Investigation and Research on Geological Disasters in Nanzheng County

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Abstract: Based on the data from the detailed survey of geological disasters in Nanzheng County, Shaanxi Province, the natural situation of Nanzheng County was introduced. The types, status and development rules of geological disasters in Nanzheng County were evaluated, and the formation conditions and influencing factors of its geological disasters were systematically analyzed and researched, which provided a geological basis for the prevention and control of geological disasters.

1. Introduction
Nanzheng County of Shaanxi Province is located in the south of Hanzhong City, southwest of the Hanzhong Basin. To the east is Chenggu and Xixiang Counties, and to the west is Ningqiang and Mian Counties. South Yiba Mountain is connected to Tongjiang, Nanjiang, and Wangcang counties in Sichuan, and Hanjiang to the north, facing Hanzhong city across the river. The county is 83km wide from east to west and 79km long from north to south, with a total area of 2849km². The transportation in the county is mainly by roads. The Xi-Han Expressway passes from east to west in the northern part of the county. Provincial Highway 211 (Hanzhong City and Nanjiang County, Sichuan) runs through the north and south of the county. Han (Middle) Zhu (Jaba), Han (Middle) Li (Ping) highway is a county-level trunk highway with convenient transportation.

Nanzheng County is located in the north-south climate transition zone, a cool subtropical continental monsoon climate zone, with four distinct seasons, abundant precipitation, sufficient heat, and mild and humid. However, rainfall is unevenly distributed in time and space, severe droughts and floods, and frequent disastrous weather.

The rivers in Nanzheng County belong to the Hanjiang River System and Jialing River System in the Yangtze River Basin. The main rivers are: Luoshui River, Lengshui River, Yangjia River, Xiliu River, Beiba River, Hou River, Changtan River, Miaoba River, etc. 365.35km.

2. Types and distribution of geological disasters

2.1. Types of geological hazards
According to the detailed survey data of geological disasters in Nanzheng County in 2009, Nanzheng County mainly includes 4 types of landslides, collapses, mudslides, and ground subsidence. There are
216 geological hazards and geological hazards in total, threatening 5190 people and approximately 65,301 million yuan in assets.

This survey adopts the method of combining remote sensing interpretation with ground investigation. There are 47 hidden danger points of landslides and collapses by remote sensing interpretation, 7 disaster points verified in the field, 606 field investigation points, 390 environmental geological survey points and 216 geological disaster (and hidden danger) investigation points. Among all the survey sites, there are 190 landslides, accounting for 88.0% of the total number of geological hazards; 15 collapses, accounting for 6.9% of the total; 8 debris flows, accounting for 3.7% of the total; only 3 ground collapses are found, accounting for 1.4% of the total number of geological hazards (Table 1).

Table 1 Statistical table of geological hazard survey points

| Types of disasters | Remote sensing interpretation | Field investigation | Field investigation excluding remote sensing interpretation | Subtotal |
|--------------------|-------------------------------|---------------------|----------------------------------------------------------|----------|
| Landslides         | 39                            | 190                 | 34                                                       | 190      |
| Collapses          | 8                             | 15                  | 6                                                        | 15       |
| Debris flows       | 0                             | 3                   | 0                                                        | 3        |
| Ground collapses   | 0                             | 390                 | 0                                                        | 390      |
| Geological environment | 0                         |                     |                                                          |          |
| Total              | 47                            | 606                 | 40                                                      | 606      |

Landslides: Landslides are the most developed type of geological disasters in the region, with the characteristics of wide distribution, large number, strong activity and great destructiveness. The investigation found 190 landslides and 186 hidden danger points. Among them, there are 159 accumulative landslides, accounting for 83.7%; 28 cohesive soil landslides, accounting for 14.7%; and only 3 rock landslides, accounting for 1.6%. In terms of landslide thickness, shallow landslides accounted for the most, accounting for 86.3%; the rest were middle-level landslides, accounting for 13.7%; deep landslides were not encountered. The scale is mainly small, accounting for 91.6%; medium and large accounting for only 7.3% and 1.1% respectively. New landslides were dominated by new landslides, accounting for 83.2%; old landslides accounted for 16.8%; no ancient landslides were found. The Wukan landslide is a typical large-scale landslide among cohesive soil landslides. The landslide is 200m long, 1000m wide, and 7.5m thick. It has caused an economic loss of 75,000 yuan and threatened 29 households, 90 people, 95 houses, and 80 mu of arable land. 1000m west main canal. Rock landslides are characterized by large scale, strong suddenness, long displacement, and rapid disaster. A large-scale landslide occurred in October 2000, blocking the road by 50m, and forming a dam on the water near the Loquat Creek (i.e. dammed lake). The height of the water was above 6m, posing a great threat to the cultivated land downstream (Figure 1).
Landslide: Collapses in the area are mainly distributed on the slopes of valleys and valleys where human engineering activities occur. Once they occur, they will block traffic and rivers, destroy houses, threaten the safety of nearby villagers and units, and pose a great threat to passing pedestrians and vehicles (Figure 2).

