

# Temporal and Spatial Changes of Ecological Environment Index in Zoige County

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## Abstract

The eco-environmental effects brought about by LUCC determine the supply of products and services in the region, and especially have an important impact on human well-being and the quality of the ecological environment. This article takes Zoige County as the research area to analyze and discuss the ecological environment quality of Zoige County. The results show that the ecological environment index of Zoige County in 2000, 2010 and 2019 were 0.541, 0.553, and 0.549 respectively. In the past two decades, the ecological environment index of Zoige County has been increasing first and then decreasing. The ecological environment of all townships in Zoige County There are obvious differences in the index, and the lowest ecological environment index in the entire study interval is Hongxing Town. The degree of interference in the territory by various external factors has deepened, and it has continued to deteriorate in some areas. The restoration and renewable ability of the ecological environment has been weakened to a certain extent. The quality of the ecological environment is generally in a relatively good state, and the regional ecological environment is maintained within a certain range. Dynamically stable.

## Keywords

LUCC; Zoige County; Ecological Environment Quality Index; Spatial and Temporal Changes.

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## 1. Introduction

Ecological effects are the accumulation of comprehensive environmental effects caused by changes in various environmental factors. Land use/cover changes mainly affect the environment from the following aspects such as climate, soil environment, water environment, chemical cycle process, and biodiversity in the time and space in which they are located<sup>[1-4]</sup>. In the context of global climate change and the accelerating local social and economic development, the ecological environment of Zoige County has become increasingly severe due to the interference of natural and man-made factors, and various ecological problems have emerged one after another. The area of lakes, peat swamp wetlands, swampy meadows and wet meadows is gradually shrinking, the water storage capacity of the swamps has dropped significantly, and the potential surface evapotranspiration has shown an obvious upward trend<sup>[5-6]</sup>, and the problem of soil erosion is serious<sup>[7-8]</sup>, Leading to the gradual imbalance of the local ecology, the raging environmental rodents and insect pests, the sharp decline in biological characteristics is quite severe, and it has a profound impact on the local ecological environment. This paper uses the regional ecological quality index to carry out a quantitative study on the ecological effects of land use in Zoige County, and provides a scientific reference for regional social and economic development and improvement of the ecological environment.

## 2. Overview of the study area and data sources

### 2.1 Overview of the study area

Zoergai County is located in the northwest of Sichuan Province and the north of Aba Tibetan Autonomous Prefecture ( $102^{\circ} 08'E \sim 103^{\circ} 39'E$ ,  $32^{\circ} 56'N \sim 34^{\circ} 19'N$ ), covering an area of about 10321.320km<sup>2</sup>, bordering the four counties of Diabu Maqu, Zhuoni, Luqu and Yemaqu in Gansu Province. Adjacent to Jiuzhaigou County, Songpan County, Aba County, and Hongyuan County in the province, it has jurisdiction over 4 towns and 13 townships, 1 provincial ranch, 1 state-owned ranch, and 5 A-level scenic spots. The national highway line G213(Lanzhou→ Mohan) leading to Lanzhou is the only route of Sichuan-Tibet line and Ganzi, crossing the main grasslands of the whole Ruoergai. Provincial highway 209 intersects with national highway 213 in the county seat, which is convenient for the development of ecological tourism (fig. 1)

