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# Determinants of villagers' satisfaction with post-disaster reconstruction: Evidence from surveys ten years after the Wenchuan earthquake

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Residents' satisfaction with post-disaster reconstruction in earthquake-stricken areas directly affects their quality of life, which cannot be ignored in post-disaster reconstruction. More than 10 years after the Wenchuan earthquake, we took ten randomly selected villages in the five areas hardest-hit by the Wenchuan earthquake as research objects and obtained 483 valid completed questionnaires. The villagers were randomly sampled and descriptive statistical analysis, factor analysis, and ordered logistic regression were used to explore the factors and relationships influencing villagers' satisfaction with post-disaster reconstruction in Wenchuan earthquake-stricken areas. The results show that: 1) the more rural residents know about the post-disaster reconstruction, the greater their level of satisfaction; 2) the more the annual income of families increases after resettlement, the greater the satisfaction of rural residents with the post-disaster reconstruction; 3) six public factors, namely the village committee acts as, housing construction quality, public service, policy of benefiting farmers, cultural environment, and hardware environment, all significantly positively affect residents' overall satisfaction with post-earthquake reconstruction. This study thus enriches the theory of residents' satisfaction studies and the practice of post-earthquake reconstruction.

## KEYWORDS

earthquake-stricken area, post-disaster reconstruction, satisfaction analysis, factorial analysis, ordered logistic regression

## 1 Introduction

Since the 20th century, there have been nearly a thousand earthquakes of magnitude 6 or above in China, and their seismic activities have been characterized by high frequency, high intensity, and wide distribution (Xie and Zhang, 2005; Ao et al., 2021). Among them, the Wenchuan earthquake occurred in the Longmenshan

seismic belt, and was in the northeast–southwest direction, and there were six earthquakes of magnitude six or above, and the largest earthquake was the Wenchuan earthquake of magnitude 8.0 in 2008 (Jiang, 2009). According to statistics, the Wenchuan earthquake was an unprecedented disaster, with the hardest-hit area exceeding 100,000 square kilometers, involving 6 cities and counties, 88 counties and cities, 1,204 towns and villages, and 27.92 million people. In Sichuan Province alone, more than four million houses collapsed or were damaged, and the infrastructure for water, electricity, and transportation suffered serious damage (China Government Affairs Monitoring Center, 2008).

Research into the damage caused by earthquakes to human production and life and the associated coping strategies has been a focus of scholars all over the world (Bryant, 1991). High-intensity earthquakes can destroy urban and rural construction in disaster-hit areas to varying degrees. To restore order to life in disaster areas as soon as possible and explore scientific and efficient modes of reconstruction, post-disaster reconstruction has become an important concern of experts around the world (Shi, et al., 2021). At the same time, there is also the issue of people's livelihoods that needs special attention in the post-disaster reconstruction of residential areas and when striving to improve rural residents' life satisfaction. To date, research into the post-disaster reconstruction of settlements has mostly focused on large cities, with less attention paid to people's satisfaction with the post-disaster reconstruction of settlements in rural areas (Li and Tian, 2015; Yang, 2017).

Satisfaction is an individual's subjective experience of his or her own quality of life, an individual's comprehensive cognitive judgment of life, which reflects an individual's general evaluation of their overall life and is influenced both by their own factors and environmental factors (Song et al., 2019). Individual differences among rural residents will lead to differences in their perceptions of a centralized living style in post-disaster reconstruction settlements, resulting in different degrees of acceptance and satisfaction with post-disaster reconstruction settlements (Peng et al., 2018a). Blakely pointed out that the post-disaster reconstruction of residential areas not only involves disaster prevention and emergency rescue considerations but also the re-planning and reconstruction of a region. The first priority is definitely the emergency planning when a disaster occurs, but more important is the functional allocation of the region, such as infrastructure, environmental planning, economic development planning, new residence resettlement, and so on (Hu, 2008). These living environment factors will affect rural residents' satisfaction with the post-disaster reconstruction of residential areas.

Most of the previous analyses conducted were from the perspective of the government. This study, on the other hand, analyzes post-disaster reconstruction settlements from the perspective of individual villagers and tries to understand rural residents' satisfaction with post-disaster reconstruction settlements in Sichuan Province. We established a system of

the factors influencing rural residents' satisfaction with post-earthquake reconstruction of residential settlements, based on existing research, and explored rural residents' overall satisfaction with post-disaster reconstruction settlements and the corresponding influencing factors and their relationships. The significant influencing factors were determined based on empirical studies, providing theoretical and practical support for post-disaster reconstruction practice.

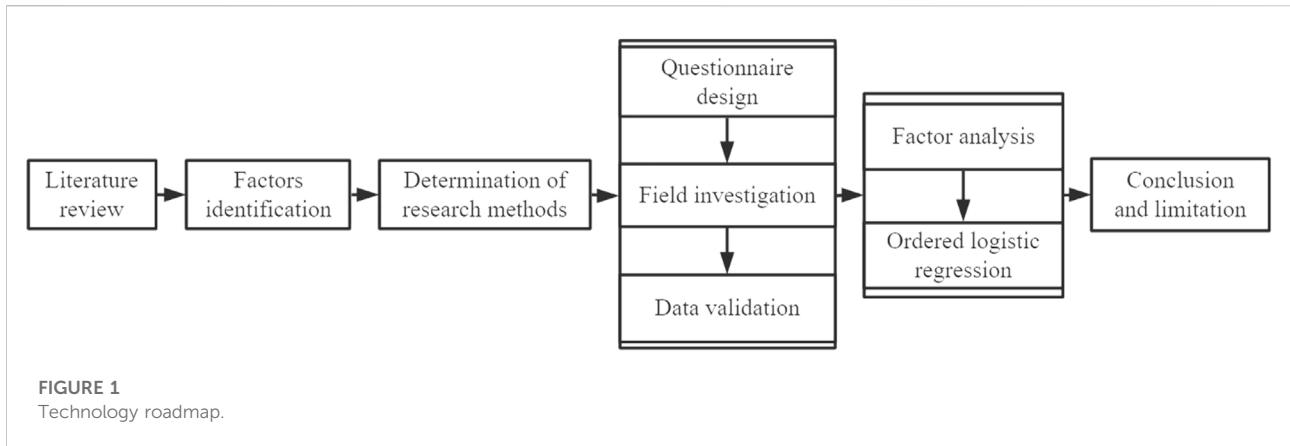
The structure of this paper is shown in Figure 1: Section 2 reviews the literature, Section 3 describes the research methods and data sources, Section 4 presents the empirical results and discusses the results, Section 5 summarizes the full text and proposes prospects for future research, and the final section presents the limitations of this study.

