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# Building improvement responses to multi-hazard risk in the historic Dali Dong Village, Guizhou, China



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## ABSTRACT

The aim of this study is to investigate the local government and the people's building improvement response to multi-hazard risk and to identify the difficulties that hampering local people's response in the case of Dali Dong Village. All 300 residential buildings were investigated mainly through observation surveys and structured interviews with the owners. The conclusions are as follows.

First, while the fire strategy-centered regulations for historical villages at the national and provincial levels suggest using non-combustible or fire-retardant materials when renewing wooden buildings, the method for improving the fire-resistance of existing wooden buildings remains unclear. As perceived by the villagers, two programs conducted by the local government in Dali Dong Village effectively reduced the fire risk. Second, nearly one-third of the local people have replaced the first stories of their wooden buildings with brick or concrete to reduce the fire risk. A few local people have also built single-skin brick retaining walls to protect against landslides. More than half of the households that experienced floods had elevated the foundations or stilted the buildings. Third, according to local people's perceptions, insufficient financial capacity, limited access to disaster-resistant building technology, and lack of flatland resources are the main difficulties limiting their building improvement activities.

Finally, multi-hazard risk-targeted regulation, detailed technical guidelines at the local level, new material and technology development targeting historical wooden buildings, long-term technical support, and multiple channels of financial support are all strongly advocated as means to reduce disaster risk in the context of World Heritage.

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## 1. Introduction

### 1.1. Research background

The Dong ethnic minority, the 12th largest ethnic minority in China in terms of population, lives mainly in the mountainous area of Southwest China. Twenty Dong villages encompassing settlements where the cultural traditions of the Dong ethnic minority are well preserved have been included in the Tentative List of properties considered for nomination to the World Heritage List, in recognition of their outstanding universal value [1]. However, as residing close to water is the most important settlement custom of Dong villages, their houses are distributed on mountain slopes along rivers [1]. These Dong villages are exposed to high risks of a number of hazards – such as fire, landslide, and flood – due to the mountainous environment and high-density wooden buildings.

For instance, reviewing the major accidental fires nationwide based on Liao [2], of the 33 major accidental fires that occurred in historical villages in China during the last two decades, 25 happened in Dong villages, including one on the World Heritage Tentative List. In contrast to other heritage types, a historical village is also a living space; residential buildings are the core elements of a historical village heritage. Therefore, the building improvement response to the multi-hazard risk can be interpreted as a basic strategy for heritage conservation.

### 1.2. Research purpose and objectives

The purposes of this study are twofold: to investigate the local government and the people's building improvement responses to multi-hazard risk and to identify the difficulties hampering building improvement activities in Dali Dong Village, one of the 20 Dong villages on China's World Heritage Tentative List. This research aims to contribute to developing specifically targeted measures to support local people in disaster-resistance enhancement in historical villages.

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### 1.3. Previous studies and positioning of this research

Through the literature review, no study could be found considering local people's building improvement in response to multi-hazard risk at the community level. At the macro level, some studies have concentrated on social and institutional improvement [3–5], while other have focused on construction management improvement [6]. One study, which focused on people's improvement activities in existing living spaces, considered building safer cities to adapt to disaster risk in the future at the city level [7].

Among the studies about Dong villages, some have discussed the local wisdom for fire prevention and mitigation [2,8–11]. For instance, they introduced the traditional firefighting water system and separately sited granaries. Other studies have analyzed the vulnerabilities of Dong villages [2,8,10,12–16], such as the remarkably low fire-resistant compact wooden buildings without a fire compartment, the tradition of firewood utilization, the aged electrical wiring systems, and insufficient firefighting facilities, etc. Several studies introduced fire risk mitigation programs [8,10,11] such as the “fire protection pilot projects”, which aim to improve the kitchens, wooden buildings, firebreaks, electrical wiring systems, and water systems in rural villages. However, most of the previous studies have focused on governmental activities, no study was found regarding the local people's building improvement activities in historical Dong villages.

