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How to avoid mass deaths in the emergency avoidance process of mountain disasters

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Outline



Background



Disaster events: case study



Experiences and lessons of evacuations



The whole process of emergency evacuation

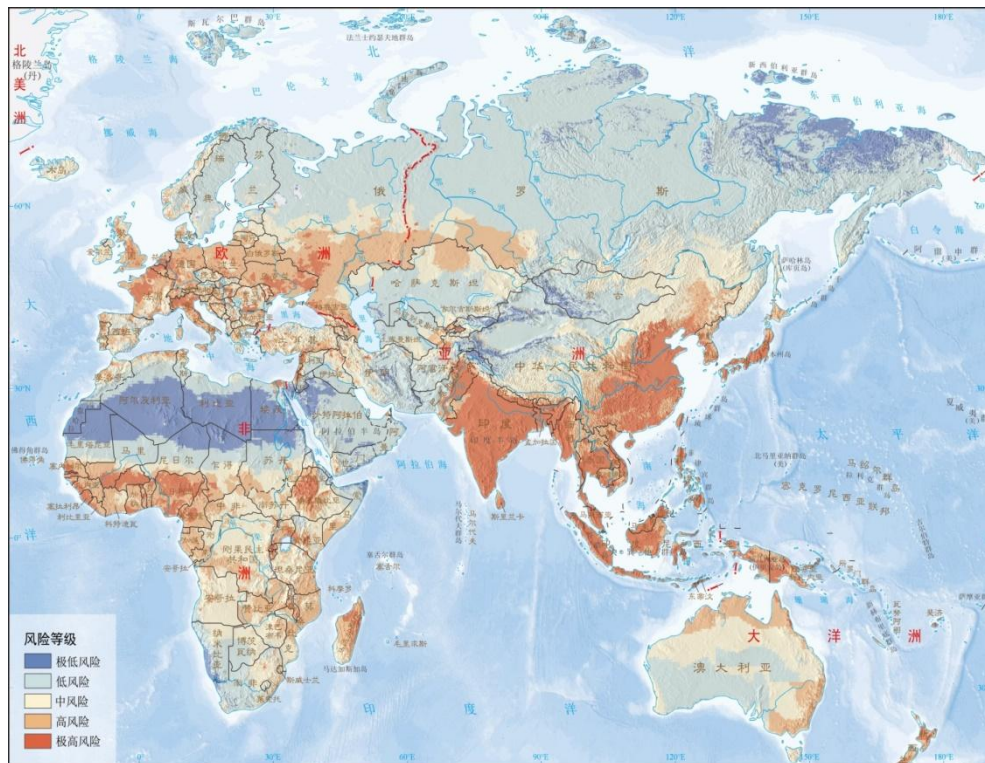


Summary

1 Research background

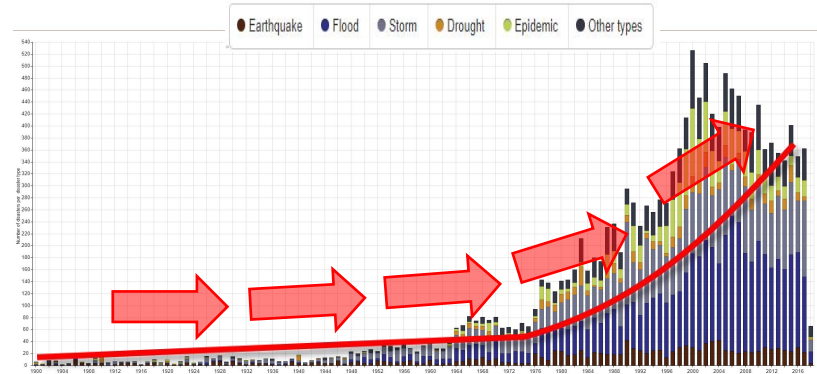
Natural disaster risk in the context of global climate change

Natural disaster risk along the Belt and Road

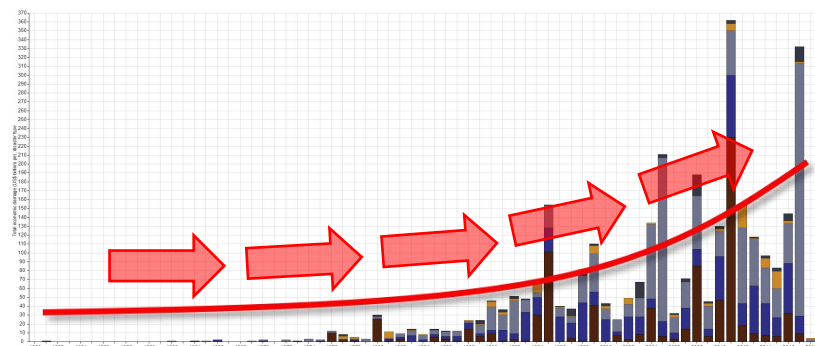


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Disaster events (1900-2018)