## 2 Literature review

China has adopted a variety of reconstruction policies for post-earthquake reconstruction in rural areas, including three main ways of overall construction, overall self-construction, and self-construction and maintenance (Peng, et al., 2013). Under the joint action of the family characteristics and production and management goals of rural residents, different types of farmers will be formed, and different types of farmers will have different positioning of maximizing the comprehensive benefits of the family, which will directly affect the decision-making behavior and mode selection of rural settlements post-disaster reconstruction (Steinberg, 2007).

Previous research into post-earthquake reconstruction has emphasized keeping pace with the times and combining corresponding development policies for reconstruction areas. For urban post-disaster reconstruction, Zhou and Xia (2008) suggested that post-earthquake reconstruction planning should follow the development strategy of "shaping an international tourist city", relocating urban functional departments and residents from severely damaged old cities to new areas, and relocating old urban areas to new areas, which should be transformed into economic development functional areas with cross-services of multiple industries. Yu et al. (2021) proposed that as rural social relations are complex, it is necessary to pay more attention to social connection and regional capacity building when planning post-earthquake reconstruction in rural areas and to maximize the flexibility of reconstruction strategies to form an adaptive mechanism for post-disaster recovery. When verifying the role and impact of participation in post-earthquake reconstruction, Wang (2018) believed that participatory post-disaster rural reconstruction could provide a basis for targeted poverty alleviation, rural revitalization, and urban and rural development.

Post-disaster reconstruction is a common behavior of social norms and government intervention. Guo and Fang (2019)



investigated rural residents' satisfaction with basic public services in rural areas. Their results showed that rural residents' satisfaction is influenced by gender, age, culture, income level, farmers' participation, and understanding of basic public services. Different individual and family characteristics of rural residents for post-disaster reconstruction residential satisfaction exist. Satisfaction with post-disaster reconstruction and resettlement shows a decreasing trend with increasing age. The higher the education level of rural residents, the greater their satisfaction with post-disaster reconstruction settlements (Yang, 2014). In addition, differences in income sources will have an impact on villagers' satisfaction. Sun and Chen (2016) investigated the factors influencing rural residents' satisfaction with resettlement in M Town, Jiangsu Province, and found that farmers with a larger proportion of non-agricultural income after resettlement in this area were less satisfied with this resettlement. The reason may be that for these farmers, the compensation of this resettlement is less attractive to them and their overall satisfaction is not high. Peng et al. (2018b) point out that the earthquakes cause serious damage to cultivated land, land consolidation and reclamation directly affected farmers' economic income, and the process of rebuilding residential areas was an important opportunity to improve economic development. The diversification of rural residents' incomes should be increased to make farmers' income no longer unitary.

In addition to the above-mentioned personal factors, satisfaction with the post-disaster reconstruction of residential areas is also affected by living environment factors (Song et al., 2019; Yang, et al., 2021). Jansen (2014) suggested that living satisfaction depends on personal expectations and that when housing does not meet the needs of residents, it will directly reduce their living satisfaction. Cao (2016) analyzed satisfaction with the living environment, with categories including housing orientation, supporting facilities, housing quality, and neighborhood relationships. Aulia and Ismail, 2013 further categorized the external influencing factors into the natural environment, equipment conditions, property services, and

traffic conditions, to analyze the factors influencing living satisfaction.

The actions of village committees or communities will have an impact on villagers' satisfaction with reconstruction. In a study of new rural construction, Hu (2016) put forward the notion that the working ability of grassroots village committee cadres and rural residents' awareness of rural construction policies will affect rural residents' satisfaction with village-level democratic system construction and cultural construction. In the process of resettlement housing allocation, Xiao et al. (2014) evaluated satisfaction with the residential areas rebuilt after an earthquake from the perspective of the affected residents and found that the disclosure of the information channel of the housing redistribution system in the rebuilt residential areas had a major influence on the resettled residents' satisfaction. Hu conducted a comparative study of the reconstruction of New Orleans in the United States and the reconstruction after the Wenchuan earthquake in China. He found that communication with local residents should be emphasized at the beginning of the reconstruction policy formulation process, and they should be invited to participate in the reconstruction process and have their opinions listened to, which is not only conducive to the application of the reconstruction policy but also helps to rebuild the confidence of local people (Hu, 2008). Paying attention to rural housing reconstruction for farmers is key to realizing sustainable recovery. The reconstruction policy has different decisions on the reconstruction of village houses damaged to varying degrees, while publicity about the reconstruction policy can clarify affected people's perceptions of post-disaster reconstruction (Peng et al., 2018b). Wang et al. (2012) pointed out that the dissemination of knowledge about earthquake disaster prevention is an important factor affecting residents' life satisfaction.

Housing construction is the top priority of post-earthquake reconstruction. According to the disaster reduction plan and regulations of the China Earthquake Administration (CEA) from 2007 to 2019, local rural housing construction planning should

be supervised in terms of site selection, avoidance of earthquake prone areas, and construction quality to ensure housing safety, and skilled technicians should be trained to master earthquake knowledge (Wu and Wu, 2020). Cassidy (2007) proposed that when a disaster occurs, the maximum duration of temporary shelter provided by the government should be 5 years, so that the construction period of post-earthquake reconstruction settlements should not exceed the maximum duration that victims can bear. At the same time, post-disaster reconstruction projects should have clear start and completion dates (Davidson et al., 2007).

