Ecological Environment Evaluation of Vegetation in Zaozhuang City Based on Landsat-8

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Abstract. Based on the remote sensing image of Landsat-8, the ecological factors of vegetation were extracted from remote sensing information, and the ecological environment of vegetation was evaluated and analyzed. The evaluation results show that the vegetation ecological environment in Zaozhuang is relatively good in general, and the evaluation index is in the majority in the range of 4-10, indicating that most of the vegetation ecological environment in Zaozhuang is in excellent state and mostly concentrated in plain and forest areas. Among them, the areas with excellent grades account for 44.07% of the total area, the areas with good grades account for 24.91%, the middle grades for 13.04%, and the poor grades for 17.98%; the western and southern regions are relatively good, the vegetation is basically undamaged, and the ecological structure is reasonable, in line with the concept of sustainable development.

1. Introduction
The ecological environment is an important condition for human survival and the basis for social and economic development. To this end, many scholars use different research methods to evaluate the ecological environment. Using the principles and methods of valuation of ecosystem services, such as Greymore and others think that the research and analysis of regional sustainable development using regional ecological environment is an important tool[1]; Wang Zhenhua and others used comprehensive index method to study the natural environment evaluation in Yahuijiang project area of north-south water transfer, and its evaluation results were basically consistent with the actual situation[2]; Ma Ronghua and others used three ecological factors to comprehensively evaluate the ecological environment quality of Hainan Province[3]; Comprehensive evaluation and analysis of ecological environment quality in Fuxian Lake Basin of Yunnan Province by using 5 evaluation factors[4]. With the continuous progress of society, the traditional ecological environment research methods are difficult to make an accurate evaluation of the ecological environment of vegetation, and can not meet the requirements of reality. Based on the remote sensing image of Landsat-8 map, this paper extracts the relevant vegetation ecological factors from the remote sensing information, and evaluates and analyzes the vegetation ecological environment. The results can better understand the quality status of the vegetation ecological environment in Zaozhuang City, and have certain reference significance in the aspect of ecological environment protection.
2. Overview of the study area
Zaozhuang is located in the south of Shandong Province, the ground span longitude 116°48’~117°49’, latitude 34°27’ north latitude 35°19’, east-west width about 56 km, north-south length about 96 km, the total area of about 4563km². The city has jurisdiction over five districts and one city, namely, Shizhong District, Gaocheng District, Shanting District, Xue Cheng District, Taierzhuang District and Tengzhou City[5]. The terrain is mainly low hills and hills, the terrain is high in the east and low in the west, high in the north and low in the south, and the mountain elevation in the mountain pavilion area in the north is higher. The terrain in Zaozhuang City is relatively complex, in which the hills account for about 54.6% of the total area, the plain accounts for about 26.6% of the total area, and the depressions account for about 18.8% of the total area[6]. Zaozhuang City soil is mainly divided into five types, the area is about 3476.11km², accounting for 79.59% of the total area of Zaozhuang City[7]. The climate of Zaozhuang city is mainly warm temperate continental monsoon climate, which has the characteristics of warm and humid climate in the south and dry and cold climate in the north. By 2017, the population of Zaozhuang reached 4.1805 million, the total GDP was 231.591 billion yuan, and the urbanization rate of the population reached about 78.87%. Zaozhuang city is rich in forest resources, among which the forest area of Baoduxia National Forest Park, located in the south of Shanting District, is a rare subtropical evergreen broad-leaved forest in China, so it is very precious; the pomegranate garden scenic spot in Yicheng District is very lush and the environment is very beautiful.

3. Data preprocessing
3.1. Data and sources
Remote sensing image is a remote sensing image of Zaozhuang Landset8-OLI satellite downloaded by geospatial data cloud. Among them, one image time is April 23, 2017, and the other image time is 30m resolution on April 30, 2017. OLI is a land imager, its 8 bands can well show the vegetation situation, is very beneficial to the studied vegetation. of the evaluation indexes used by the institute, the slope factor is provided by the digital elevation image of Zaozhuang city with 30m resolution downloaded by DEM geospatial data cloud.