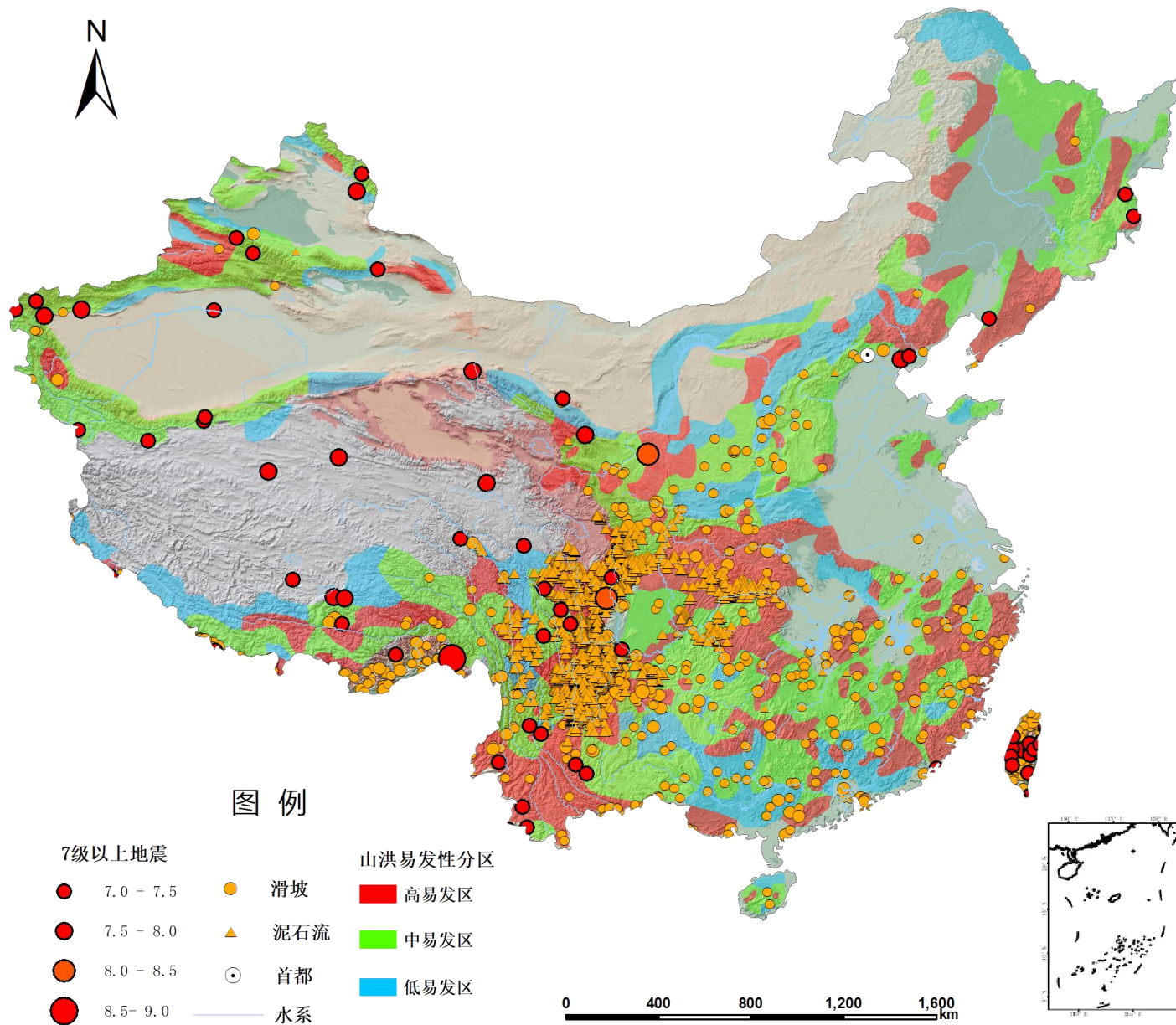


Disaster loss (1950-2018)



Data source: EM-DAT

Distribution map of natural hazard prone areas in China



2 Disaster Events

Case 1: Zhouqu debris flow in 2010

Before the event



After the event



on August 7th, 2010, the giant debris flow totally killed **1,765** persons , caused **22,667** homeless, and induced enormous property losses.