Steinberg (2007) summarized the experience of post-disaster reconstruction in Aceh and Nias in Indonesia and pointed out that the construction of residential buildings as part of post-disaster reconstruction was only the first step of reconstruction; the construction of the surrounding environment and public facilities should also be a focus of post-disaster reconstruction. Transportation is very important in post-disaster reconstruction. If roads are blocked, much of the transport of reconstruction materials will be affected. Therefore, post-disaster reconstruction of traffic systems should be a basic and pilot project (Kun, 2013). At the same time, public facilities, such as water, electricity, and communication, should also be a focus of the reconstruction of post-disaster settlements, and factors such as whether the quality of drinking water, the convenience of water use, and power supply and communication meet the needs of residents can also affect their satisfaction with post-disaster reconstruction settlements (Curti et al., 2008).

The existing research shows that relevant policies that benefit farmers will also have an impact on villagers' satisfaction with reconstruction. Developing characteristic agriculture to diversify agriculture, developing agricultural training, and introducing non-agricultural industries will enable young laborers to engage in non-agricultural work, which will increase farmers' income. This will help to make up for the increased cost of living after the disaster, which will improve rural residents' satisfaction with the reconstruction of settlements following a disaster. In addition, as the land belongs to rural collectives, after many rounds of discussion by the village committee, even the land adjustment should not encounter any difficulties, which will help to reassure residents that problems of land reclamation or cultivated land demand can be solved following a disaster (Peng et al., 2013). At the same time, the human environment is also a key point that cannot be ignored. Earthquake disasters in Sichuan Province mostly occur in areas with superior natural conditions and profound cultural heritage. Post-earthquake reconstruction should pay attention not only to the protection of the natural environment but also to the reconstruction of national cultural traditions (Li and Shi, 2008).

Therefore, it is of great theoretical and practical significance to systematically explore residents' degree of satisfaction with post-disaster reconstruction to further improve residents' quality

of life and enhance public participation in post-disaster reconstruction.

## 3 Methodology

### 3.1 Questionnaire design

For this study a questionnaire was designed according to the existing related research and the current situation of post-earthquake reconstruction of residential areas. The questionnaire comprised two parts: social-demographic information and a post-disaster reconstruction satisfaction survey scale.

Basic personal information of respondents (shown in Table 1) and family information was collected (shown in Table 2).

The satisfaction scale measured respondents' satisfaction with 28 elements of post-disaster reconstruction and was coded with a five-point Likert scale, with the lowest level of satisfaction being 1 and the highest level of satisfaction being 5 (Yang et al., 2020c). Details of the post-disaster reconstruction satisfaction scale and its measurement instructions are shown in Table 3.

### 3.2 Model specification

Several types of models have been used to study people's satisfaction with the built environment, including multiple regression models (Yang et al., 2022; Xu, 2020), structural equation models (Song et al., 2019; Kostas, 2020; Wang et al., 2020; Seongyeon and Christine, 2009; Chen et al., 2014; Margareta et al., 2018), a CCSI model (Zhou and Wang, 2022), ordered logistic regression analysis (Mao, 2022; Junghwa et al., 2020), and a Bayesian multilevel ordinal response model (Zhai et al., 2021). However, there has been limited research into the factors influencing residents' satisfaction and their relationships in post-disaster reconstruction, which restricts the rationality of the formulation of post-disaster reconstruction policies. The dependent variable used in the present study was satisfaction, a categorical variable with differences in degrees. Therefore, factor analysis was mainly used to reduce the dimension of influencing factors (Ao, et al., 2020), and an ordered logistic regression model was used to analyze the relationship between influencing factors and the satisfaction with post-earthquake reconstruction. In logistic regression analysis, when the variable level is greater than two and it is an ordered variable, ordered logistic regression analysis can be used. As the dependent variable in this study was satisfaction, the options were completely dissatisfied, not very satisfied, generally satisfied, comparatively satisfied, and very satisfied, which were suitable

TABLE 1 Description of basic personal information of respondents.

Variable	Variable declaration	Variable type
Gender	1 = Male; 2 = Female	Categorical variable
Age	The corresponding numerical value is the corresponding age For example: 25 = 25 years old	Continuous variable
Education level	1 = Uneducated; 2 = Primary School; 3 = Junior High School; 4 = Senior High School; 5 = University or above	Categorical variable
Is the current place of residence the birthplace?	Yes = 1, No = 0	Binary variable
Participate in the reconstruction decision-making process?	Yes = 1, No = 0	Binary variable
Have you received education on disaster prevention and mitigation?	Yes = 1, No = 0	Binary variable
Have you experienced secondary disasters after the earthquake?	Yes = 1, No = 0	Binary variable
Understanding of post-disaster reconstruction management regulations	Very little understanding = 1, A little understanding = 2, General understanding = 3, Better understanding = 4, Very understanding = 5	Sequence variable
Understanding of seismic fortification level of buildings	Very little understanding = 1, A little understanding = 2, General understanding = 3, Better understanding = 4, Very understanding = 5	Sequence variable
Understanding of post-disaster reconstruction methods	Very little understanding = 1, A little understanding = 2, General understanding = 3, Better understanding = 4, Very understanding = 5	Sequence variable

TABLE 2 Description of respondents' family information.

