

Evaluation of the Importance of Ecological Protection in Xiahe County

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Abstract: The importance of ecological protection is a comprehensive index reflecting the importance of ecosystem structure and function in a region, including ecosystem service function and ecological vulnerability. This paper takes Xiahe County as an example, based on the GIS and RS platform, combined with its natural environment characteristics, selects the importance of water conservation, soil and water conservation, and biodiversity maintenance in the evaluation of the importance of ecosystem service functions. Among which, we select grassland degradation vulnerability assessment and soil erosion vulnerability assessment as the basic ways to assess the Ecological vulnerability. Finally, the evaluation results are integrated, the importance of ecological protection is obtained, and the extremely important and important areas of ecological protection are identified.

Keywords: Importance of ecological protection, Ecosystem service function, Xiahe County, Ecological vulnerability assessment.

1. Preface

The importance of ecological protection is a comprehensive index that reflects the importance of the structure and function of an ecosystem in a region. The evaluation of the importance of ecological protection covers the evaluation of the importance of ecosystem service functions and the evaluation of ecological vulnerability, which is a comprehensive integration of the two. Ecosystem service functions refer to the natural environmental conditions and utility formed and maintained by ecosystems and ecological processes on which human beings depend for survival, and are all the benefits that humans can obtain directly or indirectly from ecosystems [1]. Ecological vulnerability refers to the degree of vulnerability of an ecosystem to various environmental variations and interference from human activities. The higher the vulnerability, the easier it is to produce ecological and environmental problems [2].

Xiahe County is located in Gannan Tibetan Autonomous Prefecture. It is an important part of the "Qinghai-Tibet Plateau Ecological Barrier" in the "Two Screens and Three Belts" and the national key ecological function zone "Gannan Yellow River Important Water Supply Ecological Function Zone". It is an important water conservation area in the Gannan Plateau. It is an important ecological functional area in the upper reaches of the Yellow River and a national key ecological management area. This paper takes Xiahe County as an example, combined with its natural environment characteristics, selects the importance of water conservation function, soil and water conservation function, and biodiversity maintenance function in the evaluation of the importance of ecosystem service functions [3], as for ecological vulnerability evaluation, Grassland degradation vulnerability assessment and soil erosion vulnerability assessment are selected. Finally, the evaluation results are integrated, the importance of ecological protection is obtained, and the extremely important and important areas of ecological protection are identified.

2. Data Sources and Research Methods

2.1. Overview of the study area

Xiahe County is located in the southwest of Gansu Province, the northwest of Gannan Tibetan Autonomous Prefecture, and its northeast is close to the Qinghai-Tibet Plateau. It is located between 34°32'~35°34' north latitude and 101°54' ~ 103°25' east longitude. It is under the jurisdiction of Gannan Tibetan Autonomous Prefecture. The study area is adjacent to Hezuo City and Zhuoni County in the east, Luqu County in the south, Zeku County in Qinghai Province in the west, Linxia Prefecture, Xunhua County and Tongren County in Qinghai Province in the north. The total area is 6267.08km². Located on the eastern edge of the Qinghai-Tibet Plateau, the transition zone between the Gannan Plateau and the Loess Plateau, there are high mountains and canyons, bounded by Tumen Pass, the Loess Plateau in the north, and the obvious plateau landform in the south. The altitude of most areas is between 3000 and 4200m, and the terrain slopes from northwest to southeast. It belongs to the cold humid climate, and the characteristics of the plateau continental climate are relatively obvious. The river network in Xiahe County is densely distributed, with the Daxia River system in the north and west, and the Taohe River system in the south and east. Both the Daxia River and Tao River are important tributaries of the upper reaches of the Yellow River. Soil types mainly include alpine meadow soil, subalpine meadow soil, chernozem, gray cinnamon soil, etc.. At the end of 2018, the resident population was 90,300, the per capita disposable income of urban residents reached 24,574 yuan, and the per capita disposable income of farmers and herdsmen was 7,598 yuan.

2.2. Data sources

The data used in this paper include meteorological data, remote sensing data, disaster data, digital elevation model data, data from the third national land survey of Xiahe County, and the 2018 Statistical Yearbook of Xiahe County. The data mainly come from online public data downloads or obtained from relevant departments.

