Article

The Impact of Earthquake on Poverty: Learning from the 12 May 2008 Wenchuan Earthquake

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Abstract: How to combine disaster prevention and mitigation, post-disaster reconstruction and poverty alleviation has become a new hot issue. On 12 May 2008, a major earthquake devastated the Wenchuan area in Sichuan Province in the heartland of China. After ten-years have passed, it is a good time to review what we learned from the Great Wenchuan earthquake. The impact of Wenchuan earthquake on poverty-stricken counties, poverty-stricken villages, and poverty-stricken households was analyzed. Suggestions for improving the method of combining disaster prevention, post-disaster reconstruction, and poverty alleviation were proposed. The results from this research could serve as an important reference for formulation of the poverty alleviation and development program after a major earthquake.

Keywords: Wenchuan earthquake; damage; disaster reconstruction; poverty alleviation

1. Introduction

1.1. Wenchuan Earthquake Disaster Situation

The 2008 Sichuan earthquake, also known as the Great Sichuan earthquake or Wenchuan earthquake occurred at 14:28:01 China Standard Time on 12 May 2008. Measuring at 8.0 Ms, the earthquake’s epicenter was located 80 km west-northwest of Chengdu, the provincial capital, with a focal depth of 19 km. The map of earthquake intensity published by the China Earthquake Administration (CEA) after surveying 500,000 km² of the affected area shows a maximum of XI on the China Seismic Intensity Scale (CSI) (Figure 1). Based on the final official assessment by the Chinese government, over 69,000 people lost their lives in the quake, 374,643 were reported injured, with 17,923 listed as missing by 21 November 2008. The earthquake left about 4.8 million people homeless [1,2]. It caused direct economic losses of 845.1 billion Yuan, of which Sichuan Province accounted for 91%, Gansu Province 6%, and Shaanxi Province accounted for 3% [3]. After ten-years have passed, it is a good time to review what we learned from the event. Table 1 lists the data used in this study.
counties of Sichuan, Gansu, and Shaanxi provinces increased by nearly 20,000 hectares more than that of before the earthquake. The damaged area of the ecosystem is more than 64,000 hectares [5]. The ecosystem self-adjustment capability and the environment carrying capacity have been seriously degraded. The Wenchuan earthquake-stricken area and the poverty-stricken areas are highly coincident. Among the severely affected counties, there are 43 key poverty alleviation counties, 20 revolutionary old districts, 10 ethnic minority counties, and 4834 poverty-stricken villages [6].

The number of poor people affected by the earthquake in Sichuan reached 2.1 million, and the poverty-stricken population due to the earthquake was nearly 3.7 million [7].

The objective of this study is two-fold: (1) to analyze the impact of Wenchuan Earthquake on poverty, and (2) to summarize and reflect the poverty alleviation model after the earthquake. These contributions may provide new insights into the disaster prevention and mitigation/disaster reconstruction and poverty alleviation in China.

Figure 1. Intensity and areas affected by the Wenchuan earthquake in the poverty counties.

Table 1. Datasets used in this study.

| Datasets                          | Sources                                      |
|-----------------------------------|----------------------------------------------|
| Earthquake epicenter and Seismic Intensity Scale | China Earthquake Administration              |
| Earthquake intensity             | National Disaster Reduction Center of the Ministry of Civil Affairs |
| Earthquake disaster data         | National Disaster Reduction Center of the Ministry of Civil Affairs |
| Distribution of poverty counties | Aid-the-Poor Development Office of the State Council |
| Socioeconomic statistics of earthquake-stricken areas | National Bureau of Statistics                |
| County population data           | National Bureau of Statistics                |
| Housing structural data          | The sixth national census of National Bureau of Statistics |
| Cultivated land type data        | Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences |

As a result of this earthquake a large number of people are now classed as “3-no personage”, citizens with no housing, no means of production, and no source of income. In addition, the earthquake also caused serious damages to the ecological environment. More than 13,000 hectares of cultivated
land was damaged by the disaster [4]. The area of soil erosion in the severely affected counties of Sichuan, Gansu, and Shaanxi provinces increased by nearly 20,000 hectares more than that of before the earthquake. The damaged area of the ecosystem is more than 64,000 hectares [5]. The ecosystem self-adjustment capability and the environment carrying capacity have been seriously degraded.

