villages in Wenchuan earthquake-stricken rural areas for the field survey which uses random sampling method according to different income levels. The survey issued 500 questionnaires to the villagers and collected 485 effective samples, an effective rate of 97 per cent. According the survey principles, the population was primarily selected based on information provider who is the family head and title. As the anonymity of the respondents needs to be protected, all the place names and respondent names in this paper are presented without relevant information.

This paper analyzes the results of the field survey from two sections. The first section of analysis is based on maximum membership principle which means A is a fuzzy subset in the given evaluated field U and can define a function $\mu A_{(x)} = [0, 1]$, which stands for indicating the degree of x belonging to A for any element $X \in U$. Specifically speaking, the maximum value of the elements v_j in the set of evaluated result

$V = \{v1, v2, \ldots, v5\}$ is the final evaluation. The second section of analysis is based on satisfaction. In this paper, the final evaluation of the collection V_1 (very satisfied) and V_2 (satisfied) is classified as "satisfied", and the collection V_3 (general), V_4 (dissatisfied) and V_5 (very dissatisfied) is classified as "dissatisfied", all of which are the reference system of the level of satisfaction. To make full use of the evaluation information, the parameter column vector of "very satisfied, satisfied, general, dissatisfied, very dissatisfied" is respectively assumed as the "5, 4, 3,2, 1". So the score "3.5" is the middle level in according range between satisfaction and dissatisfaction with the definition of "satisfaction"[3]. The statistics of this survey are as follows (Table II).

	Satisfaction evaluation grade membership				
Specific indicators	Very satisfied	Satisfied	General	Dissatisfied	Very dissatisfied
U_{11}	0.049	0.357	0.388	0.177	0.029
U_{12}	0.031	0.237	0.468	0.243	0.021
U_{13}	0.041	0.184	0.336	0.359	0.080
U_{14}	0.043	0.216	0.464	0.245	0.031
U_{15}	0.025	0.241	0.454	0.256	0.025
U_{16}	0.056	0.221	0.447	0.252	0.025
U_{21}	0.016	0.254	0.503	0.202	0.025
U_{22}	0.021	0.186	0.534	0.241	0.019
U_{23}	0.029	0.148	0.460	0.338	0.025
U_{24}	0.016	0.165	0.487	0.320	0.012
U_{25}	0.016	0.146	0.511	0.285	0.041
U_{31}	0.029	0.204	0.394	0.320	0.054
U_{32}	0.027	0.171	0.482	0.274	0.045
U_{33}	0.041	0.254	0.468	0.219	0.019
U_{34}	0.021	0.212	0.466	0.278	0.023
U_{35}	0.037	0.219	0.499	0.212	0.033
U_{41}	0.080	0.449	0.390	0.078	0.002
U_{42}	0.060	0.309	0.460	0.161	0.010
U_{43}	0.045	0.243	0.495	0.198	0.019
U_{44}	0.023	0.258	0.522	0.181	0.016
U_{51}	0.066	0.404	0.416	0.097	0.016
U_{52}	0.035	0.260	0.495	0.194	0.016
U_{53}	0.037	0.249	0.474	0.216	0.023
U_{54}	0.031	0.219	0.513	0.212	0.025
U_{55}	0.021	0.212	0.501	0.237	0.029
U_{56}	0.025	0.134	0.462	0.342	0.037
U_{57}	0.025	0.142	0.447	0.328	0.058
U_{61}	0.037	0.348	0.449	0.148	0.016
U_{62}	0.047	0.287	0.462	0.184	0.021
U_{63}	0.080	0.421	0.340	0.142	0.016
U_{64}	0.037	0.146	0.406	0.363	0.047
U_{71}	0.043	0.357	0.441	0.144	0.014
U_{72}	0.033	0.225	0.458	0.247	0.037
U_{73}	0.023	0.130	0.361	0.421	0.066
U_{74}	0.023	0.111	0.336	0.474	0.056
U_{75}	0.014	0.109	0.313	0.493	0.070