Variable	Variable declaration	Variable type
Number of residential floors	1 = 1, 2 = 2, 3-6 = 3, Layer 7 and above = 4	Sequence variable
Was the rebuilt house completed on time?	Yes = 1, No = 0	Binary variable
Post-earthquake reconstruction	Overall construction = 1, overall self-construction = 0	Binary variable
Annual household income after earthquake	Ten thousand yuan	Continuous variable
Stability of main household income after resettlement	Unstable = 1, stable = 0	Binary variable
Changes of annual household income after resettlement	Significant increase = 1, some increase = 2, no change = 3, some decrease = 4, significant decrease = 5	Sequence variable
Main income sources of families before the earthquake	Farming/fruit and vegetable planting, poultry/aquaculture, farmhouse tourism, land circulation, working outside, and others	Categorical variable
Main source of family income after earthquake resettlement	Farming/fruit and vegetable planting, poultry/aquaculture, farmhouse tourism, land circulation, working outside, and others	Categorical variable

for ordered logistic regression analysis. The logistic regression model used in this study is expressed as follows:

$$\text{Ln} \left[ \frac{p(y \leq j)}{1 - p(y \leq j)} \right] = \alpha_j + \sum_{i=1}^n \beta_i x_i \quad (1)$$

where  $j = 1, 2, 3, 4,$  and  $5,$  representing the five levels of satisfaction;  $y$  is residents' satisfaction with reconstruction;  $x_i$  is the explanatory variable and control variable that affects farmers' life satisfaction;  $\alpha_j$  is the intercept parameter; and  $\beta_j$  is the regression coefficient, which indicates the direction and

degree of influence of explanatory variables on the explained variables.

### 3.3 Sample selection and data collection

According to the degree of the Wenchuan earthquake disaster, the population, economy, industry, and employment status, combined with the vigilance of rural residents and the degree of cooperation reflected, this study randomly selected

TABLE 3 Post-disaster reconstruction satisfaction survey scale variables.

Variable	References	Satisfaction		Variable type
		Minimum	Minimum	
F1	Subsidy guarantee Alparslan et al. (2008) <sup>4</sup> Morimoto (2012)	1	5	Sequence variable
F2	Information channel Xiao et al. (2014) Ye et al. (2017)	1	5	Sequence variable
F3	Education and publicity of disaster prevention and mitigation Wang et al. (2012) Zhou and Liao (2015) Li and Shi. (2008)	1	5	Sequence variable
F4	Reconstruction policy propaganda Peng et al. (2018b) Qu et al. (2012) Li and Shi. (2008)	1	5	Sequence variable
F5	Reconstruction decision-making participation Li and Shi (2008) Zhou and Liao (2015) Wang (2018)	1	5	Sequence variable
F6	Type of layout of apartment Cinicioglu et al. (2007) Feyza et al. (2007)	1	5	Sequence variable
F7	House safety Ergonul (2005); Wu and Wu (2020)	1	5	Sequence variable
F8	Quality of building materials Ergonul (2005); Wu and Wu (2020) Cinicioglu et al. (2007)	1	5	Sequence variable
F9	Technology of constructors Ergonul (2005); Cinicioglu et al. (2007); Wu and Wu (2020)	1	5	Sequence variable
F10	Reconstruction duration Ergonul (2005); Davidson et al. (2007)	1	5	Sequence variable
F11	Drinking water quality Curti et al. (2008)	1	5	Sequence variable
F12	Water convenience Curti et al. (2008)	1	5	Sequence variable
F13	Power supply demand Curti et al. (2008)	1	5	Sequence variable
F14	Communication requirements Curti et al. (2008)	1	5	Sequence variable
F15	Planting space around housing Li and Shi (2008)	1	5	Sequence variable
F16	Cultivated land distance Li and Shi (2008)	1	5	Sequence variable
F17	Land reclamation Ansal et al. (2009); Peng et al. (2013) Mahdi and AsgharAlesheikh (2011)	1	5	Sequence variable
F18	Agricultural training Ansal et al. (2009); Peng et al. (2013) Mahdi and AsgharAlesheikh (2011)	1	5	Sequence variable
F19	Agricultural diversification Ansal et al. (2009); Peng et al. (2013) Mahdi and AsgharAlesheikh (2011)	1	5	Sequence variable
F20	Non-agricultural industry introduction Ansal et al. (2009); Peng et al. (2013) Mahdi and AsgharAlesheikh (2011)	1	5	Sequence variable
F21	Talent education Speare (1974)	1	5	Sequence variable
F22	Policies and systems Li and Shi (2008)	1	5	Sequence variable
F23	Cultural tradition Speare (1974); Li and Shi (2008)	1	5	Sequence variable

(Continued on following page)

TABLE 3 (Continued) Post-disaster reconstruction satisfaction survey scale variables.

Variable	References	Satisfaction		Variable type
		Minimum	Minimum	
F24	Earthquake shelter #FF0000 Wen (2001)	1	5	Sequence variable
F25	Road planning Kun (2013) (Zhou et al., 2019)	1	5	Sequence variable
F26	Road quality Steinberg (2007); Kun (2013)	1	5	Sequence variable
F27	Sanitary environment/village appearance Inneke et al. (2013) MacAskill and Guthrie (2015)	1		Sequence variable
F28	Natural environment Curti et al. (2008); Li and Shi (2008)	1	5	Sequence variable

