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Comparison study on two post-earthquake rehabilitation and reconstruction modes in China

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ABSTRACT

Two modes, reallocated reconstruction as well as in-situ reconstruction, are usually applied to post-earthquake reconstruction. This paper compares and analyzes the differences of the two modes empirically on the basis of the evaluations of the earthquake victims. Based on the framework outlined in the Tsunami Recovery Status Report issued by United Nations and the Overall Plan for Post-Wenchuan Earthquake Recovery and Reconstruction issued by China Academy of Urban Planning and Design, an evaluation indicator system is proposed, which consists of six categories of evaluation indicators, including livelihoods, urban housing, infrastructure, public services, eco-environment and spiritual homeland. The system is used to evaluate the degree of satisfaction with post-earthquake reconstruction from the perspective of measured residential satisfaction. This paper then presents the results of case analyses of two typical quake-hit regions in China's 2008 Sichuan earthquake, Wenchuan and Beichuan, which adopted reallocated reconstruction and in-situ reconstruction modes respectively for post-earthquake reconstruction. The analyses are conducted on the basis of survey data from 300 questionnaires and data from statistical yearbooks. The results show that (1) it is statistically significant that the reallocated reconstruction mode brings the higher total degree of satisfaction with post-earthquake reconstruction than the in-situ reconstruction does, and (2) the in-situ reconstruction mode only generates relatively better results than reallocated reconstruction does in terms of the spiritual homeland-related indicators, including neighbor relationship, communication with relative, family harmony, and health of families. The critical indicators affecting the total degree of satisfaction with post-earthquake reconstruction are identified as well, which are preservation and development of culture, governmental service and housing.

1. Introduction

Large earthquakes greater than 8.0 in magnitude have struck the Earth at a record high rate in the recent decade, such as the 2004 Indonesia earthquake, the 2008 Sichuan earthquake (also known as Wenchuan earthquake), the 2010 Haiti earthquake, and the 2011 great eastern Japanese earthquake. These strong earthquakes have caused enormous physical losses, destruction, casualties due to damages and psychological costs in terms of fear, anxiety or mental distress [1,2], which have highlighted the importance of post-earthquake reconstruction planning [3].

Based on geological conditions, damaged conditions and urban development, the post-earthquake reconstruction after the strong earthquake usually involves two modes: in-situ reconstruction and reallocated reconstruction. The in-situ reconstruction means the community or the village is rebuilt and the inhabitants are settled in their original location [4]. The reallocated reconstruction refers to relocating the inhabitants to the area less prone to earthquake and rebuilding the community or the village [5]. Each of them has some distinct merits. For instance, in-situ reconstruction needs little mobilization, no land acquisition, and would not result in too much social tension [4]. Reallocated reconstruction offers victims the opportunities of improving their livelihoods via better access to employment, environment and public services [6].

However, research on comparing the difference of post-earthquake reconstruction modes has not been investigated so far. The focus of this study is to examine and analyze the differences of reallocated reconstruction and in-situ reconstruction modes by empirical methods. This study demonstrates the results of the field investigation conducted in 2015 and 2016 (about 8 years after the 2008 Sichuan earthquake), and attempts to fill in the gap in the studies of natural hazards by investigating the long-term effects of different post-earthquake reconstruction modes. Particularly, this study examines the differences generated due to different post-earthquake reconstruction modes.

This paper is organized as follows. Section 2 reviews previous studies on different post-earthquake reconstruction modes. Section 3

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introduces the methodology adopted for comparison study, including evaluation indicators and data analysis methods. Sect.s 4–5 present the results and findings of case analysis in detail. Finally, Sect. 6 concludes the paper and suggests future research directions.

2. Literature review

Earthquakes are a natural force and it usually becomes destructive when a strong earthquake strikes and there is a human component in it, which aggravates or worsens the exposure to a hazard through bad planning, bad infrastructure and bad management of natural resources [7,8]. Therefore, selecting an appropriate post-earthquake reconstruction mode is of great value. It can offer an opportunity to rebuild damaged structures, reshape the fragile social and economic system, and finally improve earthquake resilience [9]. After the 2008 Sichuan earthquake, China adopted different post-earthquake reconstruction modes for different areas affected under a government-led aided reconstruction mechanism [10]. Dikmen [11] pointed out that choosing in-situ reconstruction or reallocated reconstruction was an important decision in the post-earthquake reconstruction process. In practice, the in-situ reconstruction mode was adopted more widely in the post-earthquake reconstruction process. Some researchers found that most native residents refused to relocate to the new settlement due to various reasons, including quick decisions, lack of residents participation in early decision-making period, inappropriate site-selection criteria, lack of interdisciplinary work during site-selection, few considerations on lifestyle of the residents, and lack of guidance to residents [11,12].