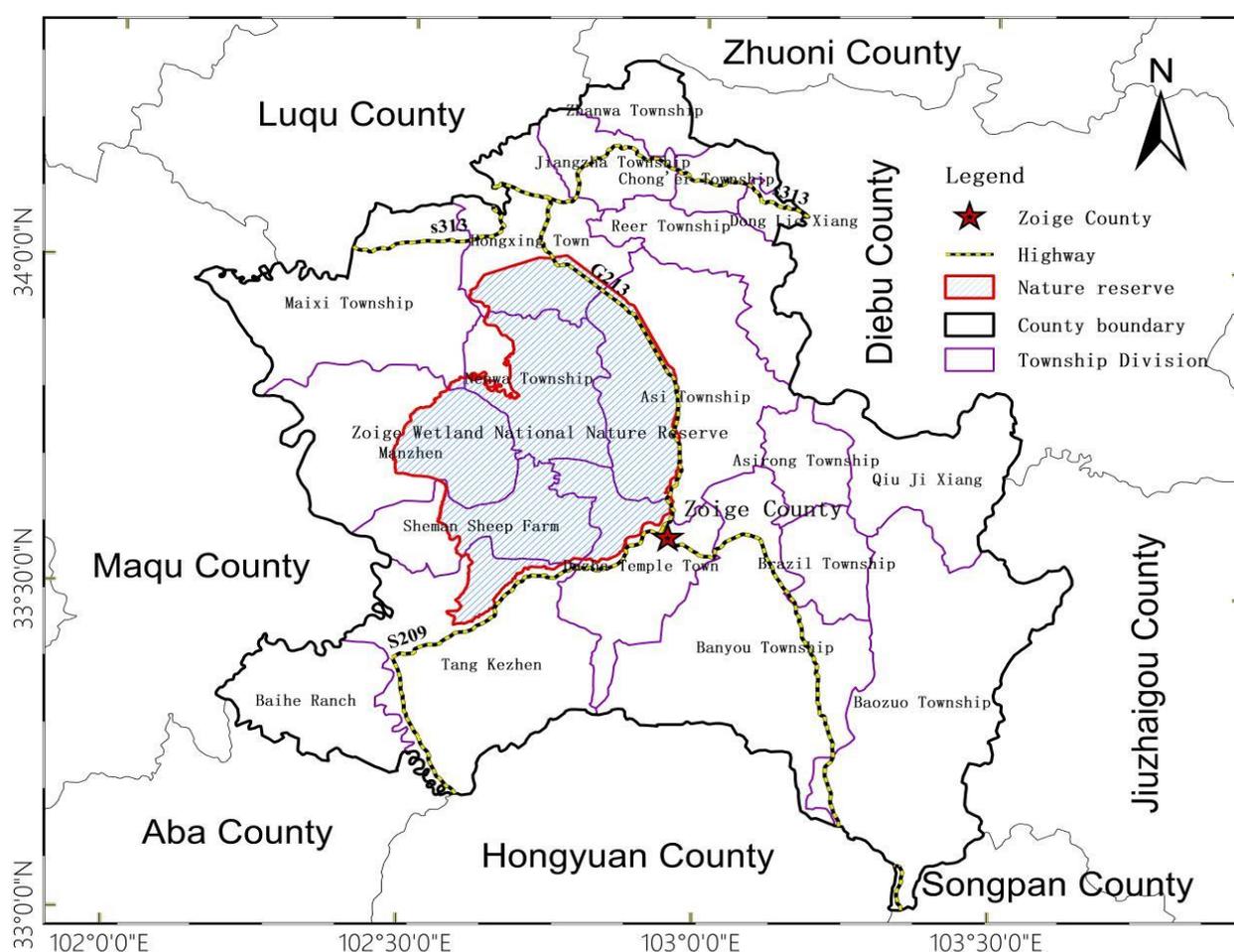


Fig. 1 Location of the study area

### 2.2 Data Sources

The land use data of 2000, 2010 and 2019 in the study area are based on 9 remote sensing images of Landsat TM/OLI in 3 periods, and the image time period is from June to October. Radiation calibration, atmospheric correction, geometric correction and Mosaic were carried out according to ENVI 5.3, and the vector boundary of the study area was trimmed to finally obtain the 3-phase remote sensing images of Zoige County. Based on the classification system of China's land use/land cover remote sensing monitoring data<sup>[9-10]</sup> and the characteristics of land resources in the study area, Zoige County was divided into seven land use types (cultivated land, woodland, grassland, water area, construction land, unused land and swamp wetland) by human-computer interactive interpretation.

Through field verification, the accuracy of each image interpretation is more than 89%, which meets the accuracy requirement.

### 3. Research Method

Eco-environmental quality can be expressed through monitoring data of vegetation, land cover, biomass, and topography and climate. At present, the commonly used evaluation methods of ecological environment quality at home and abroad mainly include landscape ecology method, comprehensive index evaluation method, etc., among which the comprehensive index evaluation method is the most commonly used.

Ecological environment quality index of various land use types (EV) integrated with the ecological environment quality and the area proportion, establish the land change and the quantitative relationship between ecological environment quality, overall reflect the change of area ecological environment quality condition, describe a certain area (county level administrative units) the eco-environment effect of the change of land use [11-12]. Its calculation formula is as follows:

$$EV_t = \sum_{i=1}^n LU_i \times C_i / TA \quad (1)$$

Where,  $EV_t$  is the regional ecological environment quality index;  $LU_i$  and  $C_i$  are the area and ecological environment index of the  $i$  th land use type in the period of  $t$  in this region;  $TA$  is the total area of the region;  $n$  is the number of land use types in the region.