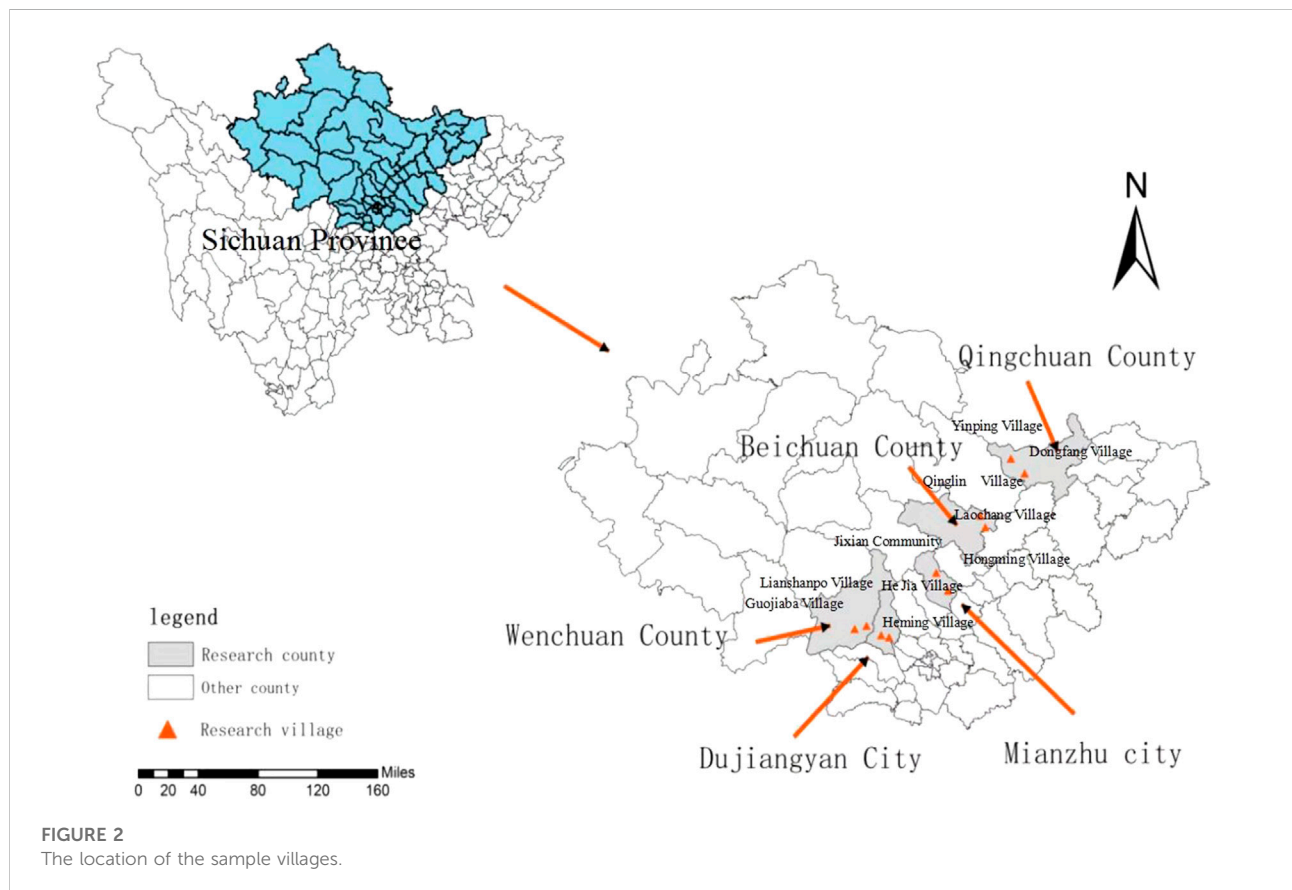


FIGURE 2  
The location of the sample villages.

10 sample villages in the 5 hardest-hit areas in Sichuan Province, with the geographical location of each village shown in Figure 2.

The field investigation part of this study was conducted from January 1 to January 5, 2019. The research team was divided into five groups, each of which was responsible for data collection in two sample villages. The research team entered the village and

randomly selected residents of the village to complete the questionnaire survey. If a resident did not accept the invitation to take part in the survey, the researchers randomly selected the next household. In this study, 516 face-to-face questionnaires were completed, of which 33 questionnaires with missing information or internal inconsistencies were



TABLE 4 Sample villages and the numbers of questionnaires collected.

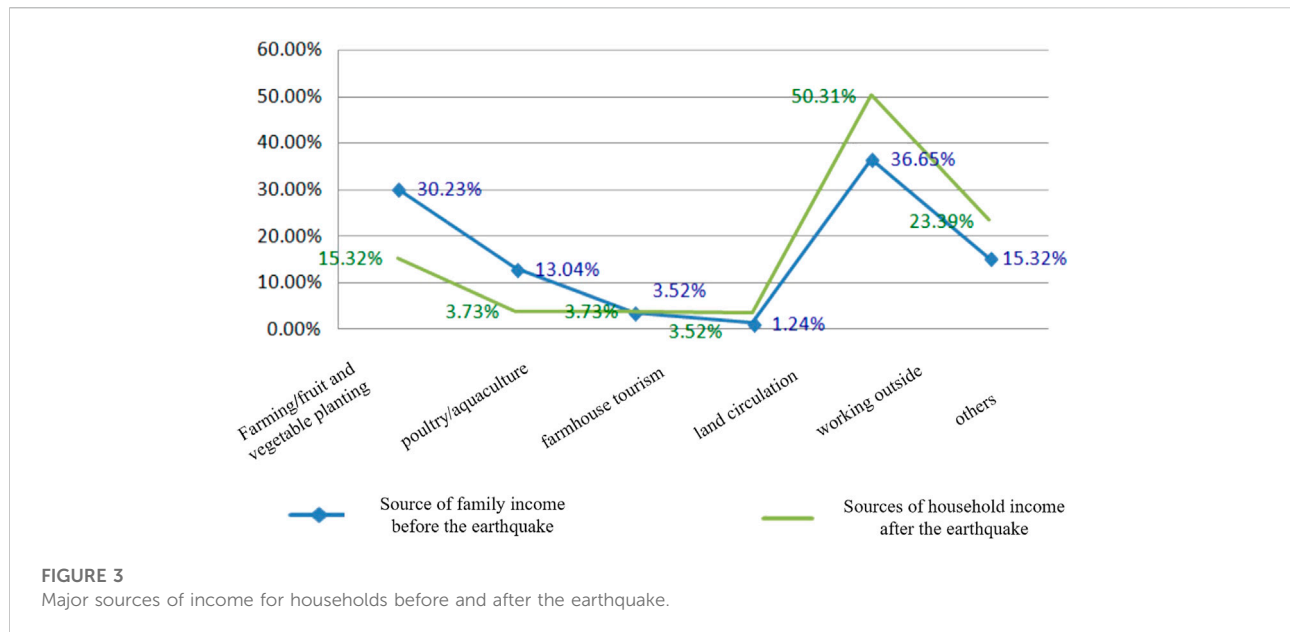
Investigation site		Degree of disaster	Reconstruction of settlement pattern	Number of questionnaires
Deyang city	Jixian Community, Hanwang Town, Mianzhu City	Severe disaster	Centralized residence	50
	Hongming Village, xinan town, Mianzhu City	Severe disaster	Decentralized residence	49
Dujiangyan city	Heming Village, LiujieTown	Severe disaster	Centralized residence	48
	He Jia Village, Anlong Town	Severe disaster	Decentralized residence	47
Guangyuan city	Dongfang Village, Qingxi Town, Qingchuan County	Severe disaster	Centralized residence	52
	Yinping Village, Qingxi Town, Qingchuan County	Severe disaster	Centralized residence	45
Aba Autonomous Prefecture	Guojiaba Village, Shuimo Town, Wenchuan County	Severe disaster	Centralized residence	49
	Lianshanpo Village, Shuimo Town, Wenchuan County	Severe disaster	Decentralized residence	42
Mianyang city	Laochang Village, Chenjiaba Town, Beichuan Qiang Autonomous County	Severe disaster	Centralized residence	51
	Qinglin Village, Chenjiaba Town, Beichuan Qiang Autonomous County	Severe disaster	Centralized residence	50

