Prediction of mountain landslide susceptibility and influencing factors of green landscape design on both sides of roads

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Abstract
By collecting basic data about the geological environment of the study area, this article introduces the geological environment of the study area in mountainous areas. Use data model, logistic regression model, and spatial logistic regression model to estimate the landslide susceptibility of the area and divide the research area. Based on the GIS platform and the regression model data model, seven evaluation factors were selected-altitude, rock characteristics, distance to the river, distance to the road, distance to the fault zone, vegetation and rainfall, etc. Using spatial logistic regression model and information model to carry out landslide risk prediction and regional assessment in this area, it shows that the development of mountain landslide disasters in the study area has considerable spatial effects. The areas with extremely high and high susceptibility to mountain landslides are mainly distributed in the study area. The southwest region is mainly distributed along rivers, both sides of roads, and near fault zones; most of the low- and medium-risk areas are scattered in higher altitude areas with large slopes, low human activities, and high vegetation coverage. At the same time, the issue of green landscape setting on both sides of the highway is also mentioned. The green landscape system is composed of the highway itself and the attached green spaces on both sides. At present, many studies on the landscape system of the two roads are focused on improving the engineering technology of the main body of the highway and improving the landscape effect. The attached green space on both sides of the road is taken as the main focus of the research. The green space on both sides of the road is an important part of the ecological zone and plays an irreplaceable ecological role. Therefore, this paper conducts a more in-depth study on the use of disaster-prone prediction technology to study landslides and the current green landscape design on both sides of the road.

Keywords Mountain landslides · Susceptibility prediction · Both sides of the road · Landscape design

Introduction
As a natural disaster, geological disasters are mainly affected by geological forces. They not only destroy the living environment on which mankind depends for survival and development, but also threaten the lives of natural persons and severely damage property safety. Landslides are one of the most frequent geological disasters. Under the influence of internal or external factors, the soil and rocks on the slope slide down on the surface of the fragile structure. This phenomenon has caused extreme damage to human society. China is one of the countries with frequent occurrence of geological disasters, especially landslides in mountainous areas. The assessment and prediction of the vulnerability of landslides is the basis for assessing the risk of landslides (Bolan et al. 2003). The assessment and prediction of landslide susceptibility must first collect historical landslide hazards, analyze the basic development characteristics of landslide hazards, and then compare them with geological conditions, select appropriate evaluation indicators, and use qualitative or quantitative evaluation methods to assess the study area. Landslides are prone to regional assessment (Liu et al. 2020). In recent years, based on the combination of the GIS platform and different evaluation methods, the research to evaluate the susceptibility of landslides has
become a common research. Using GIS technology to assess the susceptibility of landslides can collect information and data that cannot be obtained by traditional methods. The evaluation results of landslide susceptibility can not only provide theoretical basis for landslide prevention, but also provide data for mountainous area planning and development. This article combines the landslide data that has occurred in the area, the research area, and the geological environment background, and uses the information model, logistic regression model, and spatial logistic regression model to evaluate and classify the landslide susceptibility of the area based on the GIS platform (Arekhi and Kaur 2007). Therefore, the results of landslide susceptibility evaluation can provide an effective basis for landslide prevention and regional planning and construction. Through GIS, this article briefly introduces road planners and researchers from all over the world in the field of road landscape design and planning, as well as the design methods, design specifications, legal review, and design concepts used by them, as well as the comprehensive results of disciplines. Summarizing and synthesizing the advantages of different research results can provide sufficient reference and enlightening significance for the support research of the green space on both sides of the road. Road landscape planning is usually reflected in the overall consideration of the project in the road design process (Livi et al. 2011). The construction index must respond to the need to protect the natural environment along the expressway, so as to realize the harmonious coexistence of construction technology and the expressway and the environment along the expressway, taking into account environmental protection, as well as the viewability of the landscape along the route and the expressway (Shahen 2017).