Table 1. The land use classification and eco-environmental value for the land use types

Land use types	Crop land	Forestland	Grassland	Water land	Marsh land	Unused land	Marsh land
eco-environmental value Assignment	0.3	0.80	0.45	0.65	0.2	0.01	0.65

## 4. Results analysis

### 4.1 Ecological and environmental quality index

According to the calculation (Table 2), the ecological environment index of Zoige County in 2000, 2010 and 2019 is 0.541, 0.553 and 0.549 respectively. In the past two decades, the ecological and environmental index of Zoige County increased at first and then decreased. From 2000 to 2010, the ecological and environmental index increased by 0.012, and from 2010 to 2019, the ecological and environmental index decreased by 0.004. In the whole research interval, the ecological and environmental index of Zoige County increased by 0.008. The change rate was 1.479%, with an average annual increase of 0.078%. The ecological and environmental quality was slightly improved. From the overall, zoige county have not reached the expected performance of ecosystem services, provide general function, suffer the interference outside the weight factors in deepening, in some areas continued to deteriorate, the recovery of ecological environment renewable ability have a certain degree of decline, but on the whole ecological environmental quality is in relatively good condition, regional ecological environment within a certain range to maintain the dynamic stability.

Table 2. Changes of Ecological Environment Quality Index in Zoige County

years	2000 years	2010 years	2019 years
Regional EV	0.541	0.553	0.549

### 4.2 Spatial pattern of ecological and environmental quality

In different parts of the land use type and scope of the various elements of the ecological environment to difference of regional ecological environmental quality or good or worse, in order to better analysis

of different villages and towns in the area of ecological environment index differences, therefore, using the formula 1, 6-2000-2019 zoig 19 villages and towns of the ecological environment index, ArcGIS 10.4 was used to visually express the ecological environment index of each township to analyze the differences among different regions. The results are shown in Table 3 and Figure 2.

It can be seen from Table 3 that the ecological environment quality index of each township in different periods in Zoige County has led to varying degrees of increase or decrease in the ecological environment quality of each township in Ruergai County in the past 20 years. The ecological environment index of each township in Ruergai County exists. obvious difference. In 2000, the ecological environment index of each township in Zoige County ranged from 0.499 to 0.652. The high-value areas of the ecological environment quality in the study area were as follows: Donglie Township> Chong'er Township> Reer Township> Brazil Township; Zoige County in 2010 The environmental index ranges from 0.507 to 0.652. The high-value areas of regional ecological environment quality are as follows: Donglie Township> Chong'er Township> Re'er Township> Qiuji Township; in 2019, the regional ecological environment index of Zoige County ranges from 0.505 to 0.631. The high-value area of the regional ecological environment quality is as follows: Re'er Township> Chong'er Township> Qiuji Township> Brazil Township. The lowest ecological environment index in the whole research interval is Hongxing Town.

From 2000 to 2010, except for the Brazilian township ecological environment index decreased by 0.018, Tangke Township and Banyou Township remained stable, the ecological environment indexes of the other townships increased in varying degrees, and the Juman sheep farm increased the most. 0.038, Chong'er Township increased by 0.002, the least increase; from 2010 to 2019, except for Banyou Township, the ecological environment index of the study area decreased in all other regions. The township with the largest change was Donglie Township, which decreased by 0.062. From 2000 to 2019, the areas where the ecological environment index increased significantly were Shuman Sheep Farm, Dazasi Town, Asirong Township, and Banyou Township, which increased by 0.033, 0.030, 0.027, and 0.019 respectively. Areas with a significant decrease were frozen. Lie Township, Brazil Township, Chong'er Township, and Zhanwa Township decreased by 0.062, 0.020, 0.018, and 0.012 respectively. At the same time, other townships also increased or decreased to varying degrees. Among them, Baozuo Township had the smallest increase, which was 0.002; Reer Township decreased by 0.001, with the smallest change.

Table 3. Eco-environment index of each township in Zoige County from 2000 to 2019

