Characteristics, monitoring and early warning of rainstorm-type mountain torrents in Yuci District of Jinzhong City

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Keywords: Yuci District mountain torrents; Flood control measures; Early warning system; Long-term planning

Abstract: The purpose of this paper is to deeply study the prevention and control of mountain torrents in Yuci District of Jinzhong City, and comprehensively grasp the present situation, characteristics and occurrence regularity of mountain torrents in Yuci District through field investigation, data analysis and other methods, so as to provide scientific basis for disaster prevention and mitigation. Through on-the-spot investigation and analysis, this paper describes in detail the occurrence process, influence scope and disaster severity of the rainstorm flood in Yuci District in 2015, deeply analyzes the causes of the rainstorm, verifies the effectiveness of the existing flood control engineering measures, and points out the existing problems and shortcomings. In the part of the research on mountain torrents prevention and control system, this paper summarizes the main measures of mountain torrents prevention and control in Yuci District, including engineering measures and non-engineering measures, and puts forward specific prevention and control measures and countermeasures for areas with high risk zones. At the same time, a long-term plan for the prevention and control of mountain torrents in Yuci District has been formulated, and the future development direction and key tasks have been defined. By strengthening the construction of flood control facilities, improving the early warning and monitoring system and improving the emergency management ability, the loss and influence of mountain torrents can be effectively reduced.

1. Introduction

Yuci District is an important part of jinzhong city in Shanxi Province. Its unique geographical location, located at the western foot of Taihang Mountain, has a large relief, and the complexity of climatic conditions makes this area a region with frequent mountain torrents [1]. Whenever the rainy season comes, heavy rainfall often quickly gathers into a torrent, which poses a serious threat to the life and property safety of local residents [2-3]. Mountain torrents not only cause direct economic losses, such as the destruction of houses and farmland, but also may lead to traffic disruption and infrastructure damage, which seriously affects people's normal life and production activities [4].

In order to deeply understand the characteristics and laws of mountain torrents in Yuci District and provide scientific basis for disaster prevention and mitigation, we have carried out this study. In the process of research, this paper adopts a variety of investigation methods, including field survey, historical data access, interviews with local residents and so on. There are a wide range of data sources, including rainfall records of meteorological stations, flood monitoring data of water conservancy departments, and flash flood disaster files of local governments. The investigation process is rigorous and meticulous, and we strive to comprehensively and accurately grasp the historical record, occurrence frequency and influence scope of the Yuci District flash flood disaster.

The purpose of this study is to reveal the laws and characteristics of the occurrence and development of mountain torrents in Yuci District by systematically sorting out the basic situation of mountain torrents, and to provide basic data support for the monitoring and early warning of mountain torrents. At the same time, we also hope that through research, we can put forward targeted countermeasures and suggestions to improve Yuci District's ability to deal with mountain torrents, reduce disaster losses and ensure people's lives and property safety. This study provides

scientific basis for the prevention and control of mountain torrents in Yuci District, and also provides reference for the prevention and control of similar disasters in other areas, and promotes the in-depth development of mountain torrents prevention and control.

2. Field investigation and case analysis of rainstorm and flood in Yuci District

In 2015, Yuci District was hit by many rainstorms, which caused serious floods [5]. These rainstorm events have brought huge economic losses to local residents and seriously threatened people's lives. In order to deeply understand the occurrence mechanism, influence scope and disaster severity of rainstorm and flood, this paper carries out field investigation. The necessity of field investigation lies in grasping the real situation of rainstorm and flood through first-hand information, and providing scientific basis for subsequent disaster assessment, flood control and disaster reduction. The purpose of the investigation is to fully understand the background, process and impact of the rainstorm and flood in 2015, and provide strong support for the prevention and control of mountain torrents in the future.

2.1. Cause analysis and disaster description of rainstorm

From the meteorological point of view, the causes of heavy rain in Yuci District in 2015 are complex and diverse, as shown in Table 1. These factors work together, leading to the occurrence of heavy rains in Yuci District in 2015.

