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The 2008 Sichuan Earthquake and Its Impacts on Economy

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Abstract

China, with one of the largest populations and the second-largest gross domestic product (GDP), experiences severe earthquake disasters. The Great Sichuan earthquake, one of the deadliest in Chinese history and the most devastating in China since the 1980s, occurred in 2008. This earthquake is characterized by its massive damage to the economy and the loss of a huge number of human lives. This study primarily focused on summarizing the existing studies related to the economic impacts of the Sichuan earthquake and specifically sought to identify the impacts of the Sichuan earthquake on the economy in the affected area. As a result, the earthquake had a significant long-term negative impact on the overall GDP. The earthquake greatly affected the tourist industry, and it has destructively influenced the development of the tourism industry in the quake-hit area. Also, this earthquake harmed the agricultural output in the damaged areas with different magnitudes in the Sichuan province. In addition, the Sichuan earthquake caused extensive damage to local critical infrastructure. The results implied that agricultural, tourism, and infrastructure inputs were reduced in the affected areas. Finally, it could serve as an important reference for the development program after a major earthquake.

Keywords: Sichuan Earthquake, Economy, Tourism, Agriculture, Infrastructure

Introduction

Droughts, floods, storms, hurricanes, and earthquakes, as natural disasters, can cause devastating damage to humans, infrastructure, and

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economic activities (Tsai, 2019). Very few seismologists are confident that it is currently probable or forever impossible to forecast an earthquake with the time, location, and size specified accurately enough to guide evacuation plans (Chen & Wang, 2010). Similarly, it is more difficult to predict an earthquake and notify society in advance than any other natural disaster (Geller, 1997). In this regard, the governments of most industrial countries consider earthquake prediction to be presently unfeasible, regardless of its scientific merit and future development. Instead, it is normally accepted that the most effective way of minimizing the effect of earthquakes on human life and the economy is to strengthen our built environment based on a scientific assessment of earthquake hazards and risks. This practice is called seismic risk mitigation (Chen et al., 2010).

Continental earthquakes are episodic, migratory, and clustered (Lang et al., 2020). They are much less regular in space and time than interpolated earthquakes. Though the rupture processes of interpolating earthquakes are the same as those of interpolating earthquakes (Lang et al., 2020). It is a challenge to assess hazards and risks because of the complex system of intercontinental earthquakes. Additionally, earthquakes could result in tsunamis that cause fatalities and have a potential long-term impact on economic activities (Tsai, 2019; Lang et al., 2020). China, with one of the largest populations and the second-largest gross domestic product (GDP), experiences severe earthquake disasters (Lang et al., 2020). China, to some extent, may be considered relatively inactive in earthquakes (Towhata & Jiang, 2012). However, there are areas in which earthquakes have caused substantial damage in the past. Xian in 1487, for example, was shaken by an earthquake, and historical buildings were ruthlessly affected. In terms of the death toll from 1900 to 2014, three major earthquakes out of ten in the world occurred in China, which caused 34.1% of all earthquake fatalities (Lang et al., 2020).

The majority of the previous literature has only focused on the people's lives affected by the 2008 Sichuan earthquake. For example, the earthquake caused a huge loss of human capital (Tse, Wei & Wang, 2013; Jia et al., 2018). However, there has been little attention given in the existing literature to the earthquake's impact on agriculture (Tsai, 2019), tourism (Zhang, 2013), and infrastructure (Tsai, 2019). Based on previous studies, this paper aims to fill this gap in related literature. Therefore, this paper will precisely determine if the earthquake's impact on three economic sectors (agriculture, tourism, and infrastructure) varies. After thirteen years have passed, it is a good time to review how this earthquake affected the three economic sectors.