Because the study area is a county-level unit, the research scope is small, and the data sources are complicated, and the unit sizes are different, to facilitate unified calculation, all spatial data are unified to a resolution of 30m, which is used

as the basic evaluation unit of Xiahe County; Based on the national geodetic coordinate system (CGCS2000_3_Degree_GK_Zone_34N), it unifies various types of spatial data projection coordinate systems.

Table 1. Data sources for the evaluation of the importance of ecological protection in Xiahe County

| Name | Type | Resolution | Data source | Specific data required |
|---------------------|--------|------------|---|--|
| Meteorological Data | Text | — | China Meteorological Science Data Sharing Service Network | Annual precipitation of 27 meteorological stations in Xiahe and its surrounding countries in 10 years from 2008 to 2017 (mm) |
| Soil data | Raster | 1km | National Qinghai-Tibet Plateau Scientific Data Center | the soil dataset (v1.2) of the World Soil Database (HWSD) |
| Elevation Data | Raster | 30m | Geospatial Data Cloud Website | Slope |
| NPP | Raster | 250m | NASA | modis17a3 data from 2013 to 2019 |
| Ecosystem type data | Vector | — | The third land survey in Xiahe County | Land type map |
| Nature Reserve | Vector | — | Xiahe County Ecological Protection Red Line Database | Xiahe County Aquatic Germplasm Resources Protection Area |

2.3. Research Methods

2.3.1. NPP quantitative index method

In this paper, the NPP quantitative index method is used to estimate the importance of water conservation in Xiahe County [4], and the ecosystem water conservation service capacity index is used as the evaluation index. The calculation formula is:

$$WR = NPP_{mean} \times F_{sic} \times F_{pre} \times (- F_{slo})$$

In the formula, WR is the ecosystem water conservation service capacity index, NPPmean is the average value of vegetation net primary productivity for many years, Fsic is the soil seepage factor, which is obtained according to the assignment of soil texture types, Fpre is the annual average precipitation factor, and the precipitation time scale here is 10 years, and F slo is the slope factor.

2.3.2. Product calculation

In order to reflect the single-factor evaluation data of each factor's sensitivity to soil erosion, the product operation is used to calculate [5], and the formula is as follows:

$$SS_i = \sqrt[4]{R_i \times K_i \times LS_i \times C_i}$$

In the formula:SSi is the susceptibility index of water and soil loss in space unit i, and the evaluation factors include rainfall erosivity (Ri), soil erodibility (Ki), slope length and slope (LSi), and surface vegetation cover (Ci).

3. Evaluation Process

3.1. Evaluation of the importance of ecosystem service functions

3.1.1. Importance of water conservation function

Water conservation is the process and ability of an ecosystem to retain water within a certain time-space range and conditions. Under the comprehensive influence of climate change, topographical differences, land use/cover changes,

and soil physical and chemical properties, it features different Qualitative spatially and dynamic complexity [6]. In this paper, the NPP quantitative index method is used to estimate the importance of water conservation in Xiahe County. The multi-year average precipitation factor, soil seepage factor, NPP, and slope factor are selected as evaluation factors, and the ecosystem water conservation service capacity index is used as an evaluation index. The evaluation results are as follows: The importance of water resources conservation in Xiahe County has gradually increased from northwest to southeast in space, showing a trend of high in the south and low in the north. The extremely important areas are mainly located in Kecai Town, Amuquhu Town and most of Sangke Town in the south of Xiahe County, accounting for about 33.60% of the total area, with an area of 210,354.65 hectares. There are a large number of grasslands distributed in extremely important areas, and the vegetation coverage is relatively high. The grasslands intercept and accumulate the precipitation layer, reducing the precipitation runoff that directly contacts the surface. The important level area accounts for about 35.88% of the total area, with an area of 224,769.09 hectares. It is mainly distributed in Sangke Town, Amu Quhu Town, Bola Town and Zhayou Township. These areas are relatively flat and low in altitude. Although the vegetation cover Not the most, but the water and heat conditions are good, which has a high contribution to the function of water conservation. The general important areas are mainly distributed in Ganga Town, Madang Town and Qu'ao Township. These areas have poor water and heat conditions, low vegetation coverage, and relatively poor water conservation capacity.

