Study on Risk Assessment Method of Mountain Torrent Disaster of Wendeng District

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Abstract. China is a country with frequent mountain flood disasters. Especially in recent years, with climate change and social population develops rapidly, mountain torrent disaster not only cause huge economic losses, but also cause injuries to people. So the prevention and treatment of mountain torrent disaster get more and more important. This paper starts from non-structural measures of mountain flood prevention, it chooses Wendeng, Shandong as an example, considering the topography and hydrometeorology of Wendeng basin, analysis the hydrological characteristics of this basin, this paper constructs topology of Wendeng Basin, establish distributed hydrological model of Wendeng Basin. In this paper, the intensity of various disaster-causing factors and the vulnerability of disaster-bearing body in each basin of Wendeng area were analysed by taking the basin as a unit. Then through the superposition analysis, the distribution of risk in each river basin was finally obtained, which provided the basis for the prevention and control of mountain flood in Wendan City.

1. Introduction

Wendeng district is located in the eastern part of Shandong peninsula, with a total area of 1615km^2 between 36° 52 '~ 37° 23 'N and 121° 43 '~122° 19'S. It has 12 towns and 3 sub-district offices, 683 villagers' committees and 80 residents' committees. Wenden region is located in the middle latitude, belongs to the warm temperate zone continental monsoon climate. The change of four seasons and the monsoon are obvious. The average annual precipitation in Wendeng area is 810.7mm, which are quite different between different seasons. The precipitation in flood season (from June to September) is 567.1mm, accounting for 70% of the annual precipitation. Wenden area is an area prone to mountain flood disasters. In recent years, extreme weather events have increased, and heavy rainstorms often occur, resulting in relatively serious mountain flood disasters.

This paper considers the factors such as flash flood hazard-formative factors, underlying surface subsequently environment and the vulnerability of hazard-affected bodies, which are often used at home and abroad for reference. At the same time, this paper considers whether the factors are convenient to access, express and calculate in GIS, selects the elements of mountain flood disaster risk analysis from the aspects of mountain flood disaster risk and socio-economic vulnerability, and obtains the indexes by using modern GIS technology. The risk and degree of mountain flood disaster are analyzed quantitatively through the powerful spatial analysis function of GIS. Finally, on the basis of the analysis of mountain flood hazard and social and economic vulnerability, the mountain flood hazard and the mountain flood hazard risk regionalization were carried out in the Wendeng area.

2. Risk analysis of mountain flood disaster in wenden area

2.1. Multi-year average rainfall impact analysis

Rainfall is the precondition for the occurrence of mountain flood disasters and also the motivating factor of mountain flood disasters. The greater the intensity of rainfall, the longer the duration and the wider the range, the more serious the mountain flood disaster. The distribution of precipitation in wenden area is uneven, with most of the rainfall concentrated in July and August. Therefore, in this paper, the average annual rainfall of each town in July and August is selected as the basic material for the impact analysis of precipitation factors. In order to reflect the impact of precipitation on mountain flood disasters in the towns of wenden district, this paper selected the rainfall data of 17 rain stations in wenden district in the last 50 years. Then the multi-year average rainfall of each rain station in July and August was obtained, and the spatial position of each rainfall observation station in the study area was correlated with the monthly average rainfall data of the corresponding station in the flood season, so as to achieve the spatial orientation of the conventional observation data. The Tin and Grid modules in ARCGIS were used to carry out spatial interpolation discretization of the obtained multi-year average monsoon rainfall point map by means of distance weight reduction (IDW) interpolation, and the digital elevation model of the monthly average rainfall in wenden area was calculated.