Background of the Sichuan Earthquake

There are records of historical earthquakes in Sichuan Province. The Great Sichuan earthquake, one of the deadliest in Chinese history and the most

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devastating in China since the 1980s, occurred on May 12, 2008, in the afternoon. It is also recognized as the Wenchuan earthquake, which measured 8.0 magnitude (Wu et al., 2012; Tse, Wei & Wang, 2013; Rij, 2016). It was indeed one of the worst in the world in the last thirty years (Tse, Wei & Wang, 2013; Zhang, 2013). Compared to many other natural disasters producing substantial causalities, the Sichuan earthquake received extensive media attention from around the world (Liu, 2010; Wu et al., 2012). The location of the earthquake's epicenter is in a rural area of Wenchuan County, Sichuan Province, a mountainous region that is eighty kilometers west-northwest of Chengdu, the provincial capital, with a focal depth of 19 kilometers. Moreover, the seismically affected part of Sichuan Province is located along the boundary between the low and flat lands of the Sichuan Basin and the mountain ranges to the west (Zeng-zhong & Hastak, 2010; Towhata et al., 2012). This particular area is tectonically affected by the collision of the Indian subcontinent against the Eurasian continent; hence, high mountains have been generated that are underlain by big faults. It may be stated, therefore, that seismic risk in this area is high, and some earthquakes have been recognized during the historical era.

The Sichuan earthquake is characterized by its massive damage to the economy and the loss of a huge number of human lives (Wu et al., 2012; Tse, Wei & Wang, 2013). With this intention, the loss of human capital caused by the earthquake was largely caused by fatalities, especially those who were disabled in the earthquake (Tse, Wei & Wang, 2013; Jia et al., 2018). Precisely, this deadliest earthquake left about 69,226 people dead and over 17,923 people missing in the aftermath of the tremor, and the direct loss to the entire economy was nearly US$ 124 billion (Wu et al., 2012; Tse et al., 2013; Tsai, 2019; Lang et al., 2020). In addition to that, the Sichuan earthquake left 50,000 people with permanent physical disabilities and rendered about 4.8 million people homeless (Liu, 2010; Wu et al., 2012; Rij, 2016). Among these victims, many were killed by the collapse of buildings, and the number of those who were killed by slope failures is not small (Towhata et al., 2012). Also, this earthquake damaged some historic towns and historic buildings with traditional and local identities (Lang et al., 2020). It is valuable to note that, from the viewpoint of long-term development, a natural disaster directly decreases the likelihood of livelihood restoration after such a disaster (Tsai, 2019).

Research Methodology

This research is based on a mixture of primary and secondary sources. Consequently, a rich body of research materials, including electronic data, has been gathered. Written data includes journal or magazine articles,

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introductions, and guides to tourist, agriculture, and infrastructure sites. The data takes the form of formal publications and government reports.

Regarding the search procedure, the researcher extensively searched articles relevant to the Sichuan earthquake using several databases. These search engines included databases such as Google Scholar, ERIC, SAGE Journals, Springer, Elsevier, ScienceDirect, Semantic Scholar, and Research Gate. The information drawn from these journal articles in the construction of the literature review was empirical resources. This indicated that these studies were based on systematic experiments, observations, or experiences. Also, these journal articles were written using predictable structures in which the authors identified research questions, reviewed relevant literature, and presented findings and conclusions. The researcher used keywords in conducting the literature review. For example, the impact of the Sichuan earthquake on the economy in areas such as tourism, agriculture, and infrastructure. This study is based on a systematic review that performed more detailed and comprehensive literature surveying with relatively lesser involvement of the author's bias on the selected topic. The emphasis was on ensuring accurate and honest publications.

The process of analysis included organizing and cleaning the search process. Overall, the author downloaded fifty-two published research papers, doctoral dissertations, and master's theses. During this process, twenty-two inappropriate sources and articles irrelevant to the Sichuan earthquake were eliminated. Considering the formulated problem, the researcher critically reviewed thirty-three studies following a set of concepts. In addition, inclusion criteria were also established for this review. Studies published within the year range of 2008–2020 were considered to give the most recent research trends.