3.2. Image preprocessing
In order to reduce the impact of atmosphere, terrain and other factors on the original remote sensing image in the process of imaging and get higher image quality, it is necessary to preprocess the original remote sensing image to improve the data accuracy. The preprocessing operation mainly includes three steps: radiometric calibration, atmospheric correction, splicing and clipping. Finally, the result map of Zaozhuang remote sensing image preprocessing in 2017 (Figure 1) is obtained. Then the resolution is changed to 15m by changing the pixel size with resample resize data tool, and finally the DEM image of Zaozhuang City (Figure 2) is obtained.
4. Evaluation of vegetation ecological environment in Zaozhuang

4.1. Information extraction of vegetation factors

Vegetation factor is represented by normalized difference vegetation index (NDVI). NDVI index can estimate vegetation coverage. If the value of NDVI is larger, it means vegetation coverage is better. According to the calculation formula:

\[ FC = \frac{(NDVI - NDVI_{\text{min}})}{(NDVI_{\text{max}} - NDVI_{\text{min}})} \]  

(1)

NDVI_{\text{max}} represents the maximum value of the regional vegetation index NDVI_{\text{min}} the minimum value of the regional vegetation index. The NDVI index of vegetation is calculated by NDVI tools, the maximum value of the NDVI is 1 and the minimum value is -1. Because the image will be affected by noise, the calculation results will be between -1~1. According to the vector boundary of Zaozhuang City, mask files can be generated, and the NDVI_{\text{max}} of vegetation in Zaozhuang City can be calculated by Compute Statics module to be 0.654, NDVI_{\text{min}} -0.027.

4.2. Information extraction of soil factors

The composition of the soil is highly correlated with soil erosion, and usually the soil index is proportional to the ecological environment. Using the bare soil vegetation index as the soil factor to evaluate the ecological environment, which can well show the exposed condition of the soil. According to the calculation formula of bare soil vegetation index proposed by Hay et al:

\[ GR(\text{ABS}) = VI - 0.09178BI + 5.58959 \]  

(2)

VI is the greenness index of panicle cap transformation, which is used to reflect the vegetation cover; BI is the soil brightness index, which is used to reflect the bare condition of bare soil. Through the linear correlation between BI and VI, the bare soil vegetation index can be expressed, and the formed bare soil vegetation index can reflect the health status of the soil to a great extent. The soil index was calculated by using the Tasseled cap tool of panicle cap transformation in principal component analysis method, and then the unearthed loam bare soil index was calculated by Band Math. By looking at the DN value of soil index to judge the quality of soil. DN values of soil index large, indicating better soil quality; conversely, worse soil quality.

4.3. Information extraction of terrain factors

The slope in the terrain is one of the most important factors causing soil erosion. The ecological environment is inversely proportional to the size of the slope. The smaller the slope, the better the quality of ecological environment; the greater the slope, the greater the possibility of landslide and soil loss. The slope is calculated by DEM data, the slope information can be extracted directly according to the DEM image data, and the Terrain terrain model function in the Toolbox tool can be used to extract, and then the slope elements can be extracted from the DEM data, and finally the slope index map can be generated.

4.4. Normalization of ecological factors

After the three ecological factors of vegetation coverage, soil index and slope are obtained, it is difficult to be directly used to evaluate, because the criteria of each index are inconsistent and not comparable, so the factors should be normalized[8].

Normalization treatment of vegetation index: according to the importance of vegetation in Zaozhuang City to the quality of ecological environment, the vegetation coverage can be divided into 10 grades, the greater the vegetation coverage, the greater the coding value, and the classification grade is shown in Table 1.
Table 1. Classification of vegetation coverage

| Coverage rate (%) | 0-10 | 10-20 | 20-30 | 30-40 | 40-50 | 50-60 | 60-70 | 70-80 | 80-90 | 90-100 |
|------------------|------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| Encoding value   | 1    | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10     |

The vegetation coverage index map is loaded, and then the vegetation coverage is divided into the following 10 grades by the method of density segmentation. Each grade is represented by different color differentiation, and the result of vegetation coverage normalization is finally obtained, as shown in figure 3.