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1.2. Basic Situation of the Wenchuan Earthquake-Stricken Area

Most of the severely affected counties are in high plateau or mountainous areas. Most of them are also located in the high-risk areas of geological disasters such as earthquakes, landslides, and mudslides in China, as well as heavy rains, floods, and other meteorological and hydrological disasters. The annual losses caused by the disasters, combined with severe vegetation damage and soil erosion, make their ecological environment and life and production conditions even worse.

Most of the areas affected by the Wenchuan earthquake disaster are located in the western or southwestern part of China, with fragile infrastructure. In the extremely severe and severely affected counties of the three provinces (Sichuan, Gansu and Shaanxi provinces) before the earthquake disaster, there were 1056 villages without access, 187 villages without electricity, 3647 villages without running water, 371 villages without telephone, 2686 villages without broadcasting, and 1311 villages without television [8,9].

1.3. Poverty Situation before the Earthquake

Most of the areas affected by the earthquake disaster are located in the poverty-stricken areas in China (Figure 2). Among the 51 severe and medium affected counties, there are 43 poverty-stricken counties (accounting for 84% of the total). There are 1271 townships and 1565 administrative villages in the disaster areas, including 4834 poverty-stricken villages (accounting for 33% of the total), with a total population of 19.867 million, including 320,000 poor households and 2.183 million poor people (11% of the total) [10].

![Figure 2](image-url)

**Figure 2.** The poverty situation of very severely and severely affected counties in the Wenchuan earthquake.
1.4. Poverty Situation after the Earthquake

According to the Chinese government’s new poverty line standard [11] from a sample survey of severely affected counties, the poverty incidence in poor villages in 2007 was 34%, the poverty depth was 29%, and the poverty severity was 92% [12]. Based on the total population of 4834 poor villages, the number of poverty-stricken people is 1.46 million. Due to the assistance of the Chinese government and various sectors of society, the incidence of poverty, poverty depth, and poverty severity in 2008 were 19%, 17%, and 108% respectively. Therefore, the incidence and the depth of poverty after the earthquake have increased compared with those before the disaster. The incidence of poverty in 43 poverty-stricken counties in the disaster areas increased from 30% of pre-disaster to over 60% of post-disaster, and the rate of returning to poverty was 30% [13]. The per capita net income of farmers fell from an average of 1873 Yuan at the end of 2007 to less than 1000 Yuan (excluding subsidized income) after the earthquake [14]. The number of households without housing, no sources of income, and no means of production has increased substantially, and the lives of the people face more severe difficulties. The level of economic and social development of the poor villages has seriously deteriorated.

The relief from the government and the community is mainly a one-time housing repair or reconstruction subsidy for the three months after the earthquake. Therefore, due to the huge cost of housing maintenance and reconstruction, the agricultural production and living standard of farmers in the disaster areas cannot be recovered to the pre-disaster level in 2009. In spite of data limitation, changes of the poverty incidence in the severely affected counties from 2007–2016 can be seen from Figure 3.

![Figure 3. Changes of the poverty incidence in the severely affected counties by Wenchuan earthquake.](image)

2. The Impact of the Wenchuan Earthquake on Poverty

Studies have shown that disasters have become an important factor in poverty and one of the important reasons for returning to poverty [15–19].