Subsidiary road green space refers to the percentage of road and traffic area green space. According to the research theme and research field, the concept of developing green space on both sides of the road is different. In summary, it can be divided into narrow sense and broad sense. The auxiliary green space on both sides of the narrow road is the green space between the edge of the sidewalk and the red line; the auxiliary green space on both sides of the general road not only includes the road itself, but also extends beyond the road and extends upward and downward, to people’s entire field of vision, including those with vision (Arnold et al. 2011). Tourists and leisure facilities, as well as the cultural and natural landscapes along the way, integrate the road with the surrounding environment and have various features such as practicality. The subsidiary green space on both sides of the expressway studied in this paper belongs to the subsidiary green space on both sides of the general road, which is a landscape with a certain width from the edge of the sidewalk to the scope of people’s business.

### Materials and methods

#### Data source

The data sources used in the research area mainly include the following: Google Earth image data, used to identify and study landslides; UAV flight data, mainly DEM data with a resolution of 10m, used to extract very accurate altitude and slope in the research area, data such as slope direction; given area 1:500,000 geological map, extract rock properties, structure, and other information from it (Brown et al. 2013); OLI remote sensing image of research area and MODIS land use cover product with resolution of 250m, provided by geospatial data cloud platform, used to extract information about vegetation; the meteorological position ground observation data provided by China Meteorological Data Network, used to obtain information such as precipitation and temperature; Chinese Academy of Sciences Environmental and Resource Science Data Center provides soil type vector data to extract relevant research areas. Information on soil type (Shatnawi and Diabat 2016).

#### Analysis of the evaluation factors of the susceptibility of mountain landslides

On the basis of selecting factors for evaluating the susceptibility of landslides and analyzing the correlation, seven indicators including altitude, rock stratification, distance to the river, and distance to the road were selected. Use the breakpoint method to rank the evaluation factors of vegetation faults and precipitation (1), combine historical landslide data, use ArcGIS platform, and use logistic regression and spatial logistic regression models for evaluation. The susceptibility of landslides is divided into four grades: areas with extremely high incidence of landslides, areas with high incidence of landslides, areas with moderate incidence of landslides, and areas with low incidence of landslides. The accuracy of the results is tested to assess the susceptibility to landslides (Table 1).

#### Prediction and calculation of mountain landslide susceptibility

The information volume model is a susceptibility assessment model based on information theory, which expresses the possibility of a geological landslide disaster through the size of the information value in the process. The nature of the information volume method belongs to the method of statistical analysis and prediction. Through the statistical analysis of the data, the information value of the influencing factors and the impact on the geological risk of landslide can be calculated from the information caused by the landslide (Lozano et al. 2007). The information value may reflect the influence of
different factors on the landslide. Based on the ArcGIS platform, the impact of disaster development is superimposed on the information value of each factor to obtain the total information value, that is, the landslide susceptibility index, and reclassify to obtain a map of landslide-prone areas (Dutta 2016). The principle of the information model is clear, simple, easy to implement, and highly reliable, and can objectively reflect the degree of influence of various factors on landslide disasters. Information volume model information is used more and more in the fields of geological disaster susceptibility assessment and disaster zoning, and good results have been achieved.

The theoretical basis of the information volume model

The information volume model should use the information value as the standard, and divide the landslide risk level by calculating the information value of each evaluation factor.

The principle of the information model is as follows: The landslide (Y) is affected by many influencing factors. Different influencing factors have different forms of influence on landslide disasters, so their influence on the development of landslide disasters is also different (Singh et al. 2010).

