

Special Article - Earthquakes

Economic, Social and Developmental Indicators (ESDI) to Measure Earthquake Recoveries in China

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Received: June 23, 2022; Accepted: July 25, 2022;

Published: August 01, 2022

Abstract

China is a country prone to disasters and earthquake is one of the continuous threats. Most serious recent earthquake was the Sichuan earthquake in 2008 and the earlier one was the Tangshan earthquake happened in the year of 1976. China was acknowledged for its "responses" in speedily mobilizing all resources to rescue. However little has been reported on the aspects of "recovery", "mitigation" and "preparation", the other three components in disaster management cycle. This paper aims to review the attempts in disaster management in China particularly on the part of government, by examining post-disaster economic growth and social developments, in the cases of four counties namely Wenchuan, Beichuan, Yushu and Yingjiang. The former two were the hardest hit areas during the Sichuan earthquake and the latter two were epic-centers of earthquakes in 2010 and 2011 respectively. Results of local GDP increases, population mobility and formation of social associations, showed that all counties have developed tremendously in term of economic production, however social progress has achieved less impressive growth. Volunteerism has emerged as a new phenomenon in these places and supported by the policies and legislations of the Central Government.

Keywords: Post-earthquake economy; Social progress; Altruism**Introduction**

The Sichuan earthquake shocked China on May 12, 2008. At that time emergency management of the country was based on a responsive strategy. According to the United Nation, through the Yokohama and Hyogo conferences, the theory of Disaster Management Cycle and a proactive strategy was proposed. A paradigm shift was considered necessary from the responsive approach to comprehensive risk assessments, prevention education, self-rescue and mutual rescue. An Emergency and Disaster Risk Framework was later adopted worldwide [20]. The aims of this paper were to review exactly how four counties developed after the devastation of serious earthquake, from recovery onwards. The first two counties were Wenchuan and Beichuan which were both considered as the hardest hit areas in Sichuan earthquake, in fact there were debates about which of these two places was the epic center. The other two counties selected were that of Yu Shu in the Qing Hai Province, situated north of the Sichuan Province, and Yingjiang in Yunnan Province, south of the Sichuan Province. All four counties were comparable in terms of economic status and degree of modernization before earthquakes See (Table 1).

Quarantelli E L. alert that recovery is a complicated process that involves a lot of policy implications that might determine its failure or success. Abramson et al. approached this complexity with the Socio-Ecological Model of Recovery, measuring five factors of housing stability, economic stability, physical health, mental health, and social role adaptation [7]. Have attempted to develop a set of Recovery Indicators with relevance to Recovery Support Functions and Recovery Mission Area Core Capabilities of the Federal Emergency Management Agency (FEMA). It showed that universally disaster managers were in need of a set of economic and social indicators

which was comprehensive but manageable to evaluate the process of community recovery.

Li, Wang & Jin [9] pointed out that short term reopening of business operations in disaster areas, also Beichuan in their study, might not be sustainable. More importantly, pre-disaster financial conditions, post-disaster monthly average profit, borrowing of money from family or friends, the business owner's gender, and government subsidies, were critical for economic recovery. Chen and Tang (2018) addressed in particularly the issue of comparison studies of disaster reconstruction when they reviewed the situations of Wenchuan, Yushu and Loshan. A lot of recent attempts applied latest technologies of remote sensing, Geographic Information Systems and Aerial Photography to measure performances of reconstruction [3]. However measurements of these studies were focused on reconstruction of the physical facilities more than the social and cultural environments.

The research questions of this paper were to what extent these four counties have recovered. For this study it was difficult to employ the Abramson's Socio-Ecological Model which required mainly subjective data. Instead following the social indicators approach the study evaluated disaster recovery in the following areas:

- 1) Economic recovery: individual income, expenses and the elimination of poverty;
- 2) Social recovery: provision of low cost housing, universal primary education and hygienic environments; and
- 3) Communal recovery, measured by emergences of social organizations, cultural societies and community volunteer activities.

This study was based on the analysis of secondary data which are quantitative in nature. The indicators system constructed for this study can be referred as Social, Economic and Developmental Indicators (SEDI).

Social Indicators Systems

Social indicators movement has started as early as 1960's in America. Nowadays social indicators system has developed into a major method in measuring social improvements and development. In Year 2000, the United Nations announced the Millennium Development Goals (MDG) adopted by 189 nations at that time. There were eight areas of MDGs, namely elimination of poverty, universal primary education, gender equality, lowering children deaths, improved maternal health, combat HIV/Aids, malaria and other diseases, environmental sustainability, and partnership [21]. MDGs can be considered as a baseline for achieving social development in a country. The Organization for Economic Cooperation and Development (OECD) began to biennially publish a report "Society at a Glance OECD Social Indicators" since 2001, introducing 45 indicators to evaluate social policies [8]. Social Indicators can therefore be employed to measure societal recovery after a major earthquake.