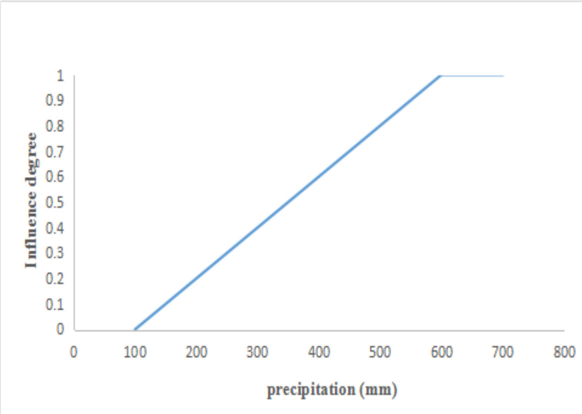

Figure 1. Map of rainfall and influence.

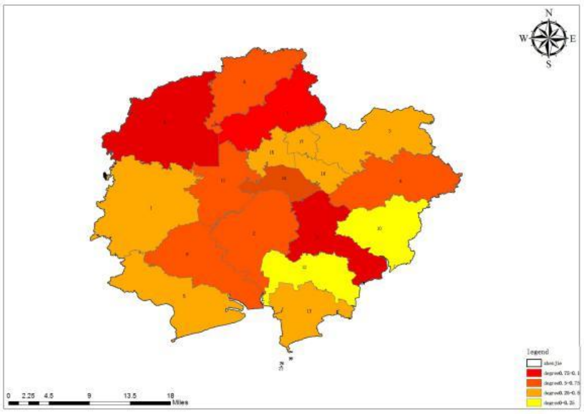

Figure 2. Rainfall influence map.

2.2. Convergent time rainfall impact analysis

Taking 6h as the time of confluence in each region, the rainfall data of 17 rain measuring stations in wenden area in the last 50 years was selected, and the average annual rainfall of each rain. The spatial position of each rainfall observation site in the study area was correlated with the annual average 6h rainfall data of the corresponding site to realize spatial positioning of conventional observation data. Then use the Tin and Grid modules in ARCGIS to discretize the multi-year average 6h rainfall point map by means of distance weight decreasing (IDW) interpolation method, and the digital elevation model of rainfall for the confluence time in wenden area was calculated.

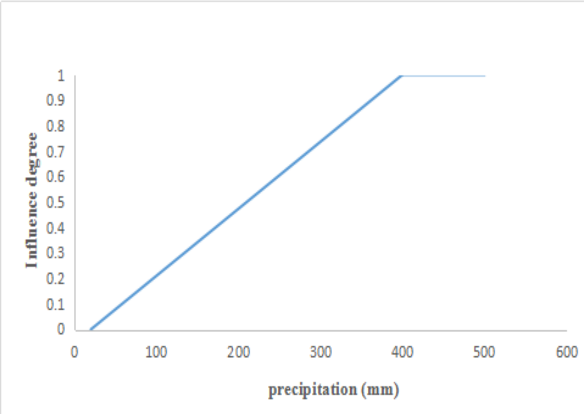

Figure 3. Map of rainfall and influence.

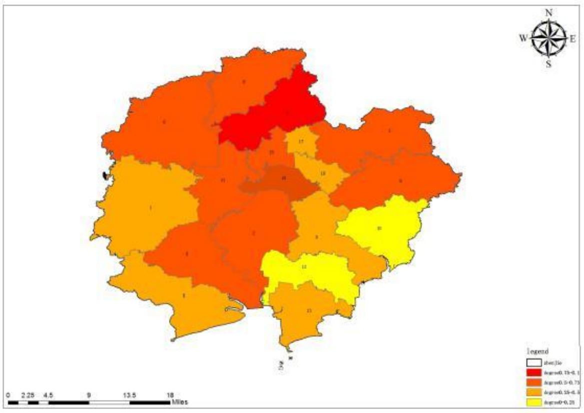

Figure 4. Rainfall influence map.

2.3. Topographic impact analysis

In topographic influence on the flood, the absolute height available digital elevation model to express, slope and terrain changes degree commonly used expression, However, the slope only takes into account the elevation change of adjacent grids, while the flood risk degree is affected by the topographic change within a certain range. In this paper, the standard deviation of 2500 grids (including itself) in the neighborhood of 500 500m^2 around the grid is used to describe the degree of terrain change. According to the principle that the absolute elevation is smaller, the relative elevation standard deviation is smaller, and the flood risk degree is higher, the relation between the comprehensive topographic factor and the flood risk degree is determined. Through spatial superposition analysis, the topographic factors of each grid are obtained.