3.1.2. Importance of soil and water conservation function

The function of soil and water conservation refers to the function of reducing soil erosion caused by water erosion through the interaction of its own structure and process in the ecosystem process [7]. According to different ecosystem types, different vegetation coverage, and different landform conditions, the importance of different ecosystems for water and soil conservation is evaluated. Overall, the soil and water conservation in forest, shrub and grassland ecosystems has a high role in ecosystems, and with the increase of vegetation

coverage and slope, the effect of soil and water conservation also increases. Through the comprehensive analysis of terrain factors, vegetation coverage and ecosystem types, the forest land, shrubs and grasslands with a slope of more than 25 degrees and a vegetation coverage of more than 80% are regarded as key areas for soil conservation. The main areas are woodlands, shrubs and grasslands with a slope greater than 15° and vegetation coverage greater than 60%. Soil conservation in Xiahe County is divided into three levels, namely extremely important, important, and generally important. The results show that the distribution of extremely important areas of water and soil conservation in Xiahe County is relatively scattered, with an area of 25,320.78 hectares, accounting for 4.07% of the total area. The trend is basically consistent with the high slope, the greater the slope, the more obvious the sensitivity to soil erosion. The area of general important areas is 428,514.66 hectares, accounting for 68.82% of the total area of the region, mainly distributed in relatively flat areas such as Ganga Town, Sangke Town and Amu Quhu Town.

3.1.3. Functional importance of biodiversity maintenance

Biodiversity maintenance function refers to the measurement of the ability to maintain species and genes in a region. The stronger the ability to protect biodiversity, the better the quality of the ecological environment will be, and it will be more beneficial to the survival, development and reproduction of animals and plants. At the level of ecosystems, high-level ecosystems such as forests, shrubs, grasslands, inland wetlands, deserts, and oceans have been evaluated and key protections have been carried out. Other ecosystems that need to be conserved are assessed as key areas for maintaining biodiversity. Based on a large number of readings, this paper refers to the classification structure data of China's terrestrial ecosystems, and sets its extremely important areas as extremely important areas for biodiversity maintenance functions, and important areas as important areas for biodiversity maintenance functions.

Among them, at the level of ecosystems, the forest ecosystems in counties included in the list of priority ecosystems for protection mainly include Qilian round pine forest, Huashan pine forest, spruce forest, purple fruit spruce forest, oil wheat hanging fir forest, western Sichuan spruce forest and Liaodong oak forest; Shrub ecosystems mainly include *Nasturtium japonicus* shrubs and *Caragana sagittarius* shrubs; grassland meadow ecosystems mainly include *Stipa kirschner* grassland and *Artemisia parviflora* alpine meadows. At the level of genetic resources, the aquatic germplasm resource protection area in the delineation results of the ecological protection red line in Xiahe County is selected as the extremely important area for biodiversity maintenance, and finally the ecological red line is superimposed on the boundary of the priority protection area to obtain the evaluation of the importance of biodiversity maintenance function. The results show that the importance of biodiversity maintenance functions in Xiahe County is mainly extremely important and important. In terms of quantity, the areas of extremely important and important areas for biodiversity maintenance are 249,148.85 hectares and 377,455.84 hectares, respectively, accounting for 39.77% and 60.24% of the total area of the county. Township, Sankoh Township and Ganga Township, accounting for 50.43% of the very important area. From the perspective of spatial distribution, the important areas of biodiversity maintenance are distributed throughout the county, with a wide variety of wild plants of high quality

and high quality, and the aquatic germplasm resource areas are mainly distributed in Sangke Town. The diversity maintenance function is more important.

3.1.4. Evaluation Results

Assess the importance of ecosystem service functions, and select the extremely important areas of water conservation, water and soil conservation functions, and biodiversity maintenance functions as extremely important areas of ecosystem service functions, and the remaining important areas are determined as important areas of ecosystem service functions. For the evaluation results, please refer to the distribution map of the importance of ecosystem service functions in Xiahe County attached.

The ecosystem service functions of Xiahe County are mainly extremely important and important. The areas of extremely important and important ecosystem service functions are 65,692.87 hectares and 558,467.86 hectares, respectively, accounting for 10.52% and 89.48% of the total area of Xiahe County. From the perspective of spatial distribution, the distribution of extremely important areas of ecosystem service functions is relatively scattered, mainly distributed in the west of Kecai Town, the northeast and south of Sangke Town, Amu Quhu Town and Jicang Township, accounting for 76.20% of the extremely important areas. This is because the water conservation and soil and water conservation functions in this area are relatively important and it is located in a very important area for biodiversity maintenance.