The event damaged 4,321 houses, which is regarded as the most severe debris-flow disaster since 1949

Case 2: Qingping debris flow and flood in 2010

On Aug 12th-13th 2010, debris flows from 21 gullies around Qingping township, delivered 3 million m³ and blocked Mianyuan River, caused 7 deaths, 5 people missed and more than 300 houses buried.



Qingping Town was once a famous rural resort for ginkgo trees. In recent years, it has created scenic spots such as “Flying Valley” and ‘Golden Avenue’, which attracting a large number of tourists to visit.



Case 3: Yingxiu debris flow and flood

Debris flow damming mainstream river,
causing a chain of disasters

Key point-preventing dam formation

Control the discharge

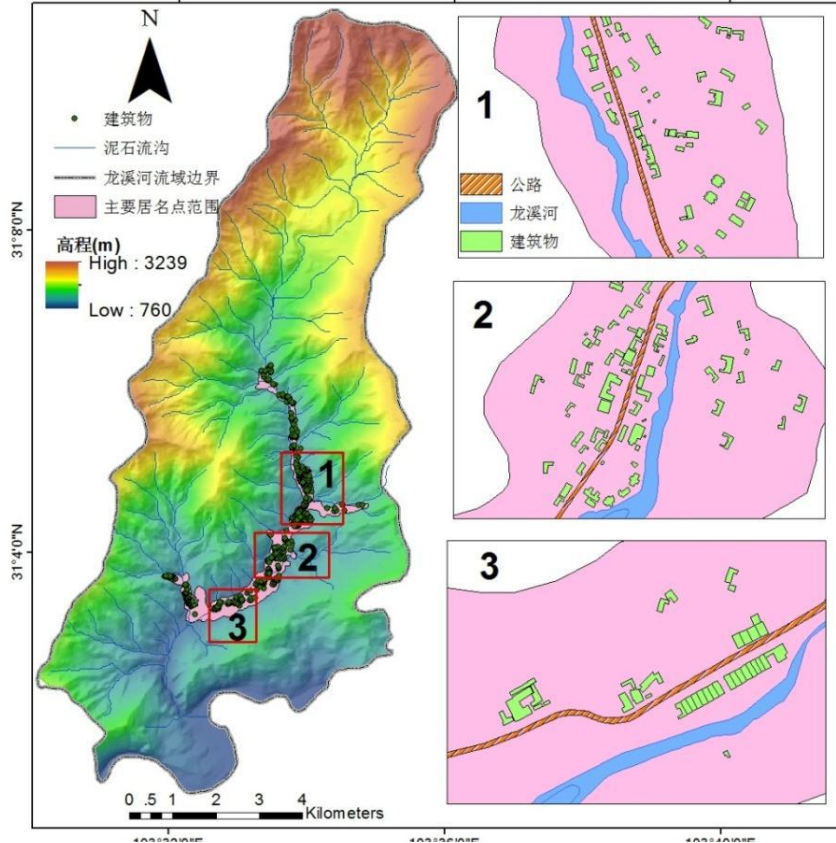
The debris flow and flood caused 13 deaths, 59 people missed and more than 8000 people affected, and part of the new towns were flooded.



Case 4: Longchi debris flow in 2010

Longchi is an ecological tourist town in Sichuan Province, which suffered mountain disasters almost every year after the "5.12" Wenchuan earthquake.

The direct economic loss in "8.13" debris flow disaster event in 2010 was 550 million RMB, the disaster resulted in 5149 people were affected and 196 houses were damaged.



Case 5: Diexi landslide in 2017



On June 24, 2017, a high mountain landslide suddenly occurred in Xinmo village, Diexi township, Mao County, sichuan province, which resulted in blocking 2 km road, more than 120 people buried, 10 people killed and 73 missing, the mud marks over 100 metres high can be clearly seen at right side of Songping gully.



Case 6: Dazhai landslide in 2010



On June 28, 2010, a massive landslide suddenly occurred in Dazhai village, Gangwu township, Guanling County, Guizhou province, which resulted in 42 people killed and 57 missing.

Case 7: Aizi debris flow in 2012

On June 28, 2012, the large debris flow occurred in Aizi Gully, Ningnan County, Sichuan Province, China was the annually most serious debris flow in construction site in China, resulting in 40 deaths or missing.



Case 8: Caogu debris flow in 2020



On June 28, 2020, a debris flow caused 17 deaths or missing in Caogu Township, Mianning County. Seven people were washed away in a tricycle on the evacuation road.

Case 9: Longmenshan flash flood and debris flow in 2012

In 2012, during the "8.17" massive flash flood and debris flow, local government successfully displaced more than 8000 tourists and 400 households, and thus created "tourists with zero died" miracle.