TABLE 5 Basic statistical information about respondents.

Variable	Variable declaration	Percentage (%)	Number of samples	Variable	Variable declaration	Percentage (%)	Number of samples
Gender	Male	45.25	219	Level of education	Without education	14.49	70
	Female	54.75	264		Primary school	30.85	149
Age	15–30 years old	16.56	80	Junior school	30.85	149	
	30–45 years old	21.33	103	Technical secondary school	4.97	24	
	45–60 years old	35.20	170	Senior high school	10.14	49	
	60–75 years old	22.57	109	Junior college	5.59	27	
	More than 75 years old	4.34	21	University or above	3.11	15	
	Number of residential floors	1	36.44	176	Sources of family income before the earthquake	Farming/fruit and vegetable growing	30.23
2		48.45	234	Poultry/aquaculture		13.04	63
3–6		14.70	71	Farmhouse tourism		3.52	17
7 or more		0.41	2	Land circulation		1.24	6
Annual household income after earthquake	<10,000	22.57	109	Working outside	36.65	177	
	10,000–50,000	62.32	301	Other	15.32	73	
	50,000–100,000	12.84	62	Sources of household income after the earthquake	Farming/fruit and vegetable growing	15.32	74
	>100,000	2.27	11		Poultry/aquaculture	3.73	18
Changes in annual household income after resettlement	Some increase	54.24	262	Farmhouse tourism	3.73	18	
	No change	34.37	166	Land circulation	3.52	17	
	Some decrease	9.32	45	Working outside	50.31	243	
	Significant decrease	2.07	10	Other	23.39	113	

excluded. In total, 483 valid questionnaires were included. Table 4 shows the sample villages and the number of questionnaires collected from each, while Table 5 presents the

basic statistical information about the respondents. The changes in the main sources of household income before and after the earthquake are shown in Figure 3.



## 4 Results and discussion

### 4.1 Exploratory factor analysis

In this study, SPSS software version 23.0 was used to conduct exploratory factor analysis (EFA) of 28 variables relating to post-disaster reconstruction satisfaction, to determine the influence of each factor on the overall satisfaction with post-disaster reconstruction. To test the applicability of the factor analysis, we used the Kaiser–Meyer–Olkin (KMO) test and Bartlett’s test to explore the applicability of factor analysis of the 28 satisfaction measurement variables. The test results showed that the KMO value was 0.882 and the  $p$ -value was 0.000. Thus, the results showed that there was a high correlation among the 28 satisfaction measurement variables, which indicated that these data were suitable for the EFA method. The factor analysis results of the 28 satisfaction indexes are shown in Table 6. Variables with a factor load of less than 0.4 were considered to be nonsignificant variables, so F15 was deleted (indicated by “–” in the Table). EFA finally determined six common factors.

### 4.2 Multiple collinearity analysis

The multiple collinearity problem may lead to a low level of significance of various spatial variables. Therefore, it is necessary to investigate the multiple collinearity of these independent variables (Ding, et al., 2017; Yang, et al., 2020a; Yang et al., 2020b; Zhao, et al., 2020; Yang, et al., 2022). To test multiple collinearity, we mainly used the variance inflation factor (VIF).

With a higher VIF value, a specific explanatory variable is more likely to be expressed by the linear function model of other explanatory variables, and there may be multiple collinearity problems in the model. The maximum VIF value of the explanatory variable in this study was 2.094, which showed that there was no multiple collinearity problem. The results of multivariate multiple collinearity tests are shown in Table 7.

### 4.3 Ordered logistic regression

In this study, ordered logistic regression was used to analyze the influence of the above factors on rural residents’ satisfaction with post-disaster reconstruction. Two models were fitted in this study. Model one contained all of the above variables, while model two was obtained by re-fitting after deleting nonsignificant variables from model 1. The results is models one and two are shown in Table 7. The  $-2\log$ -likelihood values are 1360.778 and 1178.072, respectively, while both of their Sig. values were 0.000, which means that model two fit the data better. Finally, model two was selected to interpret and analyze the data. Meanwhile, the Cox and Snell and Nagelkerke  $R^2$  values were 0.315 and 0.335, respectively, which means that the model fit the data well and had statistical significance.

#### 4.3.1 The influence of demographic variables on post-disaster reconstruction satisfaction

Villagers’ understanding of post-disaster reconstruction methods ( $B = 0.223, p = 0.012$ ) had a positive and significant influence on their overall level of satisfaction at a significance level of 5%; that is, the more fully rural residents understood reconstruction methods in

TABLE 6 Molecular results of exploratory factors.