Table 1: Analysis of the Causes of Heavy Rain in Yuci District in 2015

Cause Factor	Specific Description
Climatic Background	In a period of climate anomaly with above-average precipitation
Weather System Influence	Multiple weather systems interacting, forming a circulation pattern conducive to precipitation
Water Vapor Condition	Abundant water vapor content in the upper atmosphere, providing sufficient water vapor source

In 2015, the rainstorm and flood occurred rapidly and violently. The long duration and intensity of heavy rain caused the river water level to rise rapidly, which exceeded the carrying capacity of the river. The flood quickly spread to the surrounding areas, affecting a wide range of areas. The severity of the disaster is shocking, with many houses washed away, farmland flooded and traffic facilities seriously damaged.

2.2. Validity verification of flood control engineering measures

In the field investigation, we verified the existing flood control engineering measures in Yuci District. Through the survey data, this paper finds that these measures have played a certain role in the rainstorm and flood in 2015, but there are also some problems. Some flood control dams and revetment projects have shown good flood resistance and effectively reduced flood losses. However, some engineering measures have some problems such as unreasonable design and poor construction quality, which lead to damage and failure in the flood.

Through on-the-spot investigation and analysis, we summarized the problems and shortcomings of flood control engineering measures. The main problems include unreasonable engineering design, uneven construction quality and inadequate maintenance and management. As shown in Table 2, the existing problems and improvement suggestions of flood control engineering measures are given:

Table 2: Issues with Flood Control Engineering Measures and Improvement Suggestions

Issue Category	Specific Issues	Improvement Suggestions
Engineering Design	Unreasonable design	Strengthen engineering design review to ensure scientific and reasonable design
Construction Quality	Uneven quality	Strengthen construction quality supervision to ensure project quality standards
Maintenance & Management	Inadequate maintenance and management	Strengthen the maintenance and management of flood control projects, and promptly identify and repair issues
Construction Standards & Flood Resistance	Low construction standards, inadequate flood resistance	Increase investment to improve the construction standards and flood resistance of flood control projects

3. Study on the prevention and control system of mountain torrents in Yuci District of Jinzhong City

3.1. Regional overview and characteristics of rain and flood

Yuci District of Jinzhong City is located in the central part of Shanxi Province, which has unique natural and geographical conditions and also carries rich economic and social activities [6]. The region's varied topography, criss-crossing mountains and rivers provide unique conditions for agricultural production [7]. Yuci District, as the hub of Jinzhong City, has a rapid economic development, dense population and accelerating urbanization. However, it is accompanied by frequent rain and flood disasters. The characteristics of rain and flood in Yuci District are mainly concentrated and intense rainfall, which mostly occurs in summer and autumn. In addition, the steep terrain and fast convergence speed easily lead to flash floods [8-9]. These characteristics make the prevention and control of mountain torrents in Yuci District particularly important.

3.2. Design storm and flood analysis

In order to deal with the mountain flood disaster in Yuci District more effectively, based on the above historical data and field investigation results, we have carried out the analysis and calculation of the design storm flood. Through the in-depth analysis of rainfall data over the years, we know the intensity, frequency and distribution characteristics of Yuci District rainstorm. Combined with the flood trace and hydrological change information obtained from field investigation, we can simulate and predict the formation process of rainstorm and flood. These analysis results can provide scientific support for flood control engineering design and help us to determine key parameters such as flood control standard and design flood level more accurately.

3.3. Disaster assessment, forecasting and early warning system

In the comprehensive evaluation of the present situation of flood control in Yuci District, this paper focuses on the flood control system, facilities and management. At present, Yuci District has established a certain flood control system, including flood dikes, revetment works and drainage facilities [10]. However, the evaluation results show that these flood control facilities still have some weak links and potential risks when dealing with the flood. For example, some flood control dams have been in disrepair for a long time, and their flood control ability has declined; Some drainage facilities are designed irrationally and the drainage efficiency is low. In addition, there are some problems in flood control management, such as untimely release of early warning information and imperfect emergency response mechanism. These problems need to be improved and optimized in the future mountain flood prevention and control work.