Methodology

Factors Contributive To Social and Economic Developments

Factors leading to improvements of social, economic and developmental indicators will include 1) increase in local investments; 2) increase in population by attracting young people to return to the areas or attracting entrepreneurs from outside the areas and 3) restructuring of industries to become more diversified and profitable. Nevertheless it was beyond the scope of this paper to analyze the factors of recovery in the target areas.

Developmental Social Policy Indicators

In order to study post disaster recovery, a number of key social and economic indicators were selected to reflect partially if not comprehensively the real developments. The indicators could be grouped under economic, social and developmental. Concepts of developmental indicators were borrowed from the theory of developmental social welfare [10]. Developmental social welfare challenges the neo-liberal notions that social expenditures harm the economy, and that economic development can only take place at the expenses of social progress.

Economic indicators should include growth in Gross Domestic Product (GDP), decrease in poverty and improved equality. Social indicators should include education, housing, health and employment opportunities. They also cover services for vulnerable groups particularly the older people and disabled persons. Post disaster developmental indicators hereby refer to those policies that promote community resilience. In particular it involves the active participation of local residents in community affairs. In this study the key indicators selected were 1) income and disposable income per capita to evaluate economic performance; 2) education and health services provisions to reflect social progress; and 3) policies of local government to promote volunteerism to demonstrate civil developments.

To compile the Economic Social and Developmental Indicators (ESDI), this study employed only official data provided by government statistics at various levels of national, provincial, city and county statistics [11]. The policies on volunteer development were based on official government reports of the four counties. The post disaster data employed were mostly those of 2021 with a few collected at their respective 10th year anniversary. Due to data constraints, subjective social indicators were not included.

Findings

Economic growth

All the four counties that suffered from serious earthquakes witnessed tremendous GDP growth in the last decade. Wenchuan recorded annual GDP growth of 15.6% from 2008 to 2017. In the same period, the annual growth of GDP for Beichuan was 15%, also very high [15]. For Yushu, its GDP has doubled, as high as RMB 5.36 billion in 2018 as compared to RMB 3.19 billion in 2010 [12]. The county of Yingjiang on the other hand showed a different trend. It has a double digit growth before 2014 but gradually slowed down to 7% that year. Nevertheless according to the Yingjiang County government statistics, the annual GDP growth from 2000 to 2019 was 9.2%, which was still a remarkable increase [28]. GDP and other economic information of the four counties were listed in (Table 2).

In interpreting these results it is noteworthy that the whole nation of China has achieved unprecedented economic development from 2010 to 2020. These four counties were fortunate to carry out their reconstruction during a period of national economic take off. Nevertheless economic recovery could not be conclusive if it was only supported by GDP growth. In Table 2 the post disaster disposable income of the four counties were also reported. There was always a big difference between urban and rural populations, particularly in the poorer regions. It was noticeable that annual incomes for individuals in all counties even in rural areas have exceeded RMB10,000 with the exception of Yushu. Even taking the Yushu rural income of RMB9138, it was considerably above the United Nation's poverty line of US\$200 per year.

One socio-economic observation worth mentioning was the difference between income per capita and disposable income. Wenchuan has the highest income among the four that stood at RMB56829, which was 3.115 times that of Yushu. Disposable income in Wenchuan was only RMB29472, only a little higher than half or 51.8% of the income per capita. It suggested that economic growth in disaster areas did not necessarily lead to more equal income distribution.

Another important socio-economic indicator is the urban-rural income disparity. The ratio of urban to rural income for Wenchuan, Beichuan, Yushu and Yingjiang were 2.407, 2.246, 3.848 and 2.198 respectively. The biggest disparity happened in Yushu, where the income per capita was lowest among the four.

Education Recovery

The Chinese government considered it very important to resume schooling as soon as possible after an earthquake and the contingency measure was making temporary schools available. For example immediately after the Yingjiang earthquake, which occurred on March 10, 2011, 158 primary and secondary tent-schools were built

Table 1: Information of the Four Counties.

