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Analysis

Changes in Human Well-being and Rural Livelihoods Under Natural Disasters

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ABSTRACT

Rural areas around the world are increasingly exposed to natural disasters. To guide management intervention for sustainable development after natural disasters, scientists and policymakers need a better understanding of the linkages between livelihood changes after natural disasters and recovery outcomes. Despite the growing body of disaster research, systematic evaluation of the relationship between post-disaster changes in rural livelihoods and recovery outcomes is rare, largely due to the lack of relevant data. By taking advantage of the long-term data collection and research conducted in China's Wolong Nature Reserve (Wolong), we empirically evaluated livelihood changes after the catastrophic 2008 Wenchuan Earthquake and how those changes are linked to the recovery of human well-being. Our results show that households' livelihood portfolios in Wolong conspicuously changed after the earthquake and that human well-being had been recovering. However, we found most of these livelihood changes negatively affected, instead of facilitated, human well-being recovery. The enriched understanding of the linkages between post-disaster livelihood changes and recovery outcomes has important management implications for achieving Sustainable Development Goals amid natural disasters in Wolong and beyond.

1. Introduction

Human exposure to natural disasters has been increasing rapidly over the past decades due to factors such as human-induced ecological degradation and climate change (Cutter et al., 2015; Field, 2012; Guha-Sapir et al., 2012; Simpson et al., 2016; Tuanmu et al., 2013). These disasters, like the series of hurricanes that struck the Caribbean and the North American mainland in fall 2017, can have massive local and regional effects. Besides substantial damage to ecosystems, natural disasters often cause tremendous socioeconomic losses to human communities (van den Berg, 2010; Zhang et al., 2011). This challenge is especially acute when considered in the context of global efforts to achieve Sustainable Development Goals (United Nations, 2016) in rural areas. Rural areas provide sanctuary to the majority of the world's biodiversity. However, many of these biodiversity hotspots are in rural regions with frequent natural disasters (e.g., earthquakes, hurricanes, floods, and droughts) (Myers et al., 2000; Willis et al., 2007). In addition, human populations in those areas have continued to increase in recent decades (Bacci, 2017; Williams, 2013) and households there are often poor and thus especially vulnerable to natural disasters (Masozera et al., 2007). Without effective management interventions, short-term losses due to natural disasters can easily cause long-term poverty (Hallegatte and Dumas, 2009; Hallegatte et al., 2007). This poverty may in turn prompt destructive use of natural resources and lead to poverty-environment traps in which poverty exacerbates environmental degradation and environmental degradation worsens poverty (Barrett et al., 2016; Cao et al., 2009; Carter et al., 2007; Haider et al., 2017; Rudel et al., 2013; van den Berg, 2010).

To steward human-nature interactions toward sustainable development after natural disasters, it is crucial to understand the post-disaster changes in household livelihoods and how these changes affect socioeconomic and ecological outcomes (e.g., human well-being and biodiversity) (Barrios, 2017; Ingram et al., 2006; Lawther, 2015; Resosudarmo et al., 2012). Natural disasters are not entirely “natural”. Their effects on households depend crucially on households' livelihoods which interact with changes in factors such as institutions and biophysical environment (Barrios, 2017). In biodiverse regions, efforts to respond to adverse effects of natural disasters have the added challenge of taking biodiversity into account. Conservation polices along with development of some off-farm industries such as nature-based tourism

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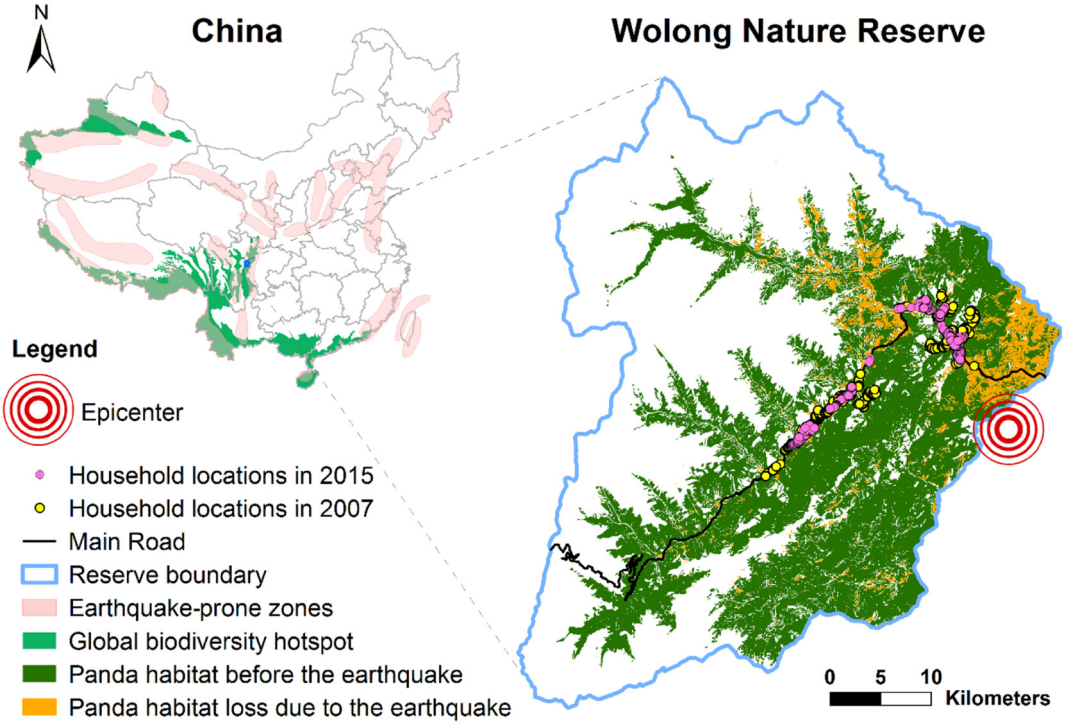

