Investigation Study on the Living Environment of Rural Mountainous in Eastern Zhejiang

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Abstract. In this paper, the living environment of rural mountainous in eastern Zhejiang were investigated. 76 geological hazards in this areas were selected as the investigation objects. The investigate results were showed that landslides, collapses and debris flows will effect the residents living. There were 43 instable disasters in the investigation areas; and 1 largest size, 41 medium size and 34 small size disasters. The risk evaluation results were showed that there were 16 high risk and 60 medium risk of disasters in this areas. The research results will provide a basis for the disaster prevention and help the residents to avoid the disasters.

1. Introduction
The eastern coastal areas of Zhejiang Province are mainly hilly and plain terrain. There are many geological hazards affected by typhoon in rural mountainous areas. Typhoon and mountainous topography will effect the mountain stability and the living environment of rural mountainous [1]. The Agricultural land and beach were changed to urban and rural construction land, and the shallow water changed to beach because of the high development of land resources since 2000. And the rural environment was deteriorating due to the increasing human activity [2, 3].

In this paper, the rural mountainous disasters in eastern Zhejiang were investigated. Potential disaster type, size and hazard potential will be researched by field investigation and comparative evaluation. The results will provide the basis for disaster prevention and help the residents to avoid the disaster.

2. Study rural mountainous introduction
The research rural mountainous are located in 120°51′42″–121°25′48″ east longitude and 29°40′30″–30°20′12″ north latitude. The survey areas are the subtropical monsoon climate zone, warm and humid, with clear four seasons and abundant rainfall. The annual average rainfall in mountainous areas is above 1900 mm, and the typhoon has a great influence on rainfall in this region. The mountainous areas belongs to the hilly area. A total of 171 geological disasters have occurred in this areas, and the economic loss add up to 121.34 million yuan.

In this paper, the environmental geological hazards were investigated first. Then, classify the landslides, collapses and debris flows. At the end, evaluate the damage degree and the hazard degree
3. Investigation on the types of environmental geological hazards

76 geological hazards in this areas were selected as the investigation objects. According to the field investigation and data collection, the type and scale of geological hazards were statistically analyzed, including 33 landslides, 12 collapses and 31 debris flows. The research showed that the landslide and collapse were small size; 5 debris flows were medium size and 26 debris flows were small size.

Table 1. Classification of environmental geological hazards

| Type        | Division basis   | Name         | Type   | Index                        | Number | Percentage |
|-------------|------------------|--------------|--------|------------------------------|--------|------------|
| Reason      | Engineering      | Human activities | 32     | Physical factor               | 1      | 3.1%       |
|             | Nature           | Soil         | 33     |                              |        | 100%       |
|             | Rock landslide   | Rock         | 0      |                              | 0      | 0          |
|             | Shallow          | <10m         | 33     |                              |        | 100%       |
| Slide thickness | Middle layer | 10~25m      | 0      |                              | 0      | 0          |
|             | Deep layer       | 25~50m       | 0      |                              | 0      | 0          |
|             | Deeper layer     | >50m         | 0      |                              | 0      | 0          |
|             | Thrust-type      | Rear push    | 0      |                              | 0      | 0          |
| Landslide   | Motion form      | Retrogressive| 33     | Front traction                | 33     | 100%       |
|             |                  | Small        | <10×104m³ |                              | 33     | 100%       |
|             | Volume           | Medium       | (10~100)×104m³ | 0                | 0      | 0          |
|             |                  | Large        | (100~1000)×104m³ | 0               | 0      | 0          |
|             |                  | Largest      | >1000×104m³ | 0                          | 0      | 0          |
|             |                  | New          | Active   |                              | 33     | 100%       |
|             | Age              | Old          | Occurs after the Holocene  | 0      | 0          |
|             |                  | Ancient      | Occurs before the Holocene | 0      | 0          |
| Composition | Soil collapse    | Soil         | 4      |                              |        | 33.3%      |
|             | Rock collapse    | Rock         | 8      |                              |        | 66.7%      |
| Collapse    | Toppling         | Affected by overturning moment | 6      |                              |        | 50%        |
| Formation mechanism | Sliding          | Shear force on slip surface | 2      |                              |        | 16.7%      |
|              | Bulging          | Vertical compression of lower strata | 0      |                              | 0      | 0          |
|              | Pull-splitting   | Tensile tension | 4      |                              |        | 33.3%      |
|              | Broken           | Shear force caused by self-weight | 0      |                              | 0      | 0          |
|              | Volume           | Small        | <1×104m³ |                              | 12     | 100%       |
|              |                  | Medium       | (1~10)×104m³ | 0                | 0      | 0          |
|              |                  | Large        | (10~100)×104m³ | 0               | 0      | 0          |
|              |                  | Largest      | >100×104m³ | 0                          | 0      | 0          |
|              | Debris flows     | Small        | <2×104m³ |                              | 26     | 83.9%      |
|              |                  | Medium       | (2~20)×104m³ | 5                |        | 16.1%      |
|              |                  | Large        | (20~50)×104m³ | 0               | 0      | 0          |
|              |                  | Largest      | >50×104m³ |                              | 0      | 0          |
|              | Basin form       | Gully type   | Basins fan or narrow strip | 19     | 61.3%      |
|              | Surface type     | Basins bucket - shaped, no obvious circulation area | 12     |                              |        | 38.7%      |
4. Risk assessment of geological hazards

4.1. Stability Analysis

According to the stability criterion of collapse and landslide and the comprehensive evaluation standard of debris flow susceptibility in "Specification of geological investigation for debris flow stabilization" [4], the stability evaluation of the hidden danger points of geological disasters in this regions were carried out. Among 76 hidden danger points of geological disasters, the most landslides and collapses were instable; and all of the debris flows were relatively stable.

4.2. Damage Degree Evaluation

The hazard degree was classified according to the classification standard of hazard degree. The results were shown in Figure 1.

There were 34 small size and 41 medium size of geological disasters in this area, which were accounting for 44.7 % and 53.9 % of the total. In addition, among the 33 landslide hazards, 16 were small size, 16 were medium size and 1 was largest size. Among the 12 collapse hazards, there were 11 small size and 1 medium size. There were 7 small size and 24 medium size debris flows in this areas.

4.3. Hazard Evaluation

According to the evaluation results of the stability and hazard degree of geological disasters, the hazard evaluation of various geological disasters were carried out. The evaluation results were showed that there were 16 high risk and 17 medium risk of landslides, medium risk of Collapses and debris flows in this areas.

5. Conclusion

This paper mainly focuses on the investigation of rural mountainous living environment in eastern Zhejiang. The study analysis results were showed that landslides, collapses and debris flows will effect the residents living. There were 43 instable disasters in the investigation areas; and 1 largest size, 41 medium size and 34 small size. The risk evaluation results were showed that there were 16 high risk and 60 medium risk of disasters in this areas. The study results will help the residents to avoid the disaster.

References

[1] LIAO Ke-wu, DING Xiao-guang, PAN Chi-hong, Types and characteristics of geologic disasters induced by typhoon “Fitow”in Yuyao city, The Chinese Journal of Geological Hazard and Control, 25(2014) 2 130-134.
[2] Yu Teng, Analysis of Landuse Exploitative Intensity in Ningbo Section of South Hangzhouwan Bay, Ningbo University, 2015.
[3] Chen Yang, Research on Land Use Pattern in Coastal Zone—The South Bank of Hangzhou Harbor as Case, Ningbo University, 2015.
[4] Ministry of Land and Resources of the People’s Republic of China, Specification of geological investigation for debris flow stabilization, 2006.