County	Province	Population	Income per capita (urban/rural)	Earthquake Date and (Magnitude)
Wenchuan	Sichuan	120000 to 150000 (including non-residents)	RMB10715/2745*	May 12, 2008 (8.5)
Beichuan	Sichuan	160000	RMB12519** (2010)	May 12, 2008 (8.5)
Yushu	Qinghai	200000	RMB3663 [#]	April 14, 2010 (7.1)
Yingjiang	Yunnan	290000	RMB12500 [^]	March 10, 2011 (5.8)

*Wenchuan Government (2008); **Beichuan Government (2010);

[#]Yushu Government (2010); [^]Yingjiang Government (2011).**Table 2:** Economic Developments of the Four Counties after earthquakes.

County	Province	Income per capita before earthquake	Income per capita after earthquake	Disposable Income(urban/rural)
Wenchuan	Sichuan	RMB10715 (2008)	RMB56829 (2017)*	RMB29472/12243 (2017)*
Beichuan	Sichuan	RMB6917 (2008)	RMB24964(2018)**	RMB29334/13061 (2018)**
Yushu	Qinghai	RMB3663 (2010)	RMB18242 (2019) [#]	RMB35167/9138 (2019) [#]
Yingjiang	Yunnan	RMB12500 (2010)	RMB30733 (2019) [^]	RMB30212/13740 (2019) [^]

*Wenchuan government (2017); ** Beichuan Government (2018);

[#]Qinghai Provincial Bureau of Statistics (2019); [^]Yingjiang Government (2020b).**Table 3:** Social Developments of the Four Counties after earthquakes.

County	Province	Inhabitants	Educational Services	Health Services
Wenchuan	Sichuan	102300	36 schools, primary education coverage 100% (2017)*	Hospital beds (4.9/1000); doctors (2.13/1000); nurses (2.08/1000)*
Beichuan	Sichuan	225,200	36 schools, (2018)**	Hospital beds (7.46/1000); doctors (1.63/1000); nurses (2.38/1000)**
Yushu	Qinghai	422500	96 schools, primary education coverage 99.30%. 4781 students study in other areas (2019) [#]	Hospital beds (5.6/1000) [#]
Yingjiang	Yunnan	365284	87 schools, primary education coverage 99.77% (2017) [^]	Hospital beds (4.2/1000); doctors (1.4/1000); nurses (1.6/1000) [^]

*Wenchuan Government (2017); ** Beichuan Government (2018);

[#]Qinghai Provincial Bureau of Statistics (2019); [^] Yingjiang Government (2017).

and classes were resumed on March 21, 2011 [6].

For Yingjiang, there were 69 primary schools, 15 junior high and 2 senior high schools and 1 higher education institutes. Coverage rate for primary education was 99.77%, junior secondary education was 112.12% and junior high educations was 81.6%. Its population was 365284 persons.

In Wenchuan, by 2011 or three years after the earthquake, 20 schools were permanently reconstructed with high standards [26]. By 2017, Wenchuan has altogether 36 educational institutions with 24085 students. Primary Education rate reached 100% and one higher education college was established with an intake of 8085 students [25]. Wenchuan in 2017 has a population of 95891 registered residents or 102300 inhabitants including non-residents.

In the case of Beichuan, education facilities were developed than Wenchuan. There were 25 primary schools, 10 junior high and 1 senior high schools in 2018. The population was 234,400 residents and 225,300 inhabitants [2]. The number if an inhabitant was less than that of residents showed that some residents did not live regularly in the area.

Finally, the recovery of Yushu in education showed that there were 82 primary schools, 10 junior high and 4 senior high schools in 2019. Among 112931 students, there were however 3380 high school students and 1401 junior college students have to receive education outside Yushu. Primary education coverage rate was 99.30% [31]. The area of Yushuzhou, equivalent to a small province, has a population of 415400 residents or 422500 inhabitants including non-residents.

Obviously Yushu has a much larger population than other 3 counties, however the number of educational facilities was not proportionally available [13].

To summarize, education services were mostly recovered and even improved. Universal Primary Education were achieved with the exception of Yushu. The inadequate education provision of Yushu perhaps is related to the geographical conditions of the area which is mountainous and the lack of economic resources of the area from the very beginning. The solution is to provide boarding primary schools and adequate educational investments must come from the District government.

Health Services Recovery

In 2019, Yinjiang with a total inhabitants of 365284, has 124 medical facilities providing 1548 hospital beds (4.2 per thousand). There were 521 doctors (1.4 per thousand) and 583 nurses (1.6 per thousand).

Beichuan, having 225,200 inhabitants, was registered with 356 medical facilities, 1680 hospital beds (7.46 per thousand), 366 doctors (1.63 per thousand) and 537 nurses (2.38 per thousand) in 2018.