The basic point of predicting landslide disaster information is to determine whether a landslide will occur in the study area, and the possibility is closely related to other influencing factors. The difference we obtained in the forecast and the quantity and quality of information about landslides that have occurred. The evaluation criterion is the value of information, namely:

\[ I(Y, x_1, x_2, x_3, \ldots, x_n) = \ln \frac{P(Y, x_1, x_2, x_3, \ldots, x_n)}{P(Y)} \]  

(1)

According to the conditional probability calculation, the above formula can be rewritten as follows:

\[ I(Y, x_1, x_2, x_3, \ldots, x_n) = I(Y, x_1) + I(x_1 | Y, x_2) + \cdots + I(x_{n-1} | Y, x_n) \]  

(2)

where \( I(Y, x_1, x_2, x_3, \ldots, x_n) \) is the amount of information contributed by the evaluation factor combination \( x_1, x_2, x_3, \ldots, x_n \) to the landslide disaster in the study area; \( P(Y, x_1, x_2, x_3, \ldots, x_n) \) is the probability of occurrence of landslide disaster when the combination of evaluation factors \( x_1, x_2, x_3, \ldots, x_n \) act together; \( P(Y) \) is the probability of occurrence of landslide disaster in the study area; and \( I(x_1 | Y, x_2) \) is the amount of information contributed by the evaluation factor \( x_2 \) to the landslide hazard under the condition that the evaluation factor \( x_1 \) acts.

In formula (2), the amount of information provided by the evaluation factor combination \( x_1, x_2, x_3, \ldots, x_n \) to the landslide disaster in the study area is equal to the amount of information provided by the evaluation index \( x_1 \) to the landslide disaster in the study area in the presence of the evaluation factor \( x_1 \). Until the evaluation factors \( x_1, x_2, x_3, \ldots, x_{n-1} \) are determined, the amount of information is provided by \( x_n \) to the landslide disaster in the study area. It shows that the information volume model fully considers the influence of various evaluation factors on landslide hazards.

Establishment of information volume model

The steps for establishing the information volume model are as follows:

Calculate the information value \( I_i(x_i, H) \) provided by each evaluation factor \( x_i \) for the occurrence of landslide disaster (H):

\[ I_i(x_i, H) = \ln \frac{P(x_i | H)}{P(x_i)} \]  

(3)

where \( P(x_i | H) \) is the probability value of \( x_i \) under the occurrence of landslide disaster, and \( P(x_i) \) is the probability value of \( x_i \) in the study area.

In actual calculations, the following formula should be used to calculate the amount of information, namely:

\[ I_i(x_i, H) = \ln \frac{N_i / N}{S_i / S} \]  

(4)
In the study area, landslides are not prone to occur. The probability of a landslide in this assessment unit is equal to the average probability of a landslide in the study area. When $I > 0$, it means that the probability of a landslide in this assessment unit is greater than the average probability of a landslide. When $I = 0$, it means that the probability of a landslide in this evaluation unit is equal to the average probability of a landslide. When $I < 0$, it means that the probability of a landslide in this assessment unit is less than the average probability of a landslide. In the study area, landslides are not prone to occur.

### Results

#### Analysis of influencing factors of landslide disaster

The study area is located in the southeast, with high altitude and complex terrain, creating favorable conditions for the development of landslide risks, and with the increase in altitude, the instability of the mountains also increases.

According to statistical analysis, landslides in the study area are mainly concentrated between 2285 and 2889m, 89 landslides occur, accounting for 47.09%, and the disaster density is the highest (Venegas-Sanchez et al. 2013). There are relatively few landslides in the low-altitude areas (<2505m), and the density of disasters is relatively low: after the altitude exceeds 2889m, the number of landslides and the density of disaster points have a clear downward trend. The results show that the study area is more susceptible to landslides in the altitude range of 2505 to 2889m, and the higher the altitude, the less likely it is to occur. In fact, low-altitude areas are more conducive to human production (Ganguly et al. 2012). Due to human activities, it will inevitably cause damage to slopes and lead to landslides. As the altitude increases, human engineering activities decrease, and snow and ice cover in high-altitude areas make landslides less prone to occur (Figure 1).