Table 1. Findings of the Reviewed Studies

Authors	Study	Method	Context	Findings
Yang, Wang, and Chen (2011)	Reconstruction strategies after the Wenchuan Earthquake in Sichuan, China	Quantitative	Southwestern University	The earthquake damage will negatively affect tourism development on a long-term basis. Yet tourism offers the potential to aid economic revival by capitalizing on world interest in the area.
Guo and Xiong (2011)	Tourism Recovery Assessment of Sichuan after the Wenchuan Earthquake	Qualitative	Leshan Teachers College	The recovery period of domestic tourism was ten months, while inbound tourism was still under recovery. The losses of inbound tourists and domestic tourists were 2.7 million

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				(till May 2010) and 24.6 million, respectively.
Zhang (2013)	Heritage, identity and sense of place in Sichuan Province after the 12 May earthquake in China	Mix Method	University of London	To sum up, it is my view that 'dark tourism' is indeed a brand of tourist development capable of powering the economic development of post-disaster sites, but it also has many ambiguous and uncertain connotations.
Tsai (2019)	Assessing the Economic Impact of a Devastating Natural Disaster	Qualitative	University of Tennessee	After the earthquake, the GDP couldn't be recovered in the damaged areas for eight years. Specifically, agricultural outputs in the affected areas became lower by 11%.
Xu et al. (2014)	Development of a UAS for post-earthquake disaster surveying and its application in Ms7.0 Lushan Earthquake, Sichuan, China	Qualitative	Institute of Geophysics, China Earthquake Administration, Beijing	The Sichuan earthquake caused a noteworthy and negative impact on agriculture.
Lingling, Jiexiu and Lianyou (2008)	People's Republic of China: Providing Emergency Response to Sichuan Earthquake.	Qualitative	Asian Development Bank Technical Assistance	The Sichuan earthquake also damaged land resources, which included farmlands, forest lands, and grasslands, with a total estimated loss of 27.87 billion RMB.
Deng et al. (2009)	Immediate impacts of the Wenchuan Earthquake on the prices and production of grain and pork products	Field Survey	Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing	The Wenchuan earthquake, undoubtedly, has some negative effects on the local agricultural yields in Sichuan province. It has caused immediate impacts on the grain and livestock breeding industries in the

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				earthquake's worst-hit counties.
Du et al. (2012)	Environmental risk evaluation to minimize impacts within the area affected by the Wenchuan earthquake	GIS-based techniques	Tsinghua University	The Sichuan earthquake caused extensive damage to local critical infrastructure, including schools, hospitals, roads, and water systems
Miyamoto, Gilani and Wada (2008)	Reconnaissance report of the 2008 Sichuan earthquake, damage survey of buildings, and retrofit options	Qualitative	Tokyo Institute of Technology	The damage from the Sichuan earthquake to infrastructure such as numerous schools, hospitals, and commercial, industrial, and residential buildings was estimated at millions of dollars.
Luo and Kinugasa (2020)	Do Natural Disasters Influence Long-Term Savings?: Assessing the Impact of the 2008 Sichuan Earthquake on Household Saving Rates Using Synthetic Control	Empirical Strategy	Kobe University	The direct loss of the Sichuan earthquake was 24.4%, accounting for housing destruction, 20.4% for non-residential ruin, and 21.9% for infrastructure damages.

Economic Impacts of the Sichuan Earthquake

The Sichuan earthquake had a significant negative long-term impact on the overall GDP (Wu et al., 2012; Tsai, 2019). Also, the significant impacts vary across economic sectors. To be more specific, the secondary industry experienced the most severe damage, followed by the tertiary and primary industries. According to Zhou and Wang (2019), the coupling relationship between frequent natural disasters and the regional economic chain is

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deepening day by day with the rapid development of China's economy, and the economic losses caused by disasters increase exponentially. The authors further stated that since the Sichuan earthquake occurred in 2008, the influence of disasters on regional economic structure and growth models has become the focus of attention for governments and economists. Some Chinese scholars, according to the researchers, evaluate the impact of the earthquake on the economy from the perspective of input and output and estimate the economic development of the disaster area and the whole country.