Fig. 1. Wolong Nature Reserve in Southwestern China. The reserve is located within one of the overlapped regions between an earthquake-prone zone and global biodiversity hotspots in China. The information on panda habitat and its change was obtained from the published results (Ouyang et al., 2008).

can substantially shape households' livelihood portfolios and mitigate their impacts on ecosystems (Liu et al., 2012; Yang et al., 2018). However, natural disasters may reshape livelihood portfolios and generate unexpected outcomes. A better understanding of interrelated changes in livelihood portfolios and recovery outcomes after natural disaster is therefore important for management agencies to develop better interventions that facilitate households' recovery after disasters while minimizing their impacts on ecosystems. Absent such interventions, unregulated livelihood activities (e.g., timber harvesting) after disasters may lead to serious biodiversity loss and compromise the natural capital that is essential for the long-term sustainability of local communities (Ingram et al., 2006).

While there is vast and sophisticated literature on natural disaster (Phillips, 2015; Rodríguez et al., 2007; Smith et al., 2018; Tierney, 2014), little if any of it directly addresses the linkages between post-disaster changes in livelihoods and human well-being, especially in biodiverse areas. The existing literature has examined the restoration of housing conditions, household income, and people's psychological health (e.g., Priebe et al., 2011; Rathfon et al., 2013; Yang, 2013), and how these recovery outcomes are influenced by demographic and socioeconomic characteristics, such as race and ethnicity (e.g., Finch et al., 2010; Wang et al., 2012; Wang et al., 2015; Zhang and Peacock, 2009), as well as external assistance (e.g., Msilimba, 2010; Resosudarmo et al., 2012). A recent study by Yang et al. (2015) has further examined the linkages between households' dependence on ecosystems services and the impact of natural disasters on human well-being. However, systematic evaluation of long-term changes in livelihoods and their linkages to recovery of human well-being after natural disasters is rare in existing literature (Burton, 2015; Lawther, 2015), largely due to the lack of relevant data.

Long-term interdisciplinary research project conducted in China's Wolong Nature Reserve (Wolong hereafter), which was seriously affected by the Wenchuan Earthquake, provides an excellent opportunity to address this issue. On May 12, 2008, a catastrophic earthquake (Ms 8.0; the most devastating in China since the 1950s) struck southwestern China, with its epicenter in Wenchuan County, Sichuan Province (Viña et al., 2011; Zhang et al., 2014). The earthquake generated tremendous socioeconomic impacts in China, as it caused 69,227 deaths, 374,643 injuries, and 17,923 people missing, in addition to over 84.51 billion yuan ($12.6 billion USD) of economic loss associated with property damage (CCTV, 2009). The earthquake also caused serious impacts on biodiversity (Zhang et al., 2014; Zhang et al., 2011). It was estimated that about 1221 km^2 of forest, grassland, and wetland was lost (e.g., converted to bare land) due to the earthquake and subsequent landslides (Ouyang et al., 2008; Xu et al., 2009). In response, the Chinese government initiated hundreds of post-disaster reconstruction projects to rebuild the facilities, infrastructures, and residential houses with a massive investment of over 1700 billion yuan ($253 billion USD) (China News, 2012).

Wolong is among the areas most seriously affected by the Wenchuan Earthquake. By taking advantage of the long-term research and data collection efforts in Wolong (e.g., An et al., 2001; Chen et al., 2012b; Linderman et al., 2005; Liu et al., 1999b; Tuanmu et al., 2011), we are able to empirically evaluate livelihood changes after the earthquake and how those livelihood changes affect human well-being. We first characterized changes in local households' livelihood portfolios in response to the direct and indirect impacts of the 2008 Wenchuan earthquake using multi-year household survey data. We then used a quantitative human well-being index system to characterize changes in human well-being for each surveyed household. Finally, we built empirical models to evaluate the effects of changes in household livelihood portfolios on human well-being recovery. This allows us to discuss the management strategies that would facilitate sustainable development amid natural disasters in Wolong and beyond.

Our study is one of the first to add a focus on the households' livelihood portfolio to the overall literature on disaster recovery. It complements existing literature on a central theme in ecological economics: how households manage a portfolio of resources to generate well-being (De Sherbinin et al., 2008; Dietz, 2015; Nguyen et al., 2015; Pour et al., 2017). In addition, a natural disaster is one of many exogenous factors that shape the success of household livelihood strategies for well-being because a natural disaster's impacts are as much a result