In the existing literature, the effects and performances of the reallocated reconstruction mode are mixed. As a uncommon post-earthquake reconstruction mode, reallocated reconstruction is usually adopted in the following conditions: (1) the original location is subject to natural hazards, (2) the original location is severely destroyed and rebuilding the structure in the original settlement is inconvenient for rapid recovery, (3) when the land for resettlement belongs to the government, and there is an opportunity relocating victims to the land [13]. However, resettlement often involves removing people from their previous environment which has gradually evolved due to centuries of adaptation, and involuntary resettlement may lead to a new man-made disaster. Therefore, many scholars suggested that the reallocated reconstruction must be avoided or minimized whenever possible [14]. Cernea [15] also pointed out that reallocated reconstruction could lead to significant negative effects on the affected residents due to the loss of shelter, land, and cultural assets. A viable livelihood made a major difference on whether resettled residents remained in new location or returned to the original location [16]. In general, previous living standards could not be met by reallocated reconstruction because the resettlement could lead to socio-economic changes and cause a decline in employment and income [5]. Moreover, the elderly resettled in the new location feel a certain social isolation and bad perception of their quality of life [17]. The women of resettlement felt more depression than that in the original location [18]. Conversely, some researchers pointed out that a better-managed resettlement could come into being satisfactory outcomes, such as new jobs, better health facilities and better access to education. For example, Shaw et al. [19] observed that the reallocated reconstruction could bring the increased educational resources, the improved infrastructure, the colorful cultural life, which could enhance community resilience and help to bond better within the community. Oliver-Smith [20] pointed out that site, layout, housing and popular input were the crucial issues for evaluating the success or failure of reallocated reconstruction, but it was also difficult to evaluate the success or failure of a resettlement project due to the mentality change of affected residents.

Referring to the natural disaster cycle management theory developed by Alexander [21], the post-earthquake reconstruction usually involves several phases: a relatively short emergency action and response phase, a short-term recovery and reconstruction phase (up to 3 years), and an post-earthquake economic development, risk reduction, mitigation and preparedness phase (up to 10 years). Wang et al. [22] pointed out that it was necessary to study the long-term effects of post-earthquake reconstruction. They examined the longitudinal changes of quality of life and psychological well-being through the community sample, and highlighted that undertaking comprehensive and prospective evaluations were very important. Abe and Shaw [12] observed different post-earthquake reconstruction performances at different time stages, who divided the 10 years process of resettlement into three stages, including carnival, conflict and renaissance. In carnival and renaissance stages, the evaluating of resettlement impact was positive, while it was negative in conflict stage. Their study suggested that the success or failure of post-earthquake reconstruction was related to the reconstruction phases. Dunford and Li [8] pointed out that the post-earthquake reconstruction was a long-term process probably requiring the development of up-to 10 years. Although some researches have studied the long-term post-earthquake reconstruction, no research has compared the long-term effects and differences of different post-earthquake reconstruction modes from the perspective of measured satisfaction of residents so far.

Different realities (e.g., social and economic status, government and community involvement and regional nationality culture characteristics) could have large effects on the post-earthquake reconstruction. It is well-known that the post-earthquake reconstruction in China has some distinct features, especially the government's abilities in motivation, organization and reconstruction [8]. In the literature investigating China post-earthquake reconstruction, a plenty of valuable studies have been done, such as meta-synthesis pattern of post-earthquake reconstruction [23], emergency medical rescue [24], resource needs for housing reconstruction [25], quality of life, physical diseases, and psychological impairment of survivors [26] and implication for the preparedness, mitigation, and management of post-earthquake reconstruction [27]. However, no research has investigated different post-earthquake reconstruction modes' effects by using China as a case. This paper aims to investigate the differences of reallocated reconstruction mode and in-situ reconstruction mode from the long-term (eight-year) effects' perspective by using the 2008 Sichuan earthquake in China as a case. Besides, the result of success or failure of post-earthquake reconstruction may be different according to different evaluation perspectives, such as economic perspective, environmental perspective and so on. Therefore, this paper does not evaluate the success or failure of post-earthquake reconstruction, but compares and analyzes the differences of two post-earthquake reconstruction modes empirically from the perspective of measured residential satisfaction.

3. Methodology

3.1. Evaluation indicators

To compare the difference of post-earthquake reconstruction modes, an effective evaluation indicator system should be defined. The United Nations outlined the general indicator groups, including shelter, infrastructure, finance, education, health, and livelihoods, and the indicators were designed to be utilized from a regional perspective [28]. However, these basic indicators are too general to be applied directly to post-earthquake reconstruction evaluation although they are used to guide the development of indicator categories. In the literature, some studies focused on the changes of livelihoods, such as agriculture and fisheries [16,28]. The indicator of participation of men and women in livelihood activities was used by Arnall et al. [16]. Ward et al. [28] classified the indicators into Recovery Indicators (RI) and Spatial Vulnerability Indicators (SVI). RI included health, education, churches, economy, municipal services and social activity. SVI mainly focused on facilities and infrastructure. Brown et al. [29] had classified the indicators into six categories: vulnerability, services, livelihoods, housing, infrastructure and environment. The Overall Plan for Post-Wench-