Debris flow: Debris flow occurs concentratedly in July, August, and September of each year. It is basically triggered by heavy rain or heavy rain. Generally, it erupts suddenly, moves quickly, and is fierce and destructive. 8 debris flow ditches investigated. 1 debris flow ditch threatening more than 100 people. From August to September 1999, there was heavy rain, which lasted nearly 2 hours. The upstream flood of the mud-rock flow ditch carried a large amount of sediment and rocks from the middle and upper reaches of the river and rushed to the downstream Nongfeng Reservoir, causing sedimentation at the bottom of the reservoir and reducing its storage capacity.

Ground collapse: generally large in scale and extremely destructive, such as Cui Xing ground collapse threatens 45 households, 195 people, 185 houses and many farmlands. The ground collapse in Jiangjiantan threatened 19 households, 84 people, 60 houses, and more than 200 acres of farmland. It has caused cracks and collapses in many houses (Figure 3).
2.2 Distribution law

The spatial distribution of geological disasters: Nanzheng County has complex geological conditions. The distribution of geological disasters in the area is strictly restricted by natural geological conditions such as topography, geological structure and human factors. Geological disasters are relatively concentrated in space. Specifically, the northern river valley terrace plain area is densely populated, with a large population, few geological disasters, and very few cohesive soil landslides. The central and midwest low mountain and hilly areas are areas where geological disasters are concentrated; most of the central mountainous areas in the south are densely forested. Geological disasters are rare, but there are geological disasters on both banks of the Beiba River and Hou River where human activities are strong.

Distribution of geological disasters in towns and townships: There are few geological disasters in the southern and central regions, and most of the remaining areas are not well developed, such as Xishenba Township and Weijiaqiao Township in the south, and Guotan Township and Xieshi Township in the central part. The density of disaster points in other towns is between 0.01 and 0.27 locations/km². Fazhen has the smallest density, with 0.01 locations/km², and the densest is Xiema Township, with 0.27 locations/km². The towns and towns with the most geological disasters in the area are Xinji Town with 26 locations, followed by Beiba Town, Qingshu Town, and Lianghe Township, with 20, 13 and 12 disaster locations respectively.

The time distribution of geological disasters: ①The survey found that the recent landslides and collapses were mostly caused by human engineering activities; ②The survey found that the occurrence frequency of landslides and collapses was positively correlated with the monthly average precipitation in the same period.

3. Formation conditions and influencing factors of geological disasters

3.1 Geological conditions

Topographic features: Most of Nanzheng County's jurisdiction is on the northern slope of Micang Mountain, and a small part is on the southern slope. The general trend is that the south is high and the north is low, and it is divided into three landforms from north to south. ① River valley terrace plain area. The plain area is 484~600m above sea level. The central and western part of the plain area is relatively wide, and the east part is narrow and long. It is covered by Quaternary red clay, loess-like sandy clay and gravel, forming a fertile field connected by terraced rice paddies. It is one of the commodity grain bases in Shaanxi Province; Mainly distributed in the middle of the county. The hillocks and dams in the area are mixed, troughs, valleys and streams alternate, the climate is warm and humid, human activities are intense, and soil erosion is serious; ② Zhongshan District. Located in the southern part of the county, it is a part of the mid-tectonic denudation of Micang Mountain and Daba Mountain. It accounts for 64.9% of the county's total area. The topography is characterized by steep and
steep mountains, jagged peaks, asymmetric "V"-shaped valleys, and karst (karst) landforms.

Stratigraphic lithology: Nanzheng County's stratum belongs to Ningqiang-Zhenba Stratigraphic District of Dabashan Sub-district, Yangtze District. The main exposed strata in the area from old to new are: Middle-Upper Proterozoic Jixian System, Upper Proterozoic Upper Sinian System, Lower Paleozoic Cambrian System, Lower Paleozoic Ordovician System, Lower Paleozoic The Silurian Ningqiang Group, Upper Paleozoic Permian, Mesozoic Lower Triassic, Cenozoic Paleogene, and Cenozoic Quaternary.