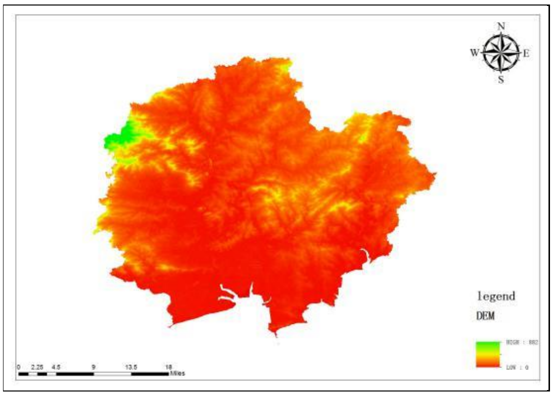

Figure 5. DEM elevation map in wenden area.

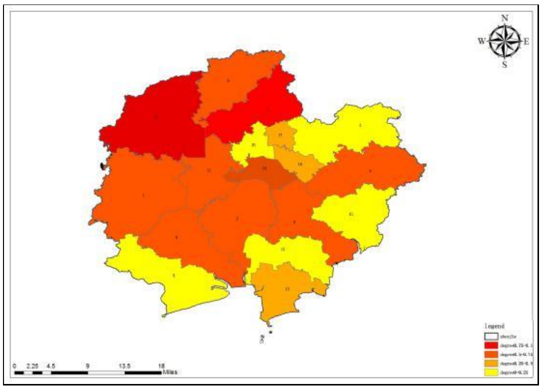

Figure 6. Topographic influence map.

2.4. Number of households close to the river impact analysis

For the river close to households number on the impact of the floods, this pape compute the grid around 500*500 m^2 in the neighborhood of 500 grid (including its own) are near the river residents number as the households distance away from the description of the flood impact according to the more households are near river number, the higher the risk, the greater the loss of the principles, determined from the river close to households households through spatial overlay analysis on the relationship between the flood impact, resulting in each grid terrain comprehensive impact factor.

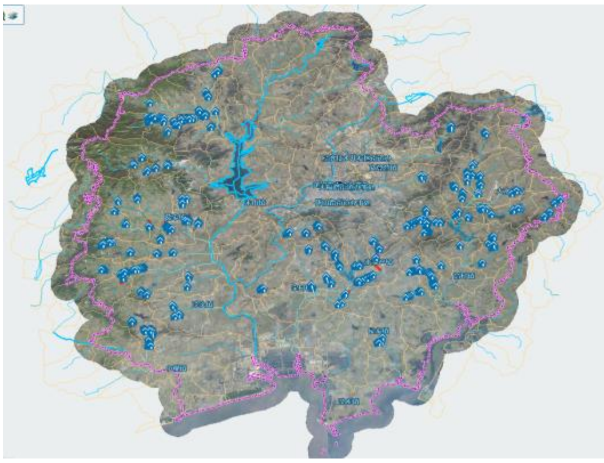

Figure 7. Map of settlement along the river.

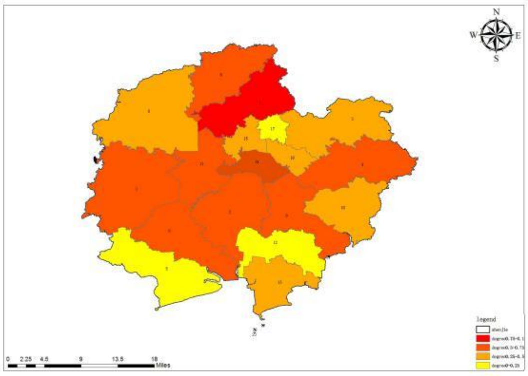

Figure 8. Household distribution influence map.