The number of inhabitants of Yushu was 422500. It has 86 medical institutions offering 2375 hospital beds (5.6 per thousand). However there were no information on the numbers of doctor and nurses.

Finally, for Wenchuan, there were 503 hospital beds (4.9 per thousand) in 22 medical institutions supported by 218 doctors (2.13 per thousand) and 213 (2.08 per thousand) nurses. The number of

inhabitants was 102300.

The provision of educational and health services were summarized in (Table 3).

Promotion of Volunteer Development

Sichuan earthquake has caused human deaths of as high as 69163 persons, with an additional 17445 missing. The number of persons injured was 374142 persons, and many of them were disabled by the earthquake [17]. This has created an unforeseen concern among all people in China. The number of volunteers flocked into Sichuan was estimated at 1.18 million [16]. Numerous volunteers and the people they served became life long charity activists. The year of 2008, coupled with the Wenchuan Earthquake and Beijing Olympic Games, was considered a turning point in the history of volunteer development for China.

The government of Wenchuan, representing the people who benefited from the voluntary efforts from all other parts of China, recognized the importance of voluntary actions and spirits. As early as 2016, the Wenchuan government via its Civic Mindedness Office, published its “Wenchuan Volunteer Organizations. Development and Practice Plan”. In 2019, a “New Era Civil Mindedness Volunteer Team Formation Plan” was further announced [23]. The number of volunteers registered for this team was 13878 persons.

In 2016, the Chinese People Congress has enacted the “Charity Law of the People’s Republic of China”. Soon after in August 2017, the State Council announced the “Volunteer Service Ordinance”. Both of these legislations provided the legal framework for the promotion and protection of volunteer developments. In particular it has provided the volunteers in emergency response a capacity to obtain insurance protection and official recognition of difference levels of government offices.

The situations of Beichuan in terms of volunteer development was similar to Wenchuan as both counties suffered from the Sichuan earthquake and received similar support from national volunteer associations. One organization among Beichuan volunteer groups worth special mention was the “Heart of China” established in 2011. It devoted especially to disaster services and participated in later earthquake relief work in Yushu, Yaon and other natural disasters. It was supported by the local government to provide community services in Beichuan and assisted in poverty elimination work, In 2021 it was renamed as the “Beichuan Spirit of the Jiang People Culture Promotion Center”. It demonstrated how a local NGO has flourished in collaboration with the local government.

The promotion of volunteer spirit was indebted to a number of external volunteers who lost their lives in helping the Yushu people after the earthquake and among them a young man from Hong Kong named Wong F. W. [4]. Among the volunteers responded to Yushu earthquake there were representatives from Wenchuan.

Yingjiang has established a volunteer team in 2010 before its earthquake composed of communist party members [5]. Immediately after the earthquake, a coordination platform was formed for participating voluntary associations to ensure better responses [29]. It indicated disaster volunteer management has reached a more mature state. After the earthquake local volunteer groups continued

to raise funds to provide assistance to vulnerable groups in the area. In 2014, the number of volunteers in Yingjiang was estimated over 30000 (Yingjiang government, 2014). Volunteer activities penetrated successfully even into the police and legal departments [19].

Conclusion

Results showed that in all four counties of Wenchuan, Beichuan, Yushu and Yingjiang, economic recovery and even growth was evident. Most of them achieved double digit annual GDP increases with the best performance in Wenchuan and weakest economy in Yushu. The latter also revealed the largest income disparity between urban and rural sectors. In the areas of social indicators all counties have achieved universal primary education coverage. Universal health care were also provided in all four counties in terms of hospital beds. However the numbers of physicians proportional to population were low as compared to more developed areas and nurses were in even higher shortages. The greatest post disaster advancement for these areas may be the development of volunteers. Disasters caused many life lost, but also changed the life goals of more.

The contribution of this study lies in the construction of ESDI, a simple indicators system to measure earthquake recovery. As many less developed countries were affected by earthquakes and other natural disasters, a comprehensive but concrete, meaningful yet manageable, inexpensive method to evaluate recovery is desirable. Economic, Social and Developmental Indicators (ESDI), which can be expanded in number of indicators if resources and information is more abundant, form a valuable theoretical framework to meet such need. For developmental indicators it will be better to include subjective data in terms of optimism, hope and gratitude. Some studies measured satisfaction of residents towards reconstruction but it does not reflect sustainability. In this study volunteer development is selected as the developmental indicator as altruism is important for long term community integration. Altruism may not be adequate to measure community resilience. However if resilience to earthquake was measured, it might not be applicable to other disasters for example the COVID-19. Altruism and volunteer spirit on the other hand is more contributive to community well-being at all times.

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