8.17 16:00	Forecast of meteorological and geological disasters	Pengzhou city
8.17 17:00	Initiate emergency plan	township
8.17 17:30	Evacuate tourists and local residents	Township and village
8.18 6:00	Immediately constructed a temporary bypass	government
8.18 17:00	Restored footpath and power	City and township
8.18 18:00	Restored mobile communications	city
8.19 18:10	All tourists are evacuated	township
9.07	All vehicles are transported out	township



Organizing tourists to evacuate



The rescue work are conducted by footpath

Among 93 respondents, 90% of the residents are satisfied with the local government's mountain disaster emergency response capacity

3.1 Experiences of successful evacuations

- **Accurately and timely forecast of meteorological conditions;**
- **Avoiding in advance;**
- **Disaster training and regular emergency drills;**
- **Disaster preparedness in communities ;**
- **The ‘Public Participatory Monitoring and Warning System’ (PPMWS), in Chinese ‘群测群防’ (qún cè qún fáng).**

Disaster training and emergency drill



Disaster preparedness in communities

虹口乡2012年度地质灾害点位责任明细表

[illegible]

Responsibility chart

虹口乡汛期地质灾害应急救援人员名单

[illegible]

Rescue team list

磁鐵、赤鐵、正石及零散之尖面

新加坡工作许可证

姓名: 李 文 芳 性别: 女 出生日期: 1960-01-01

证件号码: 12345678901234567890

职业: 教师

雇主: 新加坡教育部

地址: 新加坡 123 街 456 号

电话: 1234567890

有效期: 2025-12-31

备注: 此证有效

姓名	性别	出生日期	证件号码	职业	雇主	地址	电话	有效期	备注
李 文 芳	女	1960-01-01	12345678901234567890	教师	新加坡教育部	新加坡 123 街 456 号	1234567890	2025-12-31	此证有效

协议

甲子、己丑时好春金

乙亥、丙辰时二阴、夏成和

庚午的时好 2014 年逢庚午，庚午为猪狗年生逢品运旺年可发财进宝年下好运。

一日出时庚子、乙亥为火旺，都以天干的戊戌土为加助命年，庚午和乙亥是不以戊戌，甲子为戊戌的思想和物品的数量，并支丑和戌是丑戌。

本命的乙丑酉，不得丑时。

如庚子年丑。

甲子、己丑时好春金

乙亥、丙辰时二阴、夏成和

2014 年正月丁未

The disaster-prevention card

Material agreement

红色社区地质灾害日常巡查记录表

调查地点	调查时间	调查人员	发现物品
子河	2012.4.1	陈树强	无字票
塘子河上	2012.4.2	陈树强	无字票
塘子河下	2012.4.3	陈树强	无字票
子河	2012.4.4	陈树强	无字票
叉河沟	2012.4.5	陈树强	无字票
子河	2012.4.6	陈树强	无字票
板桥沟	2012.4.7	陈树强	无字票
子河	2012.4.8	陈树强	无字票
塘子河上	2012.4.9	陈树强	无字票