Geological structural conditions: The main structural divisions of Nanzheng County are: ① Mihan bulge. It is the first-level structural unit of the Yangtze quasi-platform, with Nanzheng span and the central part of the platform, occupying a dominant position, starting from Liangshan in the north, to the north of Zhujiaba in the south, and running through the county. It is mainly composed of the Mesoproterozoic Jixian Huodian subgroup, Sanhuashi group strata, and Jinning period intrusive basic rocks and granites; ② Ningzhen depression. It is located in the south of the Mihan platform, extending west to Sichuan Province, adjacent to the Qinling Caledonian fold belt in the east, and the Sichuan platform syncline in the south. The county is located in the eastern part of Taisao, and its distribution area is second to Taisao; ③ Hanzhong New Fault Sag. It is a fault depression formed by the Himalayas. The county borders only across the southern edge. The basement is mainly composed of granite and gabbro of the Mihan platform, overlying the Quaternary loose gravel layer and loam layer.

3.2 Inducing factors
Atmospheric precipitation: The survey found that 90% of the geological disasters of landslides and collapses in this area are caused by rainfall. According to "Nanzheng County Chronicles", floods and geological disasters are prone to occur in wet years, and they are concentrated in summer and autumn. The annual precipitation exceeds 500mm in 1952, 1955, 1956, 1961, 1981, 1983, 2003, 2005, 2006. The whole county has suffered a wide range of flood disasters, and rainfall and floods can easily induce collapse, sliding, and flow geological disasters. Statistics show that geological disasters mainly occur from July to September. Heavy rain and continuous rain are one of the main inducing factors of geological disasters such as landslides, collapses, and mudslides. The rainfall intensity is directly proportional to the probability of occurrence of geological disasters.

Earthquakes: Judging from the earthquakes that have occurred in history, Nanzheng area is a weak earthquake area, and most of the epicenters are not within the territory. The highest magnitude is 5.5, and the seismic fracture is below VII. Most of the mountains in the area are high and deep, the slopes are steep, coupled with abundant rainfall and well-developed water systems, a slight vibration may cause inestimable losses.

Human activities: ① Mining activities. Nanzheng County has a wide variety of minerals and many mining enterprises. Especially since the 1980s, the mine

Mountain enterprises have developed rapidly, and the mining economy has become the main economic pillar of the county. In mining, the mountain is seriously damaged and the slag is stacked disorderly, which provides conditions for the occurrence of collapses, landslides, and mudslides. In case of waterfall or continuous rain, it is easy to cause geological disasters; ② Road construction. In recent years, the construction of highway infrastructure projects in Nanzheng County has made great progress. Nanzheng County has 1 expressway, 1 provincial road, 3 county roads, and the highway mileage is 674.3km. However, due to the extensive excavation of the mountain in the process of road construction and bridge construction, the slope of the mountain was too steep. In some places, the mountain was seriously broken due to blasting. These are the main factors that lead to the instability of the mountain and cause collapse, landslide and other geological disasters. ③ Build water conservancy projects. In recent years, while the county has been engaged in water conservancy construction, it has also caused serious damage to the mountains. Man-made damages such as slope excavation and deforestation have caused serious soil erosion. The sedimentation of the reservoir has caused the water level of the reservoir in the area to continue to rise. The storage capacity is reduced. At the same time,
the rise of the water level in the reservoir area led to the formation of a large area of wetlands in the lower reaches of the reservoir; when the flood season came, the flood burst caused serious geological disasters such as river bank collapse and land desertification, which brought great harm to the life safety of residents in the reservoir area; With the development of economy, people's living conditions have also undergone tremendous changes. However, when building houses in mountainous areas, most slopes must be excavated. Too steep or larger areas often cause mountain instability, causing rock collapses, landslides and other geological disasters; Destroying forests and making land. In addition, deforestation, disorderly grazing, and wanton reclamation have caused serious damage to large areas of mountain forests, which are also the main reasons for the acceleration of mountain instability and soil erosion.

4. Conclusion

(1) The main types of geological disasters in Nanzheng County are landslides, collapses, debris flows and ground subsidence. The basic conditions for the formation of geological disasters are analyzed. Earthquakes, rainfall and human engineering activities are the main influencing factors of geological disasters.

(2) Geoenvironmental protection and geological disaster prevention are fundamental measures to prevent geological disasters. It must be people-oriented, raise awareness of geological environmental protection, focus on prevention, combine prevention and control, and strengthen the prevention and control of major hidden danger points of geological disasters to achieve the purpose of disaster reduction and prevention.

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