In order to evaluate the loss and impact of mountain torrents more accurately, we can adopt scientific disaster evaluation methods. Through the analysis of historical disaster data, we can master the occurrence law, influence range and loss degree of mountain torrents. This paper thinks that a perfect forecasting and early warning system can be constructed. Based on multi-source data such as meteorology and hydrology, the system can accurately predict the occurrence time and place of mountain torrents and issue early warning information in time through model simulation and real-time monitoring. The forecast and early warning system has powerful functions and perfect operation mechanism, which provides strong technical support for the prevention and control of mountain torrents in Yuci District. Through the application of this system, we can more effectively reduce the loss and impact of mountain torrents and ensure the safety of people's lives and property.

4. Yuci District mountain torrents prevention measures and countermeasures

Yuci District has taken many effective measures in the prevention and control of mountain torrents, including both engineering measures and non-engineering measures. Table 3 summarizes the main engineering measures and non-engineering measures taken by Yuci District in the prevention and control of mountain torrents, aiming at comprehensively showing the layout and strategy of flood control work in this area.

Table 3: Overview of Flood Control Measures in Yuci District

Category	Measure Content
Engineering	1. Reinforcement of dikes: Enhance flood resistance to protect surrounding residents and farmland safety
Measures	2. Dredging of river channels: Clear silt and debris to enhance river discharge capacity and reduce the risk of flood overflow
Non-engineering	1. Early warning system construction: Monitor weather and hydrological conditions to promptly grasp flood dynamics
Measures	2. Improvement of emergency management mechanism: Formulate detailed emergency plans and clarify the responsibilities and tasks of various departments

In view of the high-grade dangerous area in Yuci District, this paper puts forward specific prevention measures and countermeasures. Due to the influence of topography, climate and other conditions, the probability of flash floods in these areas is high, and once floods occur, the consequences will be very serious. Therefore, we plan to implement stricter flood control measures in these areas. Specific measures include: heightening and thickening dikes to enhance their ability to resist floods; Set up a flood dam in the upper reaches of the river to reduce the flood flow and pressure in the lower reaches. In addition, we will also strengthen the early warning and monitoring work in these areas, ensure that early warning can be issued in time before floods occur, organize personnel evacuation and transfer, and minimize casualties and property losses.

In order to fundamentally solve the problem of mountain torrents in Yuci District, this paper has formulated a long-term mountain torrents prevention and control plan. The plan defines the future development direction and key tasks, including strengthening the construction of flood control facilities, improving early warning and monitoring systems, and improving emergency management capabilities. Government departments need to continue to increase investment, promote the construction and transformation of flood control projects, and improve the standards and quality of flood control facilities; At the same time, it is necessary to strengthen scientific research and technological innovation, introduce advanced monitoring technology and equipment, and improve the timeliness of early warning and monitoring. In addition, we can also establish a sound mechanism for the prevention and control of mountain torrents, strengthen the coordination and cooperation of various departments, and form a joint force to jointly deal with mountain torrents. We believe that through long-term efforts and continuous improvement, the prevention and control of mountain torrents in Yuci District will achieve more remarkable results.

5. Conclusions

After in-depth research and systematic analysis, this study has achieved many important results and conclusions. This paper comprehensively combs the current situation of mountain torrents in Yuci District, and describes its unique characteristics and manifestations in detail. Through solid field investigation and detailed data analysis, the law and influencing factors of mountain torrents are mastered. On this basis, combining with the actual situation of Yuci District, this paper puts forward a series of prevention measures and countermeasures with strong pertinence and high operability. These measures include not only engineering measures such as strengthening dikes and dredging rivers, but also non-engineering measures such as building early warning systems and strengthening emergency management. It provides a scientific and powerful basis and practical guidance for the prevention and control of mountain torrents in Yuci District.

The future development of mountain flood prevention in Yuci District is full of hope. With the development of science and technology and the enhancement of awareness of disaster prevention and mitigation, the prevention and control of mountain torrents in this region will face new opportunities and challenges. The continuous strengthening of scientific research and technological innovation, and the introduction and application of advanced monitoring and early warning technology will effectively enhance the ability to predict and respond to mountain torrents. In addition, we will also strengthen the construction and transformation of flood control facilities, improve the flood control system, and improve the overall level of flood control and disaster reduction. Thanks to the joint efforts of governments at all levels and all walks of life, the results of mountain torrents prevention and control in Yuci District will be more prominent, providing solid support for ensuring the safety of people's lives and property.

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