Common factor	Variable	Load	
X1 The village committee acts as	F1	Subsidy guarantee	0.444
	F2	Information channel	0.594
	F3	Education and publicity about disaster prevention and mitigation	0.829
	F4	Reconstruction policy propaganda	0.835
	F5	Reconstruction decision-making participation	0.711
X2 Housing construction quality	F6	Type of layout of apartment	0.641
	F7	House safety	0.693
	F8	Quality of building materials	0.865
	F9	Technology of constructors	0.832
	F10	Reconstruction duration	0.538
X3 Public services	F11	Drinking water quality	0.798
	F12	Water convenience	0.871
	F13	Power supply demand	0.845
	F14	Communication requirements	0.742
--	F15	Planting space around housing	—
X4 Policy of benefiting farmers	F16	Cultivated land distance	0.629
	F17	Land reclamation	0.758
	F18	Agricultural training	0.779
	F19	Agricultural diversification	0.67
	F20	Non-agricultural industry introduction	0.507
X5 Cultural environment	F21	Talent education	0.527
	F22	Policies and systems	0.731
	F23	Cultural tradition	0.736
X6 Hardware environment	F24	Earthquake shelter	0.512
	F25	Road planning	0.846
	F26	Road quality	0.799
	F27	Sanitary environment/village appearance	0.456
	F28	Natural environment	0.469

residential areas, the higher their satisfaction level. Whether the residents had experienced a secondary earthquake disaster ( $B = -0.411$ ,  $p = 0.053$ ) was negatively correlated with their overall satisfaction at the 10% significance level, indicating that residents who had not experienced an earthquake disaster in the current reconstructed residential area had a high level of satisfaction with the reconstructed residential area. Indirectly explain the importance of reconstruction of residential areas in avoiding secondary earthquake disasters.

In addition, the change in annual household income before and after post-disaster reconstruction ( $B = -0.217$ ,  $p = 0.057$ ) had a negative correlation with overall satisfaction at a significance level of 10%. This option in the questionnaire of this study is designed as (significant increase = 1, some increase = 2, no change = 3, some decrease = 4, significant decrease = 5), that is, the annual household income after resettlement is higher. This is consistent with the findings of Shi et al. (2018) when they studied urban-rural migration and resettlement and found that increased income had a positive correlation with residents' life satisfaction.

#### 4.3.2 The influence of six common factors on satisfaction

The more satisfied the villagers in the post-disaster reconstruction area were with the village committee's actions

( $X1, B = 0.525$ ,  $p = 0.000$ ) during the post-earthquake resettlement process, the higher their level of satisfaction with the post-disaster reconstruction of residential areas. The implementation of government policies is directly related to the style and ability of village cadres, which shows that improving these cadres' sense of responsibility and their ability is an important part of improving rural residents' satisfaction with the post-disaster reconstruction of residential areas. Huang et al. (2020) believed that village cadres should improve their own skills, use information to improve the efficiency of rural community governance, and achieve the goal of rural governance informatization. The more stable a cadre's network is, the higher the rural residents' evaluation of village cadres will be.

The quality of housing construction ( $X2, B = 0.434$ ,  $p = 0.000$ ) significantly affected villagers' overall satisfaction with post-disaster reconstruction. The better the quality of housing construction in post-disaster reconstruction areas, the higher the overall satisfaction of villagers with the post-disaster reconstruction. This shows that good earthquake-resistance and the comfort of the house itself are an important factor that determines rural residents' satisfaction with the post-disaster reconstruction of residential areas. Xiao et al. (2014) found that in the built environment, the greater the degree of

TABLE 7 Ordered logistic regression results of villagers' satisfaction.

Variable	Model 1		Model 2		Collinearity test	
	B	p-value	B	p-value	Tolerance	VIF
Gender	-0.208	0.237	—	—	—	—
Age	-0.004	0.573	—	—	0.562	1.778
Education level	-0.004	0.959	—	—	0.554	1.804
Is the current place of residence the birthplace?	-0.255	0.195	—	—	0.952	1.050
Participate in the reconstruction decision-making process?	-0.035	0.846	—	—	0.887	1.128
Have you received education on disaster prevention and mitigation?	-0.081	0.658	—	—	0.870	1.150
Have you experienced secondary disasters after the earthquake?	-0.360	0.106	-0.411*	0.053	0.887	1.127
Understanding of post-disaster reconstruction management regulations	0.138	0.244	—	—	0.518	1.930
Understanding of seismic fortification level of buildings	-0.137	0.272	—	—	0.478	2.094
Understanding of post-disaster reconstruction methods	0.212*	0.051	0.223**	0.012	0.623	1.604
Was the rebuilt house completed on time?	-0.341	0.124	—	—	0.937	1.068
Post-disaster reconstruction mode of housing is overall construction	0.018	0.935	—	—	0.854	1.171
Annual income of families after resettlement	0.024	0.316	—	—	0.946	1.057
Family income stability after resettlement	-0.049	0.783	—	—	0.942	1.062
Changes in annual household income before and after resettlement	-0.226*	0.052	-0.217*	0.057	0.937	1.067
X1 The village committee acts as	0.548***	0.000	0.525***	0.000	0.979	1.021
X2 Housing construction quality	0.447***	0.000	0.434***	0.000	0.973	1.028
X3 Public services	0.365***	0.000	0.372***	0.000	0.955	1.047
X4 Preferential agricultural policy	0.393***	0.000	0.393***	0.000	0.950	1.052
X5 Cultural environment	0.595***	0.000	0.594***	0.000	0.950	1.053
X6 Hardware environment	0.649***	0.000	0.637***	0.000	0.982	1.018

\*, \*\*, \*\*\* represent significance levels of 10%, 5%, and 1%, respectively.

completion of residential reconstruction and the shorter the construction period, the more satisfied disaster-affected people are with the post-disaster reconstruction. Therefore, the quality and efficiency of housing construction in a post-disaster reconstruction area play an important role in improving villagers' satisfaction with post-disaster reconstruction.