The impact of the Sichuan earthquake on economic activities reached RMB 771,717 billion Yuan (Zhang, 2013; Rij, 2016). Whereas, Wu et al. (2012), Tse et al. (2013), and Li, Umaier, and Koide (2019) estimated the Sichuan earthquake's economic loss at 845.14 billion Chinese Yuan. With the destruction of a large volume of construction and infrastructure, the authors further added that the Sichuan earthquake had a noteworthy impact on the local economy and people's living conditions. The poorest regions in China are usually those that often suffer from natural disasters (Sun et al., 2010). According to the Chinese government's new poverty line standard indicated by Jia et al. (2018) in a sample survey was 34%, the poverty depth was 29% and the poverty severity was 92% in 2007, respectively. However, the depth of poverty substantially increased after the earthquake hit these regions. Similarly, before the earthquake, the per capita net capital income of farmers was an average of 1873 Yuan in 2007, but it fell to less than 1000 Yuan after the earthquake (Sun et al., 2010). In addition to that, the number of families without accommodation, no income sources, and no means of production have significantly increased. Finally, the lives of the people faced more rigorous difficulties, and the level of economic and social development in the poor villages greatly deteriorated. The Sichuan earthquake heavily impacted the mountainous western region, which, therefore, remained fairly poor, undeveloped, and a piece of forgotten land (Xu et al., 2014; Jiang, 2015; Liu, 2018). Consequently, this earthquake caused the economy of West China to fall behind by an estimated twenty years.

Economic Impact on the Tourist Industry

According to Yang, Wang, and Chen (2011), Sichuan's tourism revenue extended to 121.73 billion RMB in 2007, whereas it was only 25.8 billion in 2000. The authors specifically added that Sichuan's annual tourism revenues increased by 24.3 percent and accounted for 6.4 percent of the total GDP in Sichuan. However, the Sichuan earthquake has enormously affected all industries in the quake-hit areas, and local tourism is no exception (Zhenzhi & Hong, 2008; Yang, Wang & Chen, 2011). The Sichuan earthquake greatly affected the tourist industry, and it has destructively influenced the development of the tourism industry in the quake-hit area (Yang, Wang &

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Chen, 2011; Guo & Xiong, 2011; Zhang, 2013). Following the Sichuan earthquake, the province's tourism industry collapsed. According to the researchers, the inbound tourist arrivals between 2001 and 2007 increased from 570,000 to 1.7 million. With this in mind, it corresponds to an average annual growth rate of over 20%.

The number of tourist arrivals in 2008, in contrast, dropped remarkably by 700,000. Moreover, the authors indicated in the data from the Sichuan Tourism Administration that the estimated damage to the tourism sector in Sichuan is 46.6 billion Yuan. According to Guo and Xiong (2011), the losses of inbound tourists and domestic tourists were estimated to be around 2.7 million (till May 2010) and 24.6 million, respectively. In addition to that, the authors further presumed that the economic losses from foreign exchange and domestic tourist' expenditures were $706.8 million until May 2010 and 27.2 billion Yuan RMB, respectively. Unfortunately, tourist attraction businesses, travel agencies, and accommodations have not yet reverted to pre-earthquake levels.