Monitoring records

Shelter

Monitors' responsibility letters



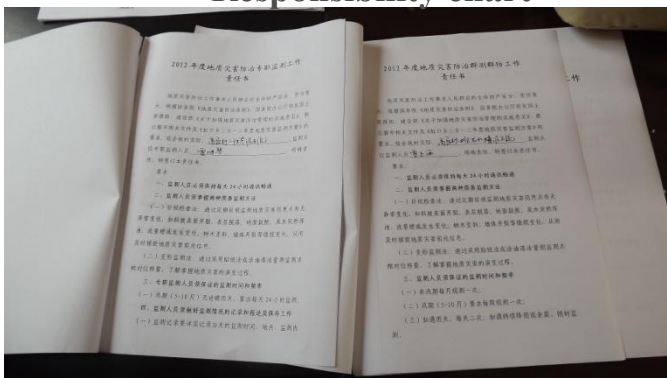
Disaster warning signs



Alarm system



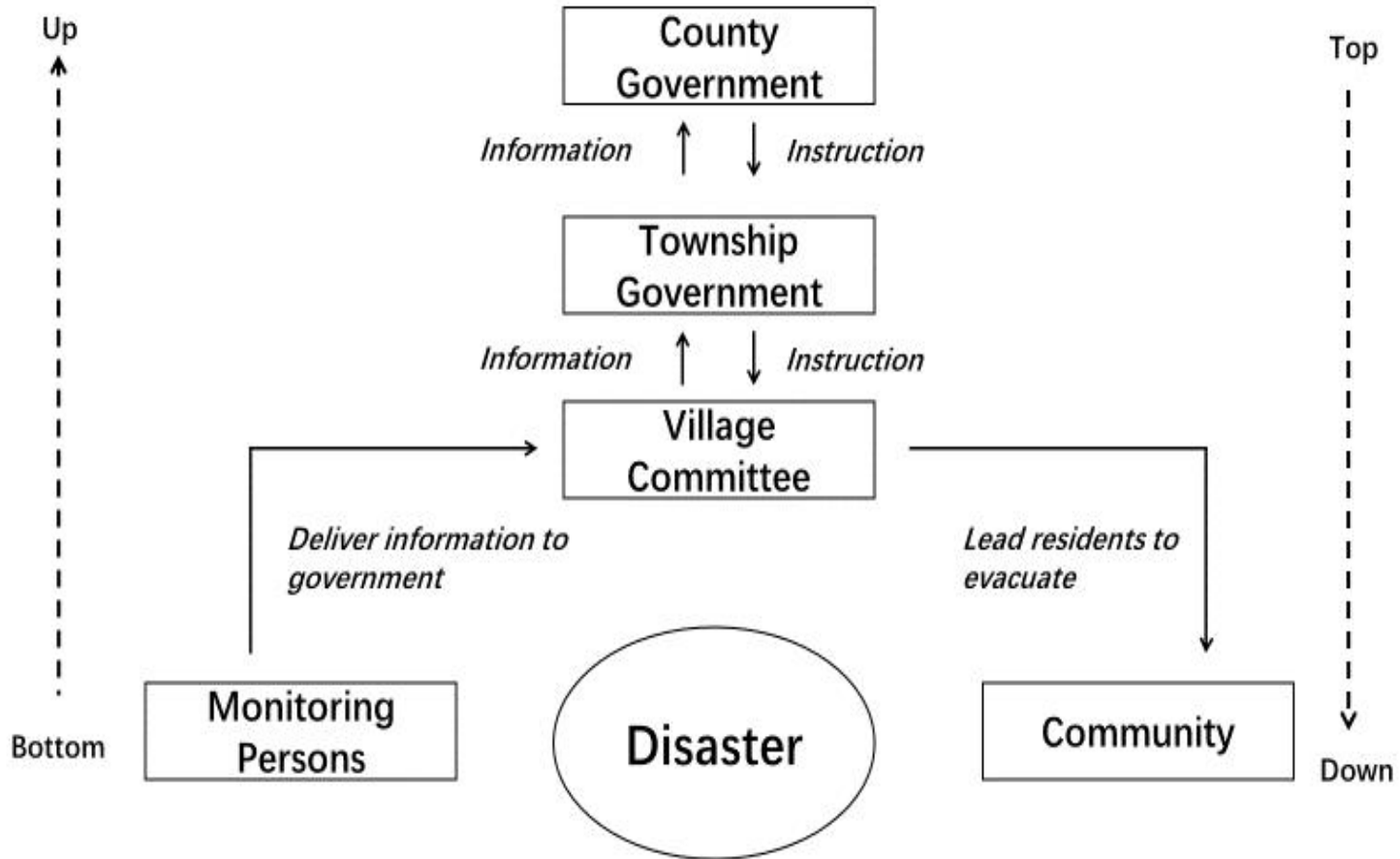
Disaster prevention drills props



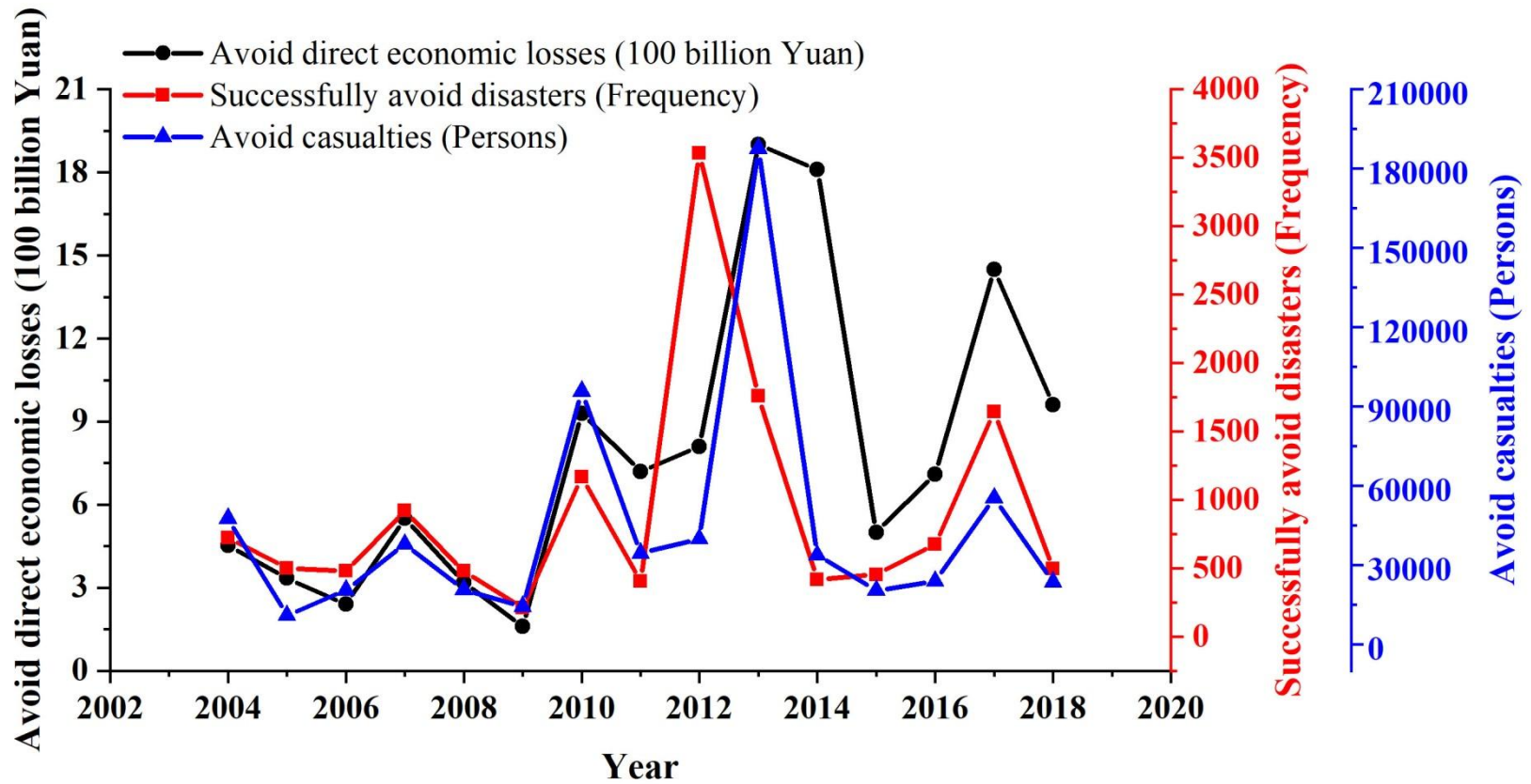
Responsibility chart

Monitors' responsibility letters

‘Public Participation Monitoring and Warning System’ (PPMWS) is to involve the public to participate in monitoring and warning mountain hazards.



PPMWS Management Pattern



The effect of PPMWS in 2006 - 2018

Disaster Mitigation Card and Disaster Avoidance Card

Appendix: Two Cards for PPMWs

Collapse, Landslide, Debris Flow and other Geological disasters Disaster Mitigation Card

No. *****

Basic Information for Disasters	Location			
	Type & Scale			
	Causes			
	Threats			
Monitoring and Early Warning	Responsible Person for Monitoring	Phone Number		
	Symbols for Monitoring	Monitoring Means and Methods		
Emergency Response and Evacuation	Criteria for disaster prediction	Set Evacuation Route	Planned Safety Spot	
	Responsible Person for delivering evacuation orders	Phone Number		
	Responsible Person/Institutes for Emergency Response	Phone Number		
	Responsible Person/Institutes for Security	Phone Number		
	Responsible Person/Institutes for Medical Aid	Phone Number		