Table II.
Questionnaire statistical results

Following the FCE method and steps, it can be deduced as follows:

$$B1 = A1 \circ R1$$

$$= (0.2458, 0.3646, 0.1593, 0.0582, 0.0492) \circ \begin{pmatrix} 0.049 & 0.357 & 0.388 & 0.177 & 0.029 \\ 0.031 & 0.237 & 0.468 & 0.243 & 0.021 \\ 0.041 & 0.184 & 0.336 & 0.359 & 0.08 \\ 0.043 & 0.216 & 0.464 & 0.245 & 0.031 \\ 0.025 & 0.241 & 0.454 & 0.256 & 0.025 \\ 0.056 & 0.221 & 0.447 & 0.252 & 0.025 \end{pmatrix}$$

$$= (0.0404875, 0.2550392, 0.4237612, 0.2470929, 0.033633)$$

Similarly, the result can be obtained:

$$B_2 = (0.0191092, 0.1976469, 0.5076159, 0.2524192, 0.023331)$$
$$B_3 = (0.0350834, 0.2256319, 0.4707254, 0.2398708, 0.0290654)$$
$$B_4 = (0.061068, 0.3510833, 0.4446985, 0.1343332, 0.0084281)$$
$$B_5 = (0.0318869, 0.2089995, 0.4712347, 0.2526354, 0.0349319)$$
$$B_6 = (0.061709, 0.36389, 0.3882915, 0.1660855, 0.0190515)$$
$$B_7 = (0.0320646, 0.2362793, 0.3970893, 0.295234, 0.0391309)$$

So these results, in three decimal places and normalized, can be obtained by using the formula: $B = A \circ \mathrm{R}$.:

$$B = A \circ R$$

$$= (0.2169, 0.1128, 0.1769, 0.1492, 0.1893, 0.1124, 0.0424) \circ \begin{pmatrix} 0.04 & 0.255 & 0.424 & 0.247 & 0.034 \\ 0.019 & 0.198 & 0.508 & 0.252 & 0.023 \\ 0.035 & 0.226 & 0.471 & 0.24 & 0.029 \\ 0.061 & 0.351 & 0.445 & 0.134 & 0.008 \\ 0.032 & 0.209 & 0.471 & 0.252 & 0.035 \\ 0.062 & 0.364 & 0.388 & 0.166 & 0.019 \\ 0.032 & 0.236 & 0.397 & 0.295 & 0.039 \end{pmatrix}$$

$$= (0.0404951, 0.2604762, 0.4485862, 0.2233187, 0.0267074)$$

Based on maximum membership principle, the calculation results in the fact that the evaluation membership of efficiency in the post-quake rural public goods provision are 0.0404951, 0.2604762, 0.4485862, 0.2233187 and 0.0267074, responding to the evaluation rank standard of "very satisfied, satisfied, general, dissatisfied, very dissatisfied". So the efficiency is 0.4485862, a "general" level. The overall comprehensive score of rural public goods is 3.0634837, a level lower than 3.5. In percentage, villagers' overall evaluation of public goods in rural areas is: very satisfied, accounting 4.04951 per cent; and satisfied, accounting 26.04762 per cent, which makes 30.09713 per cent as the degree of the satisfaction. As a whole, the efficiency of the post-quake public goods provision by means of villagers' evaluation is at a lower degree. The results of the evaluation of various classifications are as follows (Table III).

5. Conclusion

This paper, based on the AHP and FCE, has mapped the efficiency of public goods provision in Wenchuan earthquake-stricken rural areas by means of villagers' satisfaction, which varies with the individual differences by their own cognition. The result of the evaluation shows that the comprehensive grade of the public goods provision in the rural areas does not reach a relatively high degree corresponding with national reconstruction.