The landslide disaster point and slope map are superimposed and analyzed. Thanks to statistical data, the landslides in the study area are concentrated in the range of 28°–37°, and 84 landslides occurred, accounting for 44.44%, with relatively high disaster density. The density of disasters is also low. This is because areas with small slopes have relatively flat terrain and are not prone to landslides (Mulungu and Munishi 2007). Areas with too large slopes are usually not conducive to the accumulation of bulk materials. In addition, because the slopes are too large, they are not suitable for human engineering activities and have relatively low impact on the slope. Therefore, the slope of the study area is about 28° to 37°, and the sensitivity to landslides is relatively high (Table 2).

The effect of slope aspect on slope stability is that the difference in slope aspect will cause the difference in the surface temperature of the slope, and the greater the temperature difference, the easier the deformation will occur. Generally, Xiangyang Slope has a greater impact on the development of landslide risk. The landslide disaster point and aspect map are superimposed and analyzed (Walling 2006). According to statistical calculations, landslides occurred in the southwest and southwest of the study area. There were 43 landslides and 29 landslides, accounting for 22.75% and 15.34%, respectively, and the disaster density is higher, followed by the N direction and NE direction, indicating that the SW and SE directions of the study area are more prone to landslides (Figure 2).

Overlap analysis of raster layers of landslide hazard points and stratigraphic lithology. According to statistical calculations, the distribution area of early protozoa strata was the largest, and the number of landslides was the largest at 119, accounting for 62.96%, and the density of natural disasters was high. Most of the bedrock exposed in this formation exhibits the structural characteristics of alternating soft or alternating soft and hard layers. Due to the influence of tectonic action, the formation is relatively fractured, which is conducive to the formation of landslides (Table 3).

The landslide hazard points and raster layers are superimposed and analyzed. The statistical calculation results show that the landslide hazard at 1082m away from the river is very prone to occur. There are 153 landslides, accounting for 80.95% of the density. The incidence of disasters is higher. As the distance increases, the development of landslides decreases and the density of disasters decreases. The results show that the river has a significant control effect on the development of landslides (Figure 3).

The landslide disaster points and raster layers are superimposed and analyzed. The statistical calculation results show that there are 152 landslides, accounting for 80.42%, and the density of landslides is also very high at 1341m away from the highway. The number of landslides and the density of natural disasters are constantly decreasing. The results show that the road has an important control effect on the development of landslides (Table 4).

Statistical calculation results show that the number of disasters caused by landslides fluctuates as the distance from the
fault zone increases, but due to the complex topography of the area, the density of disasters tends to increase. The relationship between these two factors needs further discussion and analysis. From the perspective of the number of landslides, fault zones have a certain influence on the development of landslides (Figure 4).

Evaluation results of landslide susceptibility

On the basis of the ArcGIS platform, the grid calculator is used to overlap the evaluation index layers to obtain the total data value I of the study area, such as the landslide susceptibility index (LSI) and the natural discrete point classification method for A. The landslide susceptibility number was reclassified to obtain the distribution map of landslide susceptibility in the study area (Figure 5). The landslide susceptibility of jiang slumps is divided into four levels: extremely high-prone areas, high-prone areas, medium-prone areas, and low-prone areas accounted for 11.75%, 17.91%, 28.64%, and 41.70% of the total study area.

Based on the SPSS software, with 7 evaluation factors as independent variables, if a landslide occurs as a dependent variable, input the values of the original variables from the 7 evaluation factors at 425 sampling points, perform logistic regression analysis, and obtain logistic regression coefficients. Each rating factor is in Table 2.

Based on the ArcGIS platform, the regression results are superimposed, analyzed, and reclassified. The method is to obtain the landslide susceptibility map of the study area according to the natural discontinuity classification method (Figure 7).