The public services in the post-disaster reconstruction area (X3,  $B = 0.372$ ,  $p = 0.000$ ) had a significant positive correlation with the villagers' overall satisfaction with post-disaster reconstruction, which showed that rural residents pay attention to the level of public services at resettlement sites. The higher the level of public services, the higher the rural residents' satisfaction with the post-disaster reconstruction settlements (Wang and Li, 2019). In a study of rural medical and health services, Wang and Li (2019) found that rural residents with better self-rated health status were more satisfied with public health services and that the higher the satisfaction of rural residents with medical and health services, the higher their life satisfaction. Therefore, in the process of post-disaster reconstruction, not only should the construction work be done well but also the role of public services should not be ignored.

Preferential agricultural policies (X4,  $B = 0.393$ ,  $p = 0.000$ ) had a significant positive impact on villagers' overall satisfaction with the post-disaster reconstruction area, indicating that the greater the implementation of preferential agricultural policies, the higher the villagers' overall satisfaction with post-disaster reconstruction settlements. This is consistent with the view of Tian and Zhao (2010), that the intensity of implementation of agricultural benefit policies and the two exemption and one subsidy policies can have a great and positive impact on farmers' life satisfaction.

The higher the level of satisfaction of residents with the construction of the human environment (X5,  $B = 0.594$ ,  $p = 0.000$ ) in the post-earthquake reconstruction area, the higher the overall satisfaction of villagers with the post-earthquake reconstruction residential area. This showed that improving rural residents' satisfaction from the perspective of rural policy environment, rural talent environment, and rural cultural environment will be conducive to improving rural residents' satisfaction with post-disaster reconstruction settlements. Ye (2015) suggested that there are many problems in the construction of the rural cultural environment, which reduce the happiness of rural residents to varying degrees. They proposed that corresponding policies should be formulated for

different problems, to improve the life satisfaction of rural residents (Ye, 2015), which is consistent with the conclusion of this study.

The higher the villagers' recognition in the construction of hardware environment ( $X_6$ ,  $B = 0.637$ ,  $p = 0.000$ ), the higher the villagers' overall satisfaction with the post-disaster reconstruction, and the greatest influence of hardware facilities construction in the post-disaster reconstruction area. This shows that the construction of infrastructure for post-disaster reconstruction settlements is the most important content that affects rural residents' satisfaction with these settlements. Routes for rapid evacuation and earthquake shelters are basic requirements necessary to improve the level of seismic resilience in the new era. The timeliness of evacuation routes and the reliability of earthquake shelters during disasters will reduce casualties. Therefore, rational road planning and the safety and accessibility of earthquake shelters had a significant impact on rural residents' satisfaction with the rebuilding of settlements after a disaster, which is consistent with the conclusions of a study by Ma et al. (2021).

## 5 Conclusion

Rural residents' overall satisfaction with the post-disaster reconstruction of residential areas is influenced by many factors. Based on a literature search, combined with information about the current situation in ten post-disaster reconstruction settlements in Sichuan Province, this study summarized the factors that affect rural residents' overall satisfaction with post-disaster reconstruction settlements. In this questionnaire survey, 483 valid questionnaires were collected following face-to-face completion of the questionnaires by village residents. This research uncovered the following insights:

- 1) The more the villagers in earthquake-stricken areas know about post-disaster reconstruction methods, the greater their overall level of satisfaction with post-disaster reconstruction. Therefore, attention should be paid to improving rural residents' awareness of methods used to reconstruct residential areas and strengthening the publicity and education around post-disaster reconstruction methods.
- 2) Following earthquake disaster reconstruction, if annual household income increases to more than that before the reconstruction, the villagers in the disaster area will be more satisfied with the overall reconstruction. Therefore, we should pay attention to employment issues following reconstruction and increase the income of rural residents after a disaster.
- 3) Six public factors, such as the village committee acts as, housing construction quality, public service, policy of benefits for farmers, cultural environment, and hardware environment, all significantly positively affect residents' overall satisfaction with post-earthquake reconstruction. This study is of great importance for enriching the theory

of residents' satisfaction and the practice of post-earthquake reconstruction.

Through the post-earthquake reconstruction of Wenchuan residential satisfaction survey, this research has revealed the influence of rural residents for post-earthquake reconstruction overall satisfaction of the key factors of residential area, reveals the relationship between human activities and residents of the ecological environment. It also reveals the unreasonable planning in the construction of post-disaster reconstruction settlements from the perspective of rural residents, complements the theory development of post-disaster reconstruction settlement. More scientifically, this research describes the construction status and problems of post-disaster reconstruction settlements. This has practical significance for maintaining the spatial stability of post-disaster reconstruction settlements.

## 6 Limitations

Despite the innovative essence and significant findings of this research, this study does have some limitations, as elaborated below.

- 1) The variables collected were limited. Although this study combined the current situation in post-disaster reconstruction settlements and put forward a variety of factors based on existing research, the content cannot fully cover all aspects of rural residents' satisfaction with post-disaster reconstruction settlements. Therefore, there are limitations due to the variables collected in this study.
- 2) Data values are limited. When respondents are satisfied with each indicator, their understanding of the questions set in the questionnaire may have been biased due to their own educational level and mood at the time, so the data value has certain limitations. In future research, the formulation of the questionnaire should take this objective phenomenon into account, and the language should be as concise as possible, easy to understand, and avoid any redundancy.
- 3) The scope of the investigation also had limitations. This study selected rural residents from ten sample villages in Sichuan Province as the research objects, and the survey was conducted in the form of on-site household visits, so it was difficult to avoid contingency and regional distribution limitations. In future research, it will be necessary to increase the number of areas investigated to make the spatial distribution more representative.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

Ethical review and approval were not required for the study involving human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

## Author contributions

Conceptualization: YA, LH; data collection and analysis: LH, JZ, ZZ; writing the original draft: JZ, ZZ, TW, YW, YA; revising: TW, YC; resources: YA, TW; supervision: YA, TW, YC.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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