3.2. Assessment of ecological vulnerability

Ecological vulnerability assessment mainly includes the assessment of vulnerability to soil erosion, land desertification, rocky desertification and salinization [8]. Based on the actual findings of Xiahe County, land desertification, rocky desertification and salinization are not included in the ecological vulnerability assessment category of Xiahe County, while grassland degradation and soil erosion are important factors that cause local ecological vulnerability. Therefore, the vulnerability assessment of grassland degradation and Soil erosion vulnerability assessment.

3.2.1. Grassland degradation vulnerability

The vulnerability of grassland degradation in Xiahe County is mainly extremely vulnerable and vulnerable, with the areas of extremely vulnerable and vulnerable areas being 61533.36 hectares and 310796.99 hectares, accounting for 16.53% and 83.47% of the total area of Xiahe County, respectively. From the perspective of spatial distribution, the distribution of extremely vulnerable areas of grassland degradation in Xiahe County is relatively scattered. The extremely vulnerable areas are mainly distributed in Amu Quhu Town, Sangke Town, and Kecai Town. Due to long-term improper use and the impact of climate, the grassland continues to degrade, as a result, it not only seriously affects the survival of local herdsmen, but also poses a huge threat to the protection of wetlands and biodiversity in the upper reaches of the Yellow River.

3.2.2. Soil erosion vulnerability

The results show that the extremely vulnerable area of soil erosion in Xiahe County is 26,131.10 hectares, accounting for 4.19% of the county's total land area; the vulnerable area is 113,548.00 hectares, accounting for 18.19% of the county's total land area; It accounts for 77.63% of the total land area of the county. The vulnerability of soil and water loss in Xiahe County shows obvious spatial differences. The extremely

vulnerable and vulnerable areas are mainly distributed in the northeast of Xiahe County, including Madang Town, Qu'ao Township, Tanggaang Township and Wangertang Township. Due to the large topographical undulation here, it is greatly affected by the erosive force of rainfall, and the vegetation coverage is not high, so the soil erosion is relatively serious. Generally, vulnerable areas are mainly distributed in the central, western and southern regions, including Ganga Town, Sangke Town, Labrang Town and Amu Quhu Town. The terrain here is relatively flat, the soil erodibility factor is small, and the vegetation coverage is relatively high. , so the vulnerability to soil erosion is low.

3.2.3. Evaluation Results

The ecological fragility of Xiahe County is mainly extremely fragile and fragile. The areas of ecologically extremely fragile and fragile are 59,109.37 hectares and 315,885.43 hectares, respectively, accounting for 15.76% and 84.24% of the total area of Xiahe County. In terms of spatial distribution, the distribution of ecologically extremely vulnerable areas in Xiahe County is relatively scattered, and the ecologically extremely vulnerable areas are mainly distributed in Amuquhu Town, Sangke Town, and Kecai Town in the southwest, and Madang Town and Wangertang Town in the northeast. , these areas are areas with relatively serious grassland degradation and serious soil erosion, and are areas with relatively high ecological vulnerability in Xiahe County.

4. Results and Analysis

On the basis of existing research, select the level of ecosystem service importance and ecological vulnerability, and divide them into different types. Among them, the sum of the extremely important area of ecosystem service function and the extremely fragile area is determined as the extremely important area of ecological protection, and the sum of the remaining important and vulnerable areas is determined as the important area of ecological protection.

According to the evaluation results (as shown in Figure 1), the area of Xiahe County where the importance of ecological protection functions is extremely important cover 166,552.54 hectares, accounting for 26.57% of the county's total land area; the area in important areas is 460,196.33 hectares, accounting for 73.43% of the total land area. From the perspective of spatial distribution, the most important areas are widely distributed, and they are distributed in all towns and towns in the county. Sangke Town, Amu Quhu Town and Kecai Town in the southwest are the most distributed, accounting for more than one-fifth of the extremely important areas in the county. Fourth, this area has the important functions of soil and water conservation, water conservation and ecological balance maintenance, and it is also a place where species resources are enriched, and it is also a key area for biodiversity conservation in this research area. But Damai Township, Zhayou Township, and Qu'ao Township in the central and eastern parts are less distributed. Areas with large ecologically important areas can be used as key ecological function areas. The determination and timing arrangement of major projects for land space ecological restoration and comprehensive land improvement in the county should be carried out in priority in areas such as Kecai Town, Sangke Town, Amuquhu Town, and Jicang Township.