2.1. The Impact of Wenchuan Earthquake on Poverty-Stricken Counties

Among the very severely and severely affected counties (or urban areas) affected by the earthquake, there are 15 national key poverty alleviation counties (29%) and 5.12 million persons (25%); 28 provincial key poverty alleviation counties (55%), 11.12 million persons (53%); seven non-poverty counties (14%) and 4.74 million persons (23%) [20]. In terms of the number of the affected counties and the population, the impact of the Wenchuan earthquake on poverty counties is greater than that of non-poverty counties. The other impacts of the Wenchuan on poverty-stricken counties and non-poverty counties were compared (Figure 4).
2.2. The Impact of the Wenchuan Earthquake on Poverty-Stricken Villages

To further analyze the impact of the Wenchuan earthquake on poverty villages and non-poverty villages, death populations and collapsed houses caused by the earthquake in these two types were compared (Figure 5). From Figure 5 it can be seen that there are 4834 poverty-stricken villages (accounting for 33%), 4.363 million persons (22%), per capita net income of farmers is 1873 Yuan; and 9731 non-poverty villages (accounting for 67%), and 15.504 million persons (78%), the per capita income of farmers is 4025 Yuan. The number of deaths or the proportion of people killed by the disaster of the non-poverty villages is much more than that of the poverty villages and it is 6.9 times and 4.0 times of that of the non-poverty villages respectively. The number of collapsed houses and the number of collapsed houses per capita of non-poverty villages are also higher than those of poverty villages, and the numbers of the former are 2.1 times and 1.2 times of those of the latter respectively. From this perspective, the impact of the earthquake on poverty-stricken villages is smaller than that on non-poverty-stricken villages.

The affected poverty-stricken villages by the Wenchuan earthquake were classified into three categories based on the degree of influence—Area A1, Area A2, and Area A3. The poverty-stricken villages distributed in Area A1 are those with a relatively low level of poverty and a relatively low degree of disaster. The poverty-stricken villages distributed in Area A2 are those with a relatively severe level of the earthquake but a relatively low level of poverty. The poverty-stricken villages distributed in Area A3 are those with a high poverty level and a severe level of the disaster. The poverty-stricken villages distributed in Area A4 belong to those with a low degree of the disaster, but with a high level of poverty. The survey found that the distribution of the four types of the
poverty-stricken villages is the following: A3 type of the villages accounts for about 40% of the total 4834 villages, and the other three types each accounts for 20%. Such type analysis provides a rough basis for post-disaster reconstruction arrangements and resource allocation. The villages located in remote areas belong to the A3 type. The villages distributed in mountains areas and most ethnic minority villages also belong to this type.

Based on the assessment of disaster poverty impact, it is necessary to further quantify and qualitatively classify the types of poverty-stricken villages. We can develop different types of policies based on the different combinations of poverty levels and disaster levels. In other words, the post-disaster reconstruction and poverty alleviation should consider the relationship between the degree of disaster impact and the degree of poverty.

2.3. The Impact of the Wenchuan Earthquake on Poverty-Stricken Households

The Wenchuan earthquake disaster has caused large-scale casualties, damages to buildings and infrastructure, and the loss of cultivated land, which has reduced the stock of assets at the community and farmer levels. All have caused farmers to fall into poverty traps. The impact of earthquakes on the poverty-stricken households was analyzed mainly from four aspects: population, housing, incomes and expenses, and cultivated land change.

2.3.1. The Impact of the Wenchuan Earthquake on the Population

The loss of human capital caused by the earthquake was mainly caused by casualties, especially those who were disabled in the earthquake. From the perspective of long-term development, the natural disaster directly reduces the possibility of livelihood restoration after such a disaster. In addition to causing casualties, the earthquake also affects the health of the victims.