Moreover, Lingling, Jiexiu, and Lianyou (2008, p. 105) indicated that many tourism activities were dangled by travel agencies because of the non-availability of tourist destinations. It specifically meant that the combined effects of the earthquake mean the situation regarding tourism-related employment is grave. According to this report, more than 300,000 people have become jobless, and the average occupancy rate in hotels has been less than twenty-five percent. In addition, the report revealed that some of the unaffected tourist destinations have had no tourists because the transportation infrastructure for bringing tourists to those areas was unable to function and the government introduced a tourism prohibition in those regions. The earthquake made travel agencies suffer the most (Zhang, 2013). The writer acknowledged that the Chinese government ordered the travel agencies to call off all trips to or passing through quake-hit areas since the earthquake happened during the tourist season. The state also asked tourists to refrain from visiting these areas for some time. On the other hand, there were many tourist attractions in the quake-hit areas of Sichuan, and many of these travel agencies were reliant on these attractions to survive. Nearly all the attractions were shut down after the earthquake.

As a result, the gross income from tourism in May in Sichuan declined by 64.7%. Therefore, it is hard to enumerate the long-term effect of the disaster on the development of tourism in Sichuan, but the effects will be backbreaking and long-lasting (Lingling, Jiexiu & Lianyou, 2008, p. 105). Given the complications of renovating the spoiled infrastructure, it became challenging to resume trips to Sichuan in the short term (Zhang, 2013). Even if the China National Tourism Administration allowed the agencies to organize trips, many tourists would have been disinclined to visit the affected areas because they

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were psychologically shadowed. Meanwhile, tourist hotels had almost run out of guests in scenic areas and tourist centers because the earthquake caused severe damage to tourist facilities and damaged many historic tourist towns. Additionally, 283 tourist information centers, 8,259 travel shops and other facilities, and 3213 service centers were smashed (Zhang, 2013). Comparatively, the disaster in Tohoku in 2011 caused measurable economic impacts, including loss of tourism due to restrained consumption and radiation fears (Kajitani, Chang, & Tatano, 2013).

According to the State Planning Group of Post-Wenchuan Earthquake Restoration and Reconstruction (2008), the government of China decided to place priority on the key development characteristics of the industry with tourism in the areas suitable for proper restoration. It is worth mentioning that the earthquake destroyed old scenery but instantly created new tourist locations (Yang, Wang & Chen, 2011). The authors further stated that new landscapes can come into existence if new geomorphologic formations are properly utilized. Taking the 32 resultant quake lakes, for example, China had the plan to turn an enormous lake formed by the Sichuan earthquake disaster into a tourist destination.

Economic Impact on Agriculture

Understanding the disaster's influence on agriculture is becoming more essential as the frequency of natural disasters increases over the past decade. According to the report from the Food and Agriculture Organization of the United Nations cited by Tsai (2019), there were overall 78 natural disasters happened between 2003 and 2013, which nearly caused 14% direct losses and around 30% indirect losses in the agriculture sector. The report also suggested that natural disasters' influence on the agriculture sector can directly lower incomes and cause food insecurity.

Agriculture has been the largest sector of the local economy in most regions (Xu et al., 2014). For example, in some of the counties in Sichuan province, the percentage of agriculture-related labor exceeded 73 percent of the total labor force. However, the Sichuan earthquake caused a noteworthy and negative impact on the agriculture output in damaged areas with different magnitudes in the Sichuan province (Tsai, 2019). An important reason for rural poverty is the regular occurrence of natural disasters that have caused great harm to the local agricultural economy (Sun et al., 2010). The Sichuan earthquake also damaged land resources, which included farmlands, forest lands, and grasslands, with a total estimated loss of 27.87 billion RMB (Lingling, Jiexiu & Lianyou, 2008, p. 106). Based on this report, the Sichuan earthquake heavily destroyed or partially damaged land resources, especially in Sichuan province. For example, 58,330.99 hectares of farmland were affected. Compared to the earthquake in Japan that damaged 23,600 hectares

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of farmland (Norio et al., 2011), the affected farmland is massive in Sichuan. After the earthquake, the Chinese government insisted on using the land resources economically and intensively to protect arable land, especially farmland (State Planning Group of Post-Wenchuan Earthquake Restoration and Reconstruction, 2008).