### 1.4. Research methodology

To investigate the building improvement activities responding to multi-hazard risk affecting Dali Dong Village and to identify the difficulties hampering local people's activities, this study conducted research activities through three principal methods (Table 1). First, we sought to understand the conservation planning and its implementation by interviewing five staffs from the Dali Conservation Program Office and clarified the policies and measures related to disasters and heritage conservation by interviewing two village leaders. Second, through structured interviews, we investigated the local people's disaster experiences, damage to housing, their improvement activities to enhance the disaster-resistance of residential buildings, and the difficulties that hamper their activities. The fire-related samples were selected through spatially uniform sampling (Fig. 1) The landslide and flood-related samples comprised all the available owners among the households affected by these two disaster types. Third, we recorded the detailed building improvement measures through

observation surveys. These research activities were conducted in July 2015 and in February 2016.

### 1.5. Outline of the study area: Dali Dong Village

Dali Dong Village was established during the 1730 s and is located in the Qiandongnan Miao and Dong Autonomous Prefecture in the southeast of Guizhou Province (Fig. 2(a)). As present (recorded in 2016), Dali Dong Village has 300 households and 1,308 Dong ethnic minority residents. Most of them rely on traditional agriculture. Adapted to the terrain, the wooden buildings are spread compactly alongside the river (Fig. 2(b)), leading to the typical vulnerabilities of Dong villages to accidental fire, landslides, and flooding. Of the 300 residential buildings, 212 are traditional two-, or three-story wooden buildings (Fig. 2(c)). Dali Dong Village was included in China's World Heritage Tentative List in 2006.

## 2. Multi-hazard risk in the Dali Dong Village

### 2.1. Particularly high fire risk in and geological hazards to historical villages in Guizhou

Ethnic minorities in Guizhou constitute 37.84% of the local population; 426 historical villages preserving the colorful cultural landscape of traditional human settlements have been registered as Chinese Traditional Villages, accounting for 16.7% of all Traditional Villages in the whole country. Adapting to the limited availability of flatland and local resources in the mountainous environment, these historical villages tend to present compact layouts with traditional buildings constructed from wooden materials from time immemorial (Fig. 2(c)). In addition, the local people customarily use open fires for cooking and heating. Moreover, the original electrical networks, which were assembled in the rural areas of Southeast Guizhou in the 1980 s, are gradually running out of capacity in the wake of modern electrical facilities and appliances becoming universal over the last 30 years. Lacking a high-capacity electrical network, in combination with the local people's misoperation on their buildings' aged wiring systems, many accidental fires occur [13]. Moreover, located on the mountain sides, the historical villages usually lack sufficient water resources and firefighting facilities for the initial stage of firefighting. Thus, these historical villages are extraordinarily threatened by fire risk. Of the 33 major accidental fires that happened in historical villages in China from 1999 to 2016, 25 occurred in Dong

**Table 1**  
Outline of Field Survey.

Disaster	Methods	Sample Size	Sampling Strategy	Content
Fire accidents	Interviews	Dali Conservation Program Office staffs Village leaders	5 persons 2 persons	Conservation planning Policies and measures
	Structured interviews	Villagers	115 valid/115 collected/115 delivered (Total 309 households)	Experience, damages, measures, and difficulties
	Observations	Building structure Inner space	300 buildings (Total 300 buildings) 260 buildings	All All the available owners
Land-slides	Structured interviews	Village leaders Villagers	2 persons 39 households (Total 56 were affected)	Policy and measures Experience, damages, measures, and difficulties
	Observations	56 (Total 56 buildings were affected)	All	
Floods	Structured interviews	Village leaders Villagers	2 persons 38 households (Total 64 were affected)	Policy and measures Experience, damages, measures, and difficulties
	Observations	64 (Total 64 buildings were affected)	All	

<sup>a</sup> Spatially uniform sampling is a systematic sampling strategy through which the samples are regularly distributed in a given spatial context. The selected samples were adjusted minutely according to the owners' willingness to cooperate.

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