Figure 6 illustrates the population affected by the Wenchuan earthquake. The population of poverty-stricken counties in the disaster areas is concentrated in the category of 200,000–500,000, with a ratio of 17% (as shown in Figure 6). The proportion of the population of poverty-stricken counties >1,000,000 is 3.1% while the proportion of <200,000 is 4.9%. The survey report of 15 poverty-stricken villages in Sichuan, Gansu, and Shaanxi Provinces further shows that the proportion of family members’ injury of middle-income and poor-stricken households is higher than that of wealthy households [21]. The proportion of middle-income rural households who became sick due to the disaster is higher than that of wealthy and poverty-stricken households. In terms of gender, women are the majority of the injured people or with poor health conditions due to the disaster. Women account for 64%, 59%, and 52% of injured people, sick people, and people with poor health conditions, respectively [22]. In terms of age, middle-aged and elderly people are the majority among the people who suffered, got illnesses, or had poor health due to the disaster. The proportion of people aged 35–60 who suffered, got illnesses, or had poor health due to the disaster is 49%, 50%, and 47% respectively. The proportion of elderly people over the age of 60 who suffered, got illnesses, or had poor health due to the disaster is 30%, 40%, and 28% respectively [23]. From the perspective of the age distribution of people with poor health after the earthquake, the proportion of middle-aged people is 47%, and the proportion of the elderly is 30%.
2.3.2. The Impact of Earthquakes on Rural Housing

In terms of the proportion of collapsed houses during the earthquake, that of poverty-stricken households is 67%, that of middle income households is 58%, and that of wealthy households is 52% [24]. The damage to the farmers’ houses directly affected the labor input during the reconstruction period, which caused the different incomes for the farmers after the disaster.

According to the Sixth National population census data, the types of housing can be divided into four categories: reinforced concrete, brick and concrete, brick-wood, and others [25]. Figure 7 illustrates the ratio of brick and other structure building in the areas affected by the Wenchuan earthquake. From the data and the figure it can be seen that in poverty-stricken counties 18% of houses were of brick–concrete construction and the rest were of other construction; in contrast in non-poverty counties 37% of houses were of brick–concrete construction. The proportion of old-fashioned buildings of the poverty-stricken households is greater than that of the ordinary household and the wealthy households. The proportion of brick–concrete structure housing of poverty-stricken households is smaller than that of ordinary and wealthy households. In terms of the damaged degree of farmers’ housing, more than 98% of the households suffered different degrees of damage, but the wealthy households have relatively low degrees of damage. The proportion of completely collapsed, partially collapsed, and completely dangerous buildings of wealthy households is 53%, while that of the ordinary households is 72%, and that of the poverty-stricken households is 78% (Figure 7). This is mainly due to the fact that the wealthy households have a good family economic condition. Therefore,
their houses have a better seismic performance and strong capability to withstand the disaster. On the other hand, the houses of almost all poverty-stricken households need to be rebuilt and repaired. Due to the different types of houses, the damaged degrees of the houses during the disaster are different. Among the households whose houses need to be rebuilt, the proportion of wealthy households is 38%, and that of medium income households is 61%, and that of poverty-stricken households is 70%. Among the households whose houses need to be repaired, the proportion of wealthy households is larger than that of medium income households and poverty-stricken households, with the proportions being 54%, 38%, and 28% respectively. The poorer the farmers, the higher is the proportion of houses that need to be rebuilt after the disaster.

![Map of the affected areas of the Wenchuan earthquake](image)

**Figure 7.** Ratio of brick and other structure building in the areas affected by the Wenchuan earthquake.

2.3.3. The Impact of Earthquakes on Farmers’ Incomes and Expenses

The average annual income of wealthy households in 2007 was more than 35,000 Yuan; nearly three times that of medium income households, and nearly five times that of poor households. The total income of wealthy households in 2008 increased by 5% compared with that in 2007, while that of medium income households decreased by 21%, and that of poor households decreased by 24% [26]. Wealthy households increased their capita income slightly in the year following the disaster, whereas in medium income and poor households per capita income significantly reduced. From these analyses it can be seen that the impact of the earthquake on the farmers with different incomes is very different,
and its impact on poor and medium households is much greater than on wealthy households. The income gaps among the farmers increased significantly after the earthquake.