2.5. Population density index analysis

Population density map refers to the association between the town name field of the administrative zoning map of four cities within the river basin and the population of each town in GIS, so that the relevant statistical attribute data can be converted into spatial attribute data. Then the Calculate density command in Arc GIS spatial analysis module is used and Kernel method is adopted to obtain the spatial distribution map of the population density in wenden area Then, by referring to the mean value and standard difference of each index, the linear influence function was used to calculate the influence degree of population density, and the spatial distribution diagram of the characteristic index was converted into the influence distribution diagram of flood economic vulnerability.

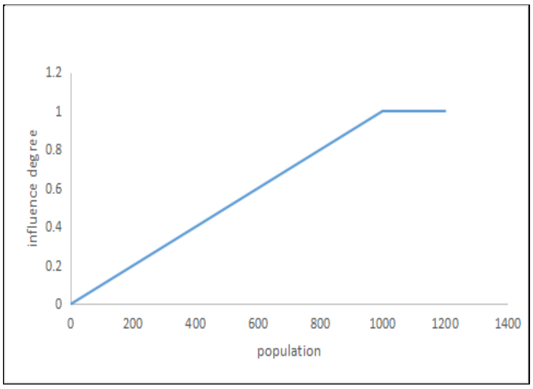

Figure 9. Regional population and influence degree relation.

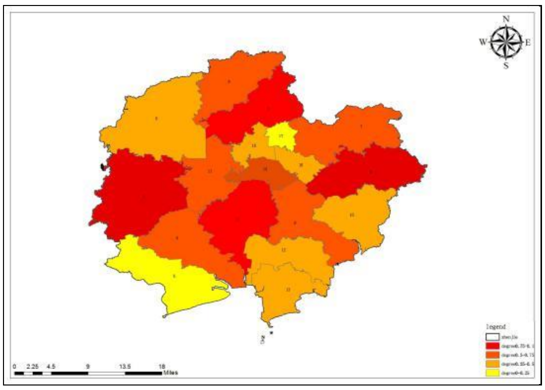

Figure 10. Population density influence map.

2.6. Impact analysis of land use type

For the influence of different land use types on flood risk, in addition to performance in the use of different types of its economic value, when flooding, result in different economic losses, also reflected in the various types of flood damage fragile degree, for example, under the same condition, tidal flats regional economic losses to less than the economic loss of regional construction land, cultivated land's vulnerability to significantly greater than forest land so the effect of land use economic vulnerability to flooding degree is on the basis of considering the above factors to assign points of each land use type.

Table 1. Land use type and influence degree.

Land type	Building land	Farmland	Forest	Undeveloped	waters
Influence degree	0.7	0.5	0.3	0.1	0.1

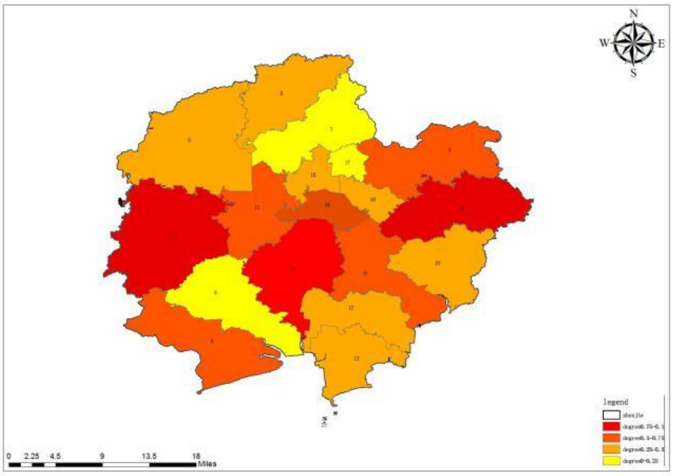

Figure 11. Map of land use type influence degree.