At present, in order to assess the susceptibility of geological disasters, the ROC curve is mainly used to verify the assessment results. This study also used the ROC curve to verify the results of the assessment of landslide susceptibility. When drawing the ROC curve, the vertical axis is the cumulative value of the actual percentage of landslide; the horizontal axis is the cumulative value of the percentage of sensitive area (Garau et al. 2007). The area under the AUC value curve is used to evaluate the accuracy of the model evaluation results. The test results show that, as shown in Figure 8, the area under the ROC curve of the information model is 0.834, which means that the accuracy is 0.834. The area under the ROC curve of the logistic regression model is 0.856, which means that the accuracy is 0.856; the area under the ROC curve of the spatial logistic regression model is 0.856, which is equal to 0.924; that is, the precision ratio is 0.924 (Nazari-Sharabian et al. 2020). The evaluation results of these three models are very accurate. The accuracy of the upper and lower three models are spatial logistic regression model>logistic regression model>information model, indicating that there is considerable room for the development of landslides in the study area. Therefore, this paper

| Slope/° | Number of landslides/piece | Number of grids/piece | Disaster density |
|---------|---------------------------|-----------------------|-----------------|
| <14     | 9                         | 624,476               | 1.48191E-05     |
| 14–28   | 34                        | 853,936               | 3.14556E-05     |
| 28–37   | 84                        | 1,705,745             | 4.19343E-05     |
| 37–47   | 49                        | 1,766,192             | 9.71943E-05     |
| >47     | 13                        | 820,354               | 1.54368E-05     |
takes the evaluation result of the spatial logistic regression model as the final result of the evaluation.

**Discussion**

**Principles of green landscape design on both sides of the road**

**The principle of ecological priority**

The construction of highways has severely damaged the natural environment along the route, causing water pollution, air pollution, and severe forest degradation, which in turn caused a series of environmental problems, such as land desertification, forest destruction, and biodiversity. Therefore, the beautification of the green space attached to both sides of the road should focus on restoring and protecting the natural ecology (Okada et al. 2005). In the design, minimize the disturbance and damage to nature; protect the original ecological landscapes such as fields, forests, grasslands, and wetlands on both sides of the road; and carry out ecological restoration of the damaged ecological environment, such as replanting forests and planting turf on both sides of the river to protect the hillside (Xi et al. 2005).

**The principle of human text**

The construction of expressways serves the people, and the landscape design that connects the green spaces on both sides should also be developed around the people’s physical and spiritual needs. From the user’s point of view, landscape design should not only ensure traffic safety, but also consider the esthetics and comfort of the drivers and passengers (Ijam and Tarawneh 2012). From the perspective of residents along the route, the construction of subsidiary green space can provide residents with entertainment venues, meet people’s spiritual needs. On the other hand, the publicity and traffic effects of expressways can also be used to help develop economic sectors and improve the living standards of residents.

**The principle of territoriality**

Landscape design should be avoided in the same way and should fully reflect the characteristics of the area. The terrain along the route is complex and diverse, and the natural resources, history, customs, and folklore along the route often have their own characteristics (Phothitontimongkol et al. 2009). As well as the proper use of these elements in landscape design, this is an important responsibility that landscape architects must assume. Its purpose is to create a cultural landscape with distinctive regional characteristics, so that local tourism and local characteristic industries can be better developed.

**The principle of adapting measures to local conditions**

The ancillary green space on both sides of the high-grade highway is different from the esthetic design and conventional landscape layout on both sides of the urban road. The green spaces attached to both sides of the highway usually have more complete natural landscape resources. In order to meet

| Strata          | Number of landslides/piece | Number of grids/piece | Disaster density       |
|-----------------|----------------------------|-----------------------|------------------------|
| Early Proterozoic | 119                        | 319,042               | 0.000326485            |
| Permian         | 20                         | 104,373               | 0.00032651             |
| Cretaceous      | 48                         | 188,228               | 0.00025412             |
| Third series    | 1                          | 13,977                | 7.26511E-05            |
| Carboniferous   | 1                          | 15,550                | 6.21225E-05            |
the basic requirements of traffic functions, they should pay more attention to the integrated natural environment. Regions usually have different topography and topographical features, as well as biological, architectural, historical, and cultural species. Therefore, the landscape construction of the green road space must adapt to the local conditions and fully demonstrate the characteristics of the area (Jakada and Chen 2020). Specific manifestations of adapting to local conditions include the following: plantation forests to maintain production functions, forests, mountains, maintenance of natural plant growth patterns, river water systems, reduction of traces of plant engineering.