In terms of cash expenditure, whether it is before or after the disaster, the family’s daily food, medical care, and education are the three most important ones, accounting for 60% of the total expenditure. Compared with those in 2007, household food and education expenditures in 2008 decreased, while medical expenses increased by 5%. For households with different levels of incomes, the expenditures of wealthy households increased after the disaster, while the average and poor households showed a trend of reduction. In terms of the proportion of food expenditure, wealthy households increased significantly, while that of the average and poor households significantly decreased. In terms of the proportion of medical expenditure, all three types of households improved, but the wealthy households had the largest increase. From the analysis, it can be seen that the earthquake had the least impact on wealthy households, compared with the impact on the average and poor households.

More than half of the average and poor households said they had no deposits, while most wealthy households had a certain amount of deposits. After the earthquake, most of the farmers used deposits mainly for housing construction, followed by household living expenses, and fewer households used deposits for medical expenses, education expenditures, and agricultural production.

2.3.4. The Impact of the Wenchuan Earthquake on Farmers’ Cultivated Land

Cultivated lands are the main sources of food for farmers. The destruction of cultivated land by the earthquake affected the livelihood of farmers more or less. Figure 8 shows the types of cultivated land in Wenchuan earthquake-stricken areas. According to the survey data of 15 villages, 25% of the farmers’ cultivated land was damaged to various degrees. Among them, 20% of poor households, 27% of ordinary households, and 32% of wealthy households suffered from farmland damage. The affected areas of cultivated land of ordinary households and wealthy households are relatively small. In addition, 27% of the farmers’ arable land was occupied by housing. Among them, 26% belongs to poor households, 29% to ordinary households, and 21% to wealthy households [26]. The housing occupation of cultivated land affected the livelihood of poor farmers, resulting in a reduction in their income sources and thus increasing poverty. At the same time, the reduction of cultivated land also turned some ordinary or wealthy households that mainly relied on crop farming into poor households. Therefore, in post-disaster reconstruction work, it is necessary to focus on finding new ways of livelihood for the farmers.
3. Reflections on the Model of Post-Disaster Reconstruction and Poverty Alleviation

Despite the damage and the deepening of poverty caused by the Wenchuan earthquake, the large amount of investment in disaster prevention and mitigation together with post-disaster recovery and reconstruction by the state and various levels of governments have also brought benefits to poverty alleviation [27]. Through the investigation of hidden high risk points such as landslides and debris flows and floods, rural housing land was rationally planned to avoid high-risk areas. Disaster monitoring, forecasting, early warning and emergency response systems were established and improved to reduce the intensity of the hazard influence and its likelihood. Economic comparison of the severely affected counties by the Wenchuan earthquake for the years of 2008 and 2017 can be seen in Figure 9.
To improve the conditions of the infrastructure of rural roads, bridges, culverts, and the resilience of public facilities such as schools and hospitals, a series of activities were carried out. For example, disaster emergency shelters were built; disaster relief materials were distributed; disaster prevention and mitigation education were invested in; and training publicity and drills of disaster prevention and mitigation, were carried out [11,15]. All of these activities improved farmers’ awareness of disaster prevention and mitigation education were invested in; and training publicity and drills of disaster prevention and mitigation were carried out [4,7,20]. All of these activities improved farmers’ awareness of disaster prevention and mitigation and disaster response. The emergency plans for disaster-stricken groups were developed and policy-based agricultural insurance was implemented. The vulnerability of disaster exposures was reduced and the capability of disaster recovery was enhanced to reduce the risk of disasters.

From the perspective of disaster economics, disaster prevention and mitigation input were used to reduce the negative economic impact of the Wenchuan earthquake disaster. In rural poverty-stricken areas, it is directly reflected in the reduction of poverty problems caused by the disaster. Figure 10 illustrates the proposed conceptual framework of combining disaster prevention and mitigation/disaster reconstruction with poverty alleviation.

**Figure 9.** Economic comparison of the severely affected counties by the Wenchuan earthquake for the years of 2008 and 2017.