The agriculture sector of Sichuan province, according to the post-quake report from the Food and Agriculture Organization, experienced huge economic damage with an estimation of $6 billion US dollars (Tsai, 2019). With the severe damage to the agricultural tools, machinery, and facilities, farmers in the affected areas had no means to grow agricultural products again to earn income. This catastrophe has specifically caused immediate impacts on the grain and livestock breeding industries (Deng et al., 2009). For example, the prices of grain and pork products were expected to rise in local mountainous areas over a short period of time. Because the grain yield in Sichuan province was reduced by more than 0.4% and pork production was reduced by at least 5% due to the earthquake.

Economic Impact on Infrastructure

Furthermore, despite human casualties, tourism, and agriculture, the Sichuan earthquake caused extensive damage to local critical infrastructure, including schools, hospitals, roads, and water systems (Du et al., 2012; Xu et al., 2014; Tsai, 2019). All of these systems endured severe destruction and prolonged service outages (Miyamoto, Gilani & Wada, 2008; Xu, 2014). Buildings and infrastructure are important factors in China's vulnerability, especially in urban areas where the majority of the residential buildings are made of concrete and bricks (Luo, 2008; Rij, 2016). Rij further stressed that the leading vulnerability was due to collapsing buildings and falling debris. For an extended period, the public infrastructure collapsed and the provision of utilities was disrupted. This had a significant impact on the local economy and people's living conditions (Tse, Wei & Wang, 2013; Zhang, 2013).

Likewise, Miyamoto, Gilani, and Wada (2008) also indicated that the damage from the Sichuan earthquake to infrastructure such as numerous schools, hospitals, and commercial, industrial, and residential buildings was estimated at millions of dollars. The total loss from the earthquake surveyed by the authors was more than one trillion Chinese Yuan (US$ 146 billion). Chen (2008) and Zhenzhi and Hong (2008) argued that the majority of the destruction of infrastructure occurred in mountainous areas. Xu et al. (2014) asserted that twenty percent of the local residential houses and the majority of the local public infrastructure were severely damaged and wiped out. After the earthquake, the critical infrastructure needed recovery.

Due to the collapse of buildings and damaged infrastructure, the direct economic loss of the Sichuan earthquake was estimated at 125.7 billion US

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dollars, and the majority of this loss was caused by infrastructure and buildings (Achour et al., 2011; Rij, 2016). Luo and Kinugasa (2020) assumed the direct economic loss of the Sichuan earthquake with an estimation of over US$120 billion. To be more precise, 24.4% of the loss was accounted for by housing destruction, 20.4% by non-residential ruin, and 21.9% by infrastructure damages. Overall, according to the authors, the total economic losses from this catastrophe were concentrated in Sichuan province. With this in mind, Zeng-zhong and Hastak (2010) and Xu et al. (2014) postulated that the management of critical infrastructure is a dynamic element of economic and social life.

Conclusion

This research paper was geared toward determining the effects of the Great Sichuan earthquake in China. Its main objective was to examine how the Sichuan earthquake affected the economy of the province. The results indicated that the Sichuan earthquake is considered to have claimed a huge number of human lives. It also caused immense harm to the economies of tourism, agriculture, and infrastructure. Precisely, the number of tourists decreased to nil in the quake-hit areas, causing a loss of 46.6 billion Yuan and the agriculture sector was not an exception. The Sichuan earthquake seriously ruined land resources. That is, 58,330.99 hectares of farmland were damaged in Sichuan province. Besides, it caused widespread destruction of local critical infrastructure. The majority of the destruction of infrastructure occurred in mountainous areas.

Implications

The results of this study implied that agricultural, tourism, and infrastructure inputs were reduced in the affected areas. The central government remains accountable for answering questions like how people on this fragile land will deal with it and how human interventions will be made practically and sustainably. Finally, this research could serve as an important reference for the development program after a major earthquake.

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