The principle of integrity and continuity

The landscape design on both sides of the highway is not a partial design, but must organically integrate the different local landscapes of the project. Not only must the coordination and integration be considered, the internal units must also be integrated with the surrounding environment (Yan et al. 2014). The designer should create the continuity and scalability of the landscape through the spatial research of the road landscape, and avoid obstructing the original ecological environment and the user’s visual space. In landscape design, it is necessary to fully grasp the characteristics of existing resources, and effectively use scene combination and borrowing methods to integrate the road landscape with its surrounding environment and enhance the characteristics of the landscape, the integrity and continuity of the environment.

Green landscape design on both sides of the road based on land use factors

Roadside cultivated land landscape

The main function of arable land is to grow crops, but the arable land on both sides of the road is also an important part of the road landscape. According to the viewing height of the public, this article divides the cultivated land landscape into three categories:

- **Basically equal to the shoulder**
  - Landscape features: good natural landscape effect and wide field of vision.
  - Design strategy: In order to ensure transparency, the pastoral landscape in the field of vision is complete and continuous, and remote villages and mountains are also displayed.
  - Crop design: Planting trees with higher branches near the shoulder of the road can be used in combination with local crops, which will help guide traffic and ensure that the line of sight is not obstructed. In the field of arable land, you can choose local special crops for large-scale planting, such as rape + rice mixture, rice and milk vetch, and cabbage + soybean intercropping mixed crops, so as to create a changing farmland landscape (Porter et al. 2004).

- **Significantly lower than the shoulder**
  - Landscape characteristics: If the cultivated land is lower than the road shoulder, the side slope of the embankment will be formed, and the public view cannot capture the landscape beside the road. The focus of the scene is mainly farmland and farm.

| Distance to road/m | Number of landslides/piece | Number of grids/piece | Disaster density |
|-------------------|---------------------------|-----------------------|-----------------|
| <625              | 68                        | 194,472               | 0.000236523     |
| 625–1341          | 84                        | 178,596               | 0.000365254     |
| 1341–2123         | 23                        | 140,237               | 0.000845125     |
| 1341–2123         | 10                        | 90,624                | 0.000366625     |
| >3129             | 4                         | 37,243                | 0.000122254     |
Design strategy: Ensure transparent visibility and protect the original farmland. At a lower position, you can see a broad view, and you can use land art techniques to create cultural and regional art land.

Crop design: According to the height difference between the field and the road and the crop characteristics of each region, local trees with high stems and bright colors can be selectively planted on slopes such as tea trees, sunflowers, sesame seeds, and pumpkins.

Significantly higher than the road shoulder Landscape characteristics: The cultivated land is much higher than the road surface. When the audience crosses the road, the open slope obstructs the audience’s sight and cannot feel the scenery from the heights.

Design strategy: Protect the biological slope of the embankment to ensure the safety of vehicles on the road and improve the greening effect of the landscape.

Crop design: For crops, you can choose local plants with slope protection and strong growth ability, such as tea, cotton, and sesame. It can be used in combination with brightly colored shrubs and vines such as honeysuckle and forsythia, and increase the visualization of the landscape.

Roadside woodland landscape

Mountain Landscape features: complex geological conditions, fragile ecological environment, and fast driving speed.

Design strategy: Protect the ecological environment along the route and ensure safe driving. Use borrowed scenes for parts with good scenery, and parts with poor scenery will be blocked. Observation platforms and scenery nodes can be set to actively display regional elements (Kothyari and Jain 1997).

Crop design: Planting on the roadside needs to pay attention to the sequence, visual guidance, and ensure safe driving. In mountainous areas, when the original trees can be preserved, areas with low green efficiency can be replanted and restored to protect the stability of the ecological environment along the route.

Flat ground Landscape features: flat terrain and wide field of vision.