Especially, the comprehensive scores of infrastructure and environmental construction, agricultural production services, social administration, social security, cultural & sports services are all at a lower level. Combining the weights and statistics of the indicators, it can be found that the main influencing factors are water, electricity, gas, telecommunications, Internet construction, agricultural disaster prevention and housing security. As for the medical & health services, and public education, the efficiency is a little better but still at a lower degree. It could be found that this kind of provision of rural public goods has formed institutionalized model at the national level before the Wenchuan earthquake, so the efficiency is influenced by the policy sustainability. In the survey, the villagers generally reflect relative satisfaction with the two items due to the fact that many schools and hospitals were built in the reconstruction. From the specific evaluation of satisfaction, in some field of government-conducting provision for rural public goods, villagers' satisfaction is high, such as compulsory education, radio and television services. Relatively, in some field which is suitable for village-level grassroots organizations to provide, such as rural waste disposal, rural social security, villagers' satisfaction is low. How to enhance the service function of village-level grassroots organizations to improve efficiency is currently a major problem.

From the analysis, we can infer that the reconstruction in Wenchuan earthquake-stricken areas is to be a long-term project and that the three-year or short-term reconstruction has just solved some temporary issues. Although the reconstruction has completed some high-quality infrastructure, schools, hospitals and houses, all of which are urgently needed in the quake-stricken areas, we still face more macroscopic and long-term problems of recovering and sustaining the post-quake communities, for example, in the fields of social work, mental health, economical management and ecological restoration. Therefore, it is necessary to classify the rural public goods provision, devote greater effort to meet the most urgent, concerned, basic public goods demand in the post-quake rural areas, avoiding the cask effect. A rational expression mechanism needs to be established to

Table III.
The results of the evaluation

Classifications	Membership level	Comprehensive score
Infrastructure and environmental construction	General (0.4237612)	3.0216967
Agricultural production services	General (0.5076159)	2.9371507
Social administration	General (0.4707254)	2.9989278
Medical and health services	General (0.4446985)	3.3208632
Social security	General (0.4712347)	2.9493393
Public education	General (0.3882915)	3.280202
Cultural and sports services	General (0.3970893)	2.926307
Whole evaluated result	General (0.4485862)	3.0634837

strengthen the villagers' demand expression, through the villagers meeting, satisfaction surveys and other methods to encourage the active participation, brewing multi-centric decision mechanism, both top-down and bottom-up process. Village self-governance should play an important role in the reconstruction process, determining the basic public goods, how to provide them and what should be provided firstly in the earthquake-stricken rural areas.

It is a huge challenge how to implement post-earthquake reconstruction. Moreover, it is more worthy to consider how to improve its efficiency. The approach for the efficiency of public goods provision by means of villagers' satisfaction could contribute to the evaluation for the post-earthquake reconstruction with another perspective from disaster victims' real demand, rather than traditional outputs and outcome. Furthermore, the research findings could reflect the current provision situation under present reconstruction policy, helping the government to improve the efficiency of rural public goods provision, as well as referenced information for policy-making of post-disaster reconstruction in the future.

Notes

1. According to the Wenchuan earthquake restoration and reconstruction master plan by the State Council in 2008, the disaster caused US$6.4 billion of agricultural direct economic losses, approximately 34,125 kilometers of highway, 1,263 reservoirs, 7,444 schools, 11,028 medical organizations were devastated and 107 million square meters rural resident houses were collapsed.
2. According to the Sichuan Provincial People's Government Work Report in 2012, the reconstruction solved the housing problem for more than 12 million people of over 5.4 million households, rebuilt 2,989 schools and 1,359 health or rehabilitation institutions, relocated 200,000 farmers, provided safe drinking water for 6.22 million people, ensured 1,449 people living allowances who became orphans, childless or disabled in the earthquake, provided medical rehabilitation for 27,000 people who were wounded and disabled in the earthquake, provided timely assistance to those in need, helped 3,194 families who lost their children in the earthquake to restart a family, completed reconstructing 95.6 per cent of the 4,847 kilometers national or provincial highways, a total of 29,028 kilometers rural roads.
3. A score higher than "3.5" indicates higher efficiency, and a score lower than "3.5" indicates lower efficiency in public goods provision in the post-quake rural areas.

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