*This card is supposed to release to the Responsible Persons/Institutes

Pressed by the Ministry of Natural Resources of the People's Republic of China

Collapse, Landslide, Debris Flow and other Geohazards Disaster Avoidance Card

No. *****

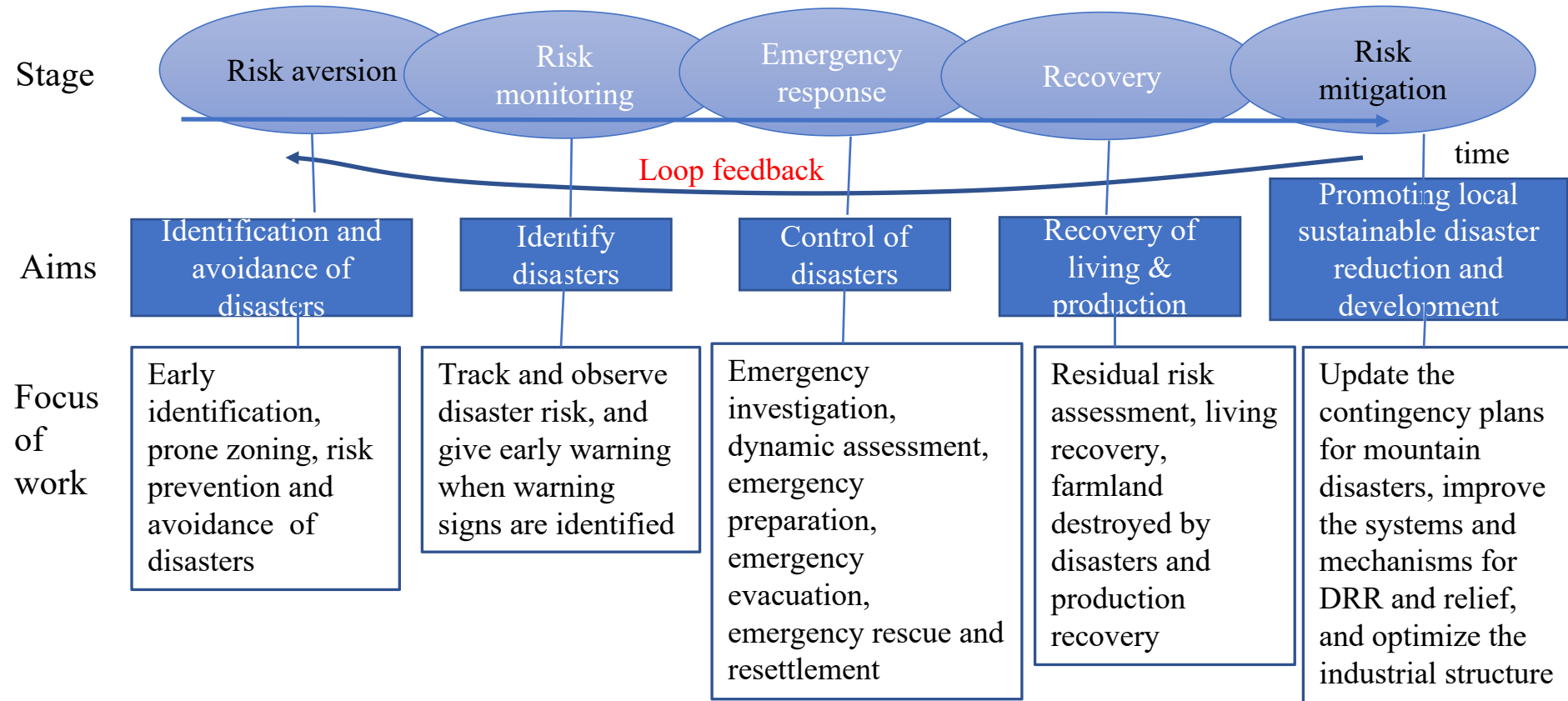
Name of Houseowner	Family Size	Type of House	Basic Information of Disasters				
Home Address			Disaster Type	Disaster Scale			
Family Members	Name	Gender	Age	Name	Gender	Age	Location of Household to the Potential Disaster
							Causes
							Attention & Notes
Monitoring and Early Warning	Monitoring Person	Phone Number	Evacuation Route				
	Symbol for Early Warnings		Evacuation and Resettlement	Location for Resettlement	Responsible Person	Phone Number	