Township name	2000	2010	2019	2000-2010	2010-2019	2000-2019
Asirong Township	0.529	0.562	0.556	0.033	-0.006	0.027
Asi Township	0.519	0.530	0.529	0.011	-0.001	0.010
Brazil Township	0.619	0.601	0.599	-0.018	-0.002	-0.020
Baihe Ranch	0.513	0.519	0.506	0.006	-0.013	-0.007
Banyou Township	0.506	0.525	0.525	0.019	0	0.019
Baozuo Township	0.551	0.554	0.553	0.003	-0.001	0.002
Chong'er Township	0.646	0.648	0.628	0.002	-0.020	-0.018
Dazha Temple Town	0.529	0.564	0.559	0.035	-0.005	0.030
Dong Lie Xiang	0.652	0.652	0.590	0	-0.062	-0.062
Hongxing Town	0.499	0.507	0.505	0.008	-0.002	0.006
Jiangzha Township	0.586	0.598	0.590	0.012	-0.008	0.004
Maixi Township	0.509	0.520	0.513	0.011	-0.007	0.004
Nenwa Township	0.576	0.601	0.599	0.025	-0.002	0.023
Qiu Ji Xiang	0.608	0.628	0.624	0.020	-0.004	0.016
Reer Township	0.632	0.636	0.631	0.004	-0.005	-0.001
Tang Kezhen	0.512	0.512	0.509	0	-0.003	-0.003
Manzhen	0.540	0.559	0.550	0.019	-0.009	0.010
Sheman Sheep Farm	0.533	0.571	0.566	0.038	-0.005	0.033
Zhanwa Township	0.593	0.597	0.581	0.004	-0.016	-0.012

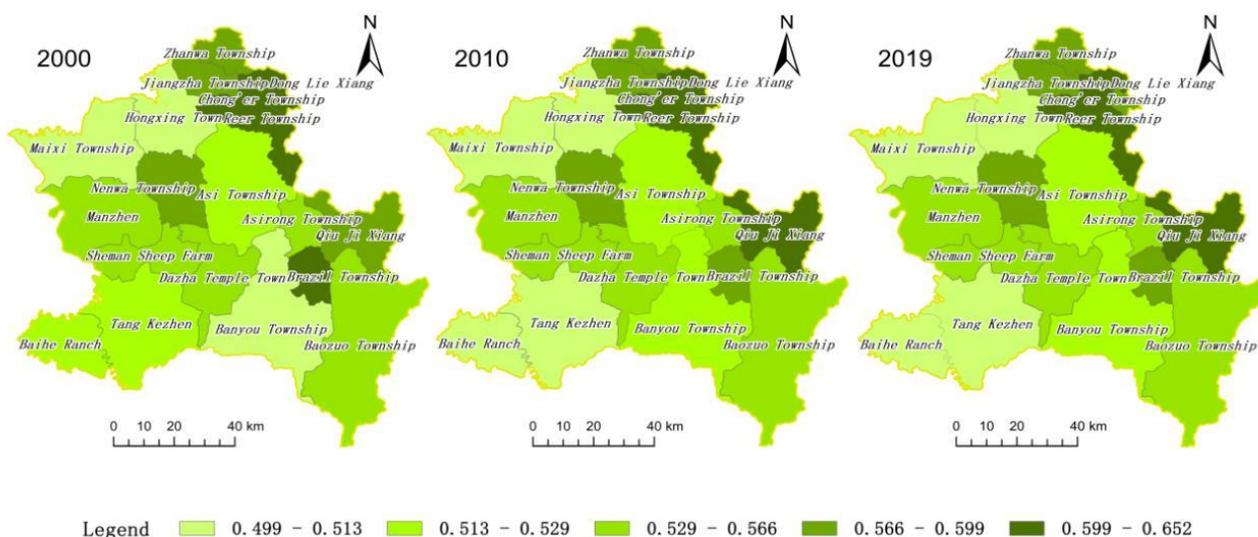


Fig. 2 Spatial differences of EV in Zoige County from 2000 to 2019

## 5. Summary

As an important distribution area of alpine wetland in Zoige County, it is of great significance to carry out research on ecological environment quality for regional ecological maintenance. Based on Landsat TM/OLI data in 2000, 2010 and 2019, this paper analyzed the temporal and spatial changes of ecological and environmental effects in the study area, and the results showed that:

- (1) The eco-environmental index of Zoige County in 2000, 2010 and 2019 was 0.541, 0.553 and 0.549, respectively, which showed a trend of increasing at first and then decreasing.
- (2) There are obvious differences in the eco-environmental index among the townships in Ruoergai County, and Hongxing Town has the lowest eco-environmental index in the whole research region. In the territory, the degree of interference by various external factors is deepened, which continues to deteriorate in some areas, and the restoration and regeneration ability of the ecological environment is weakened to a certain extent. Overall, the ecological environment quality is in a relatively good state, and the regional ecological environment maintains dynamic stability within a certain range.
- (3) Pay attention to the supervision and protection of ecological land, implement dynamic monitoring, build a solid ecological security barrier, promote the coordinated development of ecological construction, and practice the concept that "clear waters and green mountains are golden hills and silver mountains".

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