The importance of ecological protection

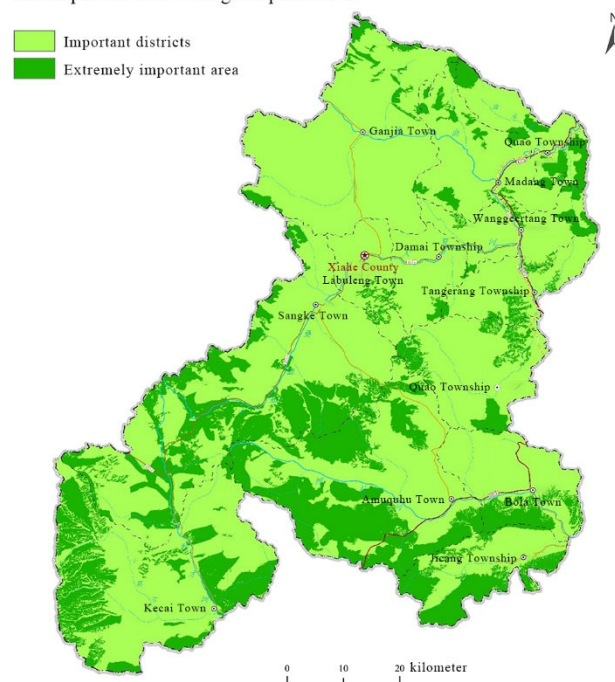


Figure 1. Grading diagram of the importance of ecological protection

5. Conclusions and Recommendations

This paper takes Xiahe County as the research area, and based on its natural environment characteristics and ecological problems, builds an evaluation index system for the importance of ecological protection in Xiahe County. The main conclusions are as follows: Xiahe County has an area of 166,552.54 hectares in the extremely important area of ecological protection function, accounting for 26.57% of the county's total land area; an area of 460,196.33 hectares in the important area, accounting for 73.43% of the county's total land area. From the perspective of spatial distribution, the most important areas are widely distributed, and they are distributed in all towns and towns in the county. Sangke Town, Amu Quhu Town and Kecai Town in the southwest are the most distributed, accounting for more than one-fifth of the extremely important areas in the county. Fourth, this area has the important functions of soil and water conservation, water conservation and ecological balance maintenance, and it is also a place where species resources are enriched, and it is also a key area for biodiversity conservation in this research area. But Damai Township, Zhayou Township, and Qu'ao Township in the central and eastern parts are less distributed.

Xiahe County is an important water conservation area in the Gannan Plateau area, an important ecological function area in the upper reaches of the Yellow River and a national key ecological control area. Based on the further optimization of the land spatial structure, Xiahe County needs to focus on strengthening the protection of the ecological environment, and form an ecological environment spatial pattern that focuses on water conservation, grassland management, river, lake and wetland protection, and gives priority to the protection of grassland, forest and wetland ecosystems. The construction of ecological civilization should be placed in a more prominent position, and green development should be integrated into local economic construction; Actively strive

for the implementation of projects, such as forest, grassland, and wetland protection, urban and rural greening, environmental pollution control, and grass industry and animal husbandry infrastructure construction; We should also strengthen the protection and restoration of the ecological environment, the comprehensive control of geological disasters, the return of grazing land to grassland, and the protection of natural forests.

It's important to establish a long-term mechanism for ecological protection, promote ecological compensation in national key ecological function areas, increase special transfer payment subsidies, improve the national grassland ecological subsidy and reward standards, and extend the subsidy period. At the same time, forest land and wetland will be included in the scope of supplementary rewards, support for the development of the under-forest economy will be increased, and the identity of the masses in the ecological core area will be replaced by forest and grassland caregivers. Guide the masses to change industries and jobs, and solve the problem of energy consumption of the masses in forest areas by promoting new energy sources and replacing wages with electricity.

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