Pressed by the Ministry of Natural Resources of the People's Republic of China

3.2 Lessons of unsuccessful evacuations

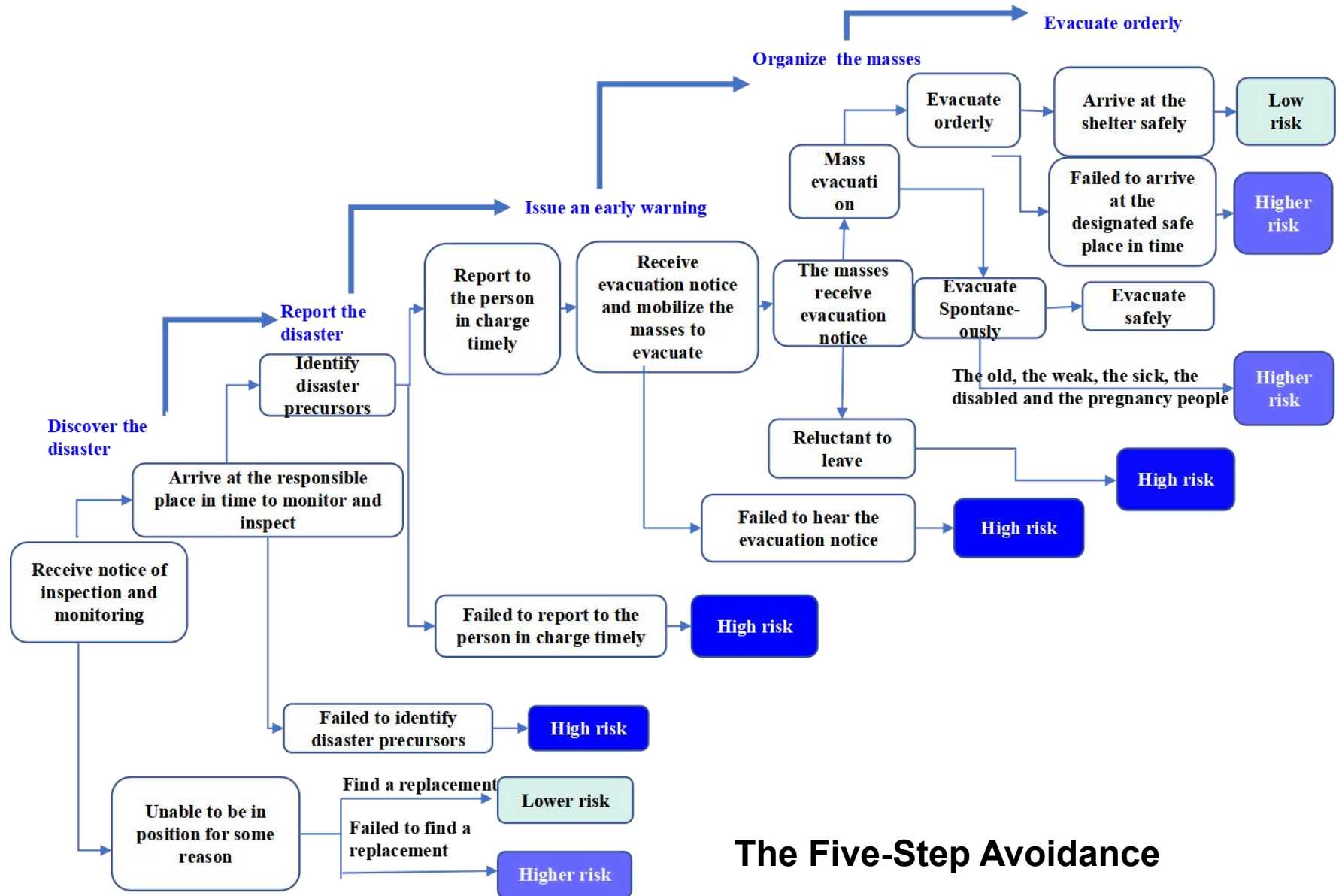
- **Limited warning accuracy**
- **Warning signals are not fully covered, such as remote mountainous areas, engineering sites and traffic lines**
- **Lack of disaster awareness, emergency knowledge and skills.**
- **Invulnerability inhibit the opportunity for avoiding risk, and avoiding risk has not yet become first reaction.**
- **Secondary disaster due to most of the residents return to the area prone to mountain hazards voluntarily.**

4.1 Stage division of emergency risk management



*Risk aversion and mitigation falling into forward and backward extension processes

4.2 Event Tree Analysis Method to identify the weak links



The Five-Step Avoidance

Challenge



Primary issues :

Safety of tourists during flood season

Management of emergency shelters

The monitoring and emergency response team is unstable

5 Summary

- ❖ **Since it is difficult to accurately predict the occurrence time, space and intensity of mountain disasters, limited by manpower, material resources and funds, and adopted sustainable, emergency avoidance is still a relatively effective choice at present;**
- ❖ **PPMWS, the emergency warning, emergency training and exercises, disaster preparedness in communities are key points of successful emergency evacuation.**
- ❖ **Limited warning accuracy, warning signals are not fully covered, Lack of disaster awareness, Secondary disaster are lessons of unsuccessful evacuations.**
- ❖ **Analysis of mountain disaster emergency evacuation process and weak links, and challenge.**

A scenic landscape featuring a calm river in the foreground, reflecting the surrounding environment. The riverbanks are lined with trees in autumn foliage, ranging from green to yellow and orange. In the background, majestic mountains with significant snow cover rise against a clear blue sky. A semi-transparent blue banner with rounded corners is centered over the image, containing the text "Thank you so much!" in a bold, red, italicized font.

Thank you so much!