Design strategy: Protect the ecological environment along the way. In order to avoid monotony, a characteristic landscape can be added to the open area to reduce eye fatigue and increase esthetic interest.

Crop design: In the transition phase of the road, local trees and shrubs of the same species as the forest area can be planted to maintain the linearity and continuity of the landscape; the design of the plantation focuses on maintaining the original natural landscape, matching trees, shrubs, and grass to enrich the green sense.

Slopes Side slope refers to the structure of a sloping roof, with slopes on both sides of the platform to stabilize the platform (Renard et al. 1991). According to whether the foundation is lower or higher than the original ground, the foundation can be divided into two types: excavation slope and embankment slope. The main function of slope greening is to coordinate the
surrounding environment, prevent soil erosion, and stabilize the foundation.

**Roadside water landscape**

The horizontal landscape covers the rivers, lakes, reservoirs, ponds, ditches, and swamps along the way. The selection of vegetation along the river does not need to be too complicated, and appropriate space should be reserved to facilitate the appreciation of the scenery.

**Rivers, lakes, reservoirs** Land: a lot of water and good natural landscape.

Design strategy: highlight the water surface as much as possible, and use plants to create a bright water surface and reflection to fully demonstrate the characteristics of the waterscape. At the same time, the focus should be on protecting environmentally sensitive areas along the river to maintain the stability of the ecosystem.

Plant design: Extend the distance of plants along the road to make the waterscape transparent. Plant natural water-tolerant ornamental plants on the water bank such as willows, aquatic plants, and maples, which can be combined with shrubs and mulch to improve the landscape. Plant grasses on the river bank to protect the hillside, restore the natural ecological environment, and protect the stability of biological organisms such as birds and fish.

**Table 5** Logistic regression model parameters

| Evaluation factor        | B          | S.E   | Sig   |
|--------------------------|------------|-------|-------|
| Elevation                | -1.0236    | 0.2365| 0.0000|
| Formation lithology      | -0.2254    | 0.234 | 0.0465|
| Distance to the river    | -0.3652    | 0.8745| 0.0362|
| Distance from road       | -0.8547    | 0.2351| 0.0125|
| Distance from break      | 0.235      | 0.2541| 0.0126|
| vegetation               | 0.5623     | 0.5843| 0.3203|
| Rainfall                 | 0.1253     | 0.5888| 0.3201|
| Constant                 | -0.2653    | 0.0413| 0.6845|

**Ponds, ditches, and marshes** Landscape features: small water surface area, good natural landscape effect.

Design strategy: create a rural wetland landscape.

Plant design: Wet and aquatic plant clusters can be planted, such as berry’s hooves-Spartina vulgaris + rush grass clusters, rush-hermadagras + broken coins clusters, and cattail lotus clusters; aquatic crops can also be planted; For example, two-year interplanting of water chestnut + lotus root + gorgon + cress, lotus root + loach polyculture, etc., can show pastoral characteristics and increase farmers’ economic income.

**Green landscape planning and design strategies on both sides of the road based on different factors**

**Survey of landscape resources**

Before proposing landscape design, detailed landscape resources should be investigated to determine the type, function, and highway traffic of the building. The economy, culture, tourism, and natural resources along the line should be classified, inspected, analyzed, and summarized in order to maximize the use of various resources and promote the coordinated development of highway construction and the environment along the line.

**Overall layout planning of landscape**

The overall layout of the green space attached to both sides of the road plays a very important role in improving the value of the road landscape. Starting from the planning background, planning positioning, and planning ideas, consider the overall planning of the auxiliary green spaces on both sides of the expressway, and propose macro planning strategies and suggestions to coordinate the main projects, structural functions, node layouts, and other factors to create overall unity. In landscape planning and layout, combined with preliminary investigation and analysis of landscape resources, considering the spatial hierarchy of landscape design, its esthetic value and the interaction between people and the environment, the best plan to guide landscape design is derived from the comprehensive analysis.
Division of landscape units

Based on the implementation of comprehensive landscape planning and environmental layout of local landscapes along the road, the division of landscape units requires further consideration of topography and landforms, history, culture, architectural styles, popular traditions, and other landscape elements. Determine each part of the landscape unit, landscape planning goals, and design content. In addition, the landscape theme is defined according to the resource characteristics of the landscape unit part, and detailed arrangements are made for the landscape design.