**Figure 10.** Conceptual framework of combining disaster prevention and mitigation/disaster reconstruction with poverty alleviation.
Post-disaster recovery and reconstruction could bring together more resources, funds and technology resources that are urgently needed for the development of disaster-stricken areas [4,7,20]. They could be used directly to improve the living standards and production activities of poor people, and then to help them escape from poverty. As far as the positive economic performance of disasters is concerned, the post-disaster recovery requires multiplier effects and opportunities for post-disaster technological innovations and production development, which may be conducive to the elimination or reduction of poverty in the disaster areas.

4. Conclusions

Overall, the Wenchuan earthquake disaster caused a large loss of material capital, human capital, financial capital, and physical capital in the disaster areas, and its impact is far-reaching.

(1) The impact of the earthquake on the population with different characteristics is different. For households with different incomes, the proportion of casualties of wealthy households due to disasters is lower than that of ordinary households and poor households; for different gender and age structures, women are more likely to have suffered from the disaster than men, and older people are more likely to have suffered from the disaster than young people.

(2) In terms of the impact of the earthquake on housing collapse, the proportion of collapsed housing of poor households is greater than that of ordinary households and wealthy households. Among the proportion of housing needs to be repaired, the proportion of housing of wealthy households is the largest, and that of the poor households is the smallest.

(3) As far as household incomes after the disaster are concerned, there has been an increase in the number of wealthy households, and that of medium and poor households have decreased significantly. The expenditures of wealthy households have increased after the disaster, while the ordinary households and poor households have shown a trend of shrinking.

(4) The proportion of damaged cultivated land for ordinary households and wealthy households is larger than that for poor households. In terms of housing occupied farmland, poor households and ordinary households are larger than rich households.

The scope of poverty alleviation and reconstruction after the Wenchuan earthquake was 4834 poverty-stricken villages [2]. LGOPAD (Leading Group Office of Poverty Alleviation and Development of the State Council) carried out a pilot project involved in 100 villages. In August 2018, the Sichuan Provincial Government approved 15 counties such as Beichuan County to exit the poverty-stricken counties [28]. The effective ways of reconstruction of the poverty-stricken villages after the Wenchuan earthquake can be summarized with the following aspects:

(1) Stimulating the internal vitality of the reconstruction of poverty-stricken villages.

In the post-disaster reconstruction process of poverty-stricken villages, the government always aimed at targeting the poor and vulnerable groups, persisting in the development of livelihoods, and adopting various means to improve their confidence and ability in reconstruction and sustainable development.

(2) Improving the basic production and living conditions of poverty-stricken villages.

According to statistics, the total capital investment of the 100 pilot villages is 183 million Yuan [2]. After the disaster, the poverty-stricken villages resumed reconstruction planning and poverty alleviation funds, and established a platform from various resources to support the reconstruction of poor villages.
(3) Improving the way with a series of special training activities.

How to improve the ability to participate in post-disaster reconstruction through training and exchanges to promote poverty alleviation systems is an important way for disaster prevention and mitigation/disaster reconstruction with poverty alleviation in poverty-stricken villages. The reconstruction training of people in the poverty-stricken villages after the disaster may be divided into three types: mobilization training, thematic training, and communication training.

(4) Exploring the multi-sectoral involvement in reconstruction mechanisms of poverty-stricken villages.

Various departments including the LGOPAD, the Ministry of Civil Affairs, the Ministry of Housing and Urban-Rural Development, the Ministry of Science and Technology, the national Women’s Federation, and other ministries and commissions have worked with UNDP (the United Nations Development Programme) and relevant departments to explore multi-sectoral cooperation in the recovery and reconstruction mechanisms for poverty-stricken villages. It is an innovation where multiple departments participate in the same project design, implement interrelated and mutually supportive project content, and form a complete project implementation mechanism.

Suggestions were given in this study to improve the mode of combining disaster prevention and mitigation/disaster reconstruction with poverty alleviation. The post-disaster reconstruction and poverty alleviation should consider the relationship between the degree of disaster impact and the degree of poverty. The results from this study may serve as an important reference for the formulation of poverty alleviation and development policies for future disaster management.

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