Table 2. Classification of soil index normalization treatment

| Index value | -17050--3000 | -3000-2500 | -2500--2000 | -2000--1500 | -1500--1000 |
|------------|--------------|------------|-------------|-------------|-------------|
| Encoding value | 1            | 2          | 3           | 4           | 5           |
| Index value | -1000-500   | -500-0     | 0-500       | 500-1000    | 1000-13925  |
| Encoding value | 6            | 7          | 8           | 9           | 10          |

The bare soil vegetation index map is loaded, and then the soil index is normalized by density segmentation. Each grade is represented by different color distinctions. Finally, the soil index normalization treatment results are obtained, as shown in figure 4.

Table 3. Grade of slope index normalization treatment

| Value of slope (°) | <3 | 3-8 | 8-13 | 13-18 | 18-23 | 23-28 | 28-33 | 33-38 | 38-43 | >43 |
|--------------------|----|-----|------|-------|-------|-------|-------|-------|-------|-----|
| Encoding value     | 1  | 2   | 3    | 4     | 5     | 6     | 7     | 8     | 9     | 10  |

The slope index map is loaded, and then the soil index is normalized by density segmentation. Each grade is represented by different color distinctions. Finally, the slope index normalization results are obtained, as shown in figure 5.
4.5. Comprehensive assessment of the ecological environment of vegetation

Because the contribution of each factor to the ecological environment of vegetation is different in the evaluation, the weight coefficient of the evaluation will also be different, and the rationality of the weight distribution will affect the rationality and scientific nature of the evaluation results[9]. Comprehensive evaluation of vegetation ecological environment based on the following calculation formula:

\[ E = W_1 \times S_v + W_2 \times S_s + W_3 \times S_t \]  

(3)

Where the weight values of the three factors of vegetation, soil and slope are \( W_1, W_2, W_3 \), 0.7, 0.2, 0.1, respectively. \( S_v \) represents the vegetation coverage normalization, \( S_s \) represents the soil index normalization, and \( S_t \) represents the slope index normalization. A mask file is used to process the background area, and then according to the estimated weight of each factor contribution, the Band math tool is used to calculate, and finally the gray scale map of vegetation ecological environment evaluation in Zaozhuang city is obtained (figure 7).

4.6. Classification of ecological environmental status of vegetation

According to the calculation of comprehensive evaluation index and the existing data, according to the actual situation of Zaozhuang City, the ecological environment of vegetation is divided into four grades: excellent, good, medium and poor, and the quality of ecological environment is finally judged according to the final index score of comprehensive evaluation. First of all, the results of ecological environment evaluation are treated with background, which are divided into excellent, good, medium and poor four levels according to the method of density segmentation, and finally, the results map of vegetation ecological environment evaluation in Zaozhuang City can be obtained (figure 7). According to the comprehensive evaluation of the final ecological environment, Zaozhuang City formulates the corresponding policies to protect the local vegetation ecological environment.

5. Evaluation findings and analysis

Finally, the final results of ecological environment evaluation are analyzed by using Compute Statistics statistical module, and the proportion of each evaluation grade is obtained. According to the principle that the larger the DN value is, the better the vegetation ecological environment is, the statistical analysis of each evaluation grade is carried out, and the result of the proportion of the area of the ecological environment evaluation grade in Zaozhuang is obtained (Table 4).
Table 4. Proportion results of ecological environment assessment grade area in Zaozhuang City

| Evaluation level | Area (km²) | Proportion (%) |
|------------------|------------|---------------|
| Excellent        | 2010.91    | 44.07         |
| Good             | 1136.64    | 24.91         |
| Medium           | 595.02     | 13.04         |
| Poor             | 820.43     | 17.98         |

According to the evaluation results, the overall vegetation ecological environment in Zaozhuang is relatively good, and the evaluation index accounts for the majority in the range of 4-10, indicating that most of the vegetation ecological environment in Zaozhuang is in excellent state and mostly concentrated in plain and forest areas. Ecological rings in urban core areas in the north and centre the environment is generally poor, the ecosystem's own function is very weak, and the ability of self-recovery is very weak, which is not in line with the concept of sustainable development. Therefore, paying attention to the construction of green space and green road in cities, reducing urban land use, rationally distributing land resources and strengthening environmental management and protection are important ways to improve the ecological environment level of vegetation in Zaozhuang City.

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