Detailed landscape design

The detailed design of the landscape is based on the completion of the master plan of the landscape and the division of landscape units, as well as the detailed design and observation platform of the constituent elements of the landscape (such as slopes, intersections, service areas, pillars). The method of enhancing landscape details must be consistent with the landscape concept and theme of the entire road section, and must conform to the characteristics of the unit landscape theme, show respect for nature and human-oriented design, and actively reflect unique regional culture.
Plant planting design

There are many rural agglomerations along the highway. The design of plantation forests should follow the principle of adapting measures to local conditions, giving priority to ecology and choosing native tree species. The planting method should also be more natural, usually with many detours to recognize the driver’s instructions and improve road safety. Tree species should be mainly evergreen trees and shrubs. After falling leaves in autumn and winter, deciduous trees have criss-cross branches, which are easy to dazzle. It is not suitable to plant too many tree species, tree shapes, and colors to replace. Will affect the driver, should not choose plants with strong smell and a lot of pollen, so as not to harm the body and affect the lives of pedestrians and people along the way.

Conclusion

Based on the susceptibility prediction technology, this article explains the disaster points of landslides in a certain area, analyzes the development characteristics of landslides and the factors affecting the occurrence of landslides, and selects altitude, rock layers, distance from the river, and roads. Seven evaluation factors include distance and distance from the fault zone. Based on the ArcGIS platform, the logistic regression model and logistic regression model are used to predict and analyze the susceptibility of the study area to landslides. This article combines historical landslide hazard points and landslide hazard influencing factors for analysis. The statistical results show that the occurrence of landslide disasters in the study area is mainly concentrated in the altitude range of 1962–2889m. The slope of most landslides is concentrated in the range of 28°–37°, and most of the landslides are distributed along the direction of slope and SE, the area has the largest number of landslide disasters, and the disaster density is relatively high; it is closer to rivers, roads, and faults. The development of landslides is obvious in the areas of the belt. The farther the distance, the lower the susceptibility rate and the larger the overall vegetation coverage. The relationship between the two must be further analyzed. The impact of precipitation on mountain landslides is that as precipitation increases, the disaster density of landslides will also increase. The impact of annual temperature difference on landslides is that as temperature difference increases, the higher the possibility of landslide occurrence. The disaster density analysis shows that the development of landslides has strong spatial autocorrelation. According to the principles of ecological priority, regional characteristics, people-oriented, local conditions, integration, and continuity, this paper classifies the landscape of land use types on both sides of the highway, and summarizes the targeted design methods. The relative height position relationship of the plane is divided into three situations: above the road shoulder, the regional road shoulder, and the level with the road shoulder. They are characterized by the permeability of the lines, the pastoral landscape touched by the field of vision must be complete and continuous, and the villages and mountains in the distance must be seen. According to the topographical characteristics, the forest landscape can be divided into mountains, plains, and slopes. Landscape mountains and roadside trees should be planted in sequence to ensure visibility. The forest area can retain the original trees, replant, and restore the greening effect. In the flat landscape, it is necessary to keep the landscape free and the ecological environment stable. Adding other characteristic landscapes to the open terrain, the landscape design should try to avoid the same pattern, and fully reflect the natural resources, history, culture, and folk customs along the route. Excavating and developing the local rural characteristics, folk customs, historical relics, and other elements in depth, the proper use of these elements in landscape design is an important responsibility of landscape architects. The purpose is to create a unique cultural landscape with regional characteristics and promote the development and prosperity of tourism and local characteristic industries in the region.

Declarations

The authors declare no competing interests.

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