2.7. Risk analysis of mountain flood in wenden area

Mountain flood risk is the comprehensive calculation of mountain flood risk and socio-economic vulnerability using the map algebra in ARCGIS. The spatial superposition analysis of mountain flood risk factor and socio-economic vulnerability factor is carried out to obtain the flood risk map of wenden area.

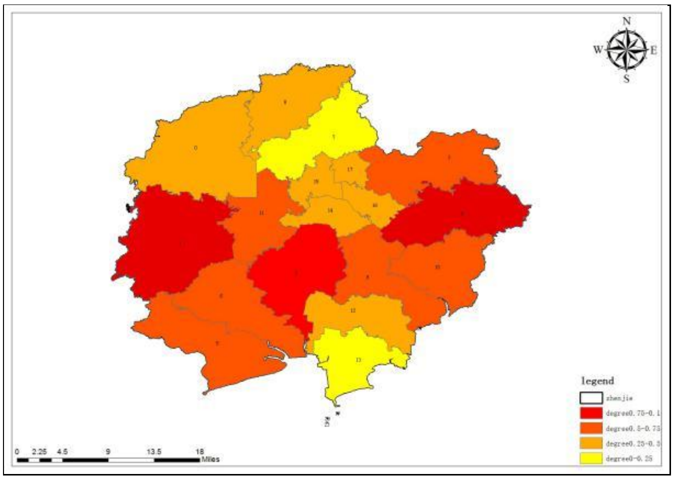

Figure 12. Total risk map.

3. Water system impact analysis

The distribution of rivers is the decisive factor for the regional flood disaster. At the same time, the degree of disaster is also related to the level of the river, the higher the level of the river, the greater the extent of the impact of the flood, the greater the harm. The analysis of the impact of water system on flood risk mainly aims at establishing different levels of buffer zones in the water system and conferring different degrees of influence on buffer zones of different widths, so as to achieve quantitative expression of the difficulty level of flood invasion. Buffer in this article, do not only consider the rivers dry tributary of the difference, also consider the terrain factors First according to the need of classification, topography and digital elevation model in front of the reclassification, received the elevation of the hierarchical graph (grid format) into vector format, and drainage system diagram again, so you can be in different dry tributary stream figure, different terrain elevation for different levels of the buffer.

Table 2. Buffer sizing.

relief area level	Primary buffer	Secondary buffer	Tertiary buffer
relief area range	400	500	800

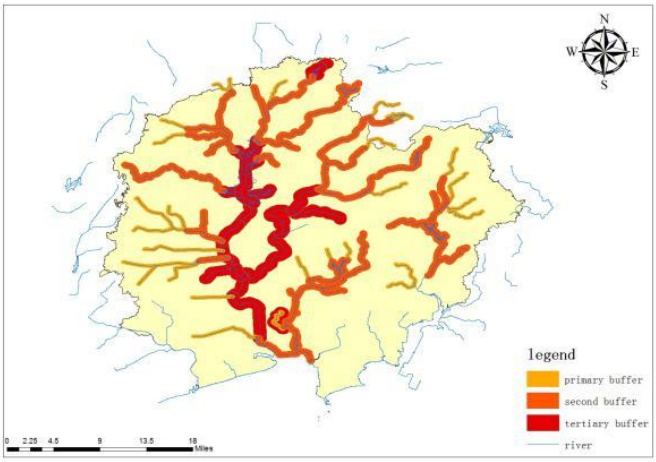

Figure 13. Buffer sizing map.

4. Conclusion

In this paper, the model of mountain flood disaster risk degree and the risk evaluation index system are constructed, and the distribution diagram of mountain flood disaster risk degree is made.

This article field investigation results and the degree of mountain torrent disaster risk level, according to the chart compares the map risk is of high precision but also has certain limitation, reflect the construction of mountain torrent disaster risk degree model and the corresponding mountain torrent disaster risk evaluation index system for the area, but still need to further optimize the model parameters and improving the risk classification method.

Acknowledgments

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