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REVIEW ARTICLE

RESEARCH AND EVALUATION OF GEOGRAPHIC INFORMATION SYSTEM BASED ON HIGHWAY ECOLOGICAL LANDSCAPE

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ABSTRACT

With the rapid development of traffic, highway users' demand for highway is no longer just a passageway between two points, but an important landscape element in the highway environment. Based on the analysis of the relevant research at home and abroad, the GIS technology is used to identify the ecological information in the road area, the spatial superposition analysis of the remote sensing image in the road area and the GIS is studied, the remote sensing image before and after the highway construction is compared, the influence of the highway landscape is studied, and the geographical information system is studied and evaluated. It improves the rationality and accuracy of ecological information extraction, classification and analysis, and provides strong technical support and methods for objective, comprehensive and accurate analysis of ecological changes before and after highway construction.

KEYWORDS

Geographic information system, Ecological landscape, GIS, Remote sensing technology.

1. INTRODUCTION

According to the development outline of highway maintenance and management in the 11th five-year plan issued by the ministry of communications, the highway maintenance and management in China is still at a relatively low level of development on the whole compared with the increasing travel needs of the people. The main performance is two "still obvious shortage" and two "still outstanding", the effective supply of highway infrastructure is still insufficient; The leading role of science and technology is still insufficient, and the highway management and decision-making information system that can adapt to the requirements of modern management has not been established. The integration and application of modern information technology and other high and new technologies are relatively weak, and basic and prospective studies are insufficient [1].

Secondly, the institutional obstacles are still prominent. Restrictive factors are still prominent, and insufficient funds are still an important factor restricting the healthy development of highway maintenance and management. Similarly, with the rapid development of transportation, people have higher and higher requirements for transportation. Highway landscape, as a part of the aesthetic environment, has been attached more and more importance in daily life. It requires not only its safety, speed, economy, convenience and comfort, but also its enjoyment and experience of visual beauty. Road user is no longer just to the requirement of highway passenger and cargo from one place to safely and quickly transported to another place, but an important landscape elements of highway environment, should have a pleasing appearance, beautiful line, harmony with the surrounding environment, become a part of the natural environment is satisfactory, therefore, the research of highway landscape is becoming increasingly urgent.

Foreign highway traffic industry attaches great importance to ecological landscape area along the road, many countries at the beginning of the highway construction is generally considered ecological function, landscape beautification function, function of coordination with the surroundings, the perfect combination of various ancillary facilities of transportation function, so that the highway construction maximum harmony with nature. Among these countries, the United States, Germany, Japan, Canada, France, Switzerland, Britain and South Korea are the most typical [2].

Since Germany started to build highways in the 1930s, it has paid great attention to the ecological landscape of the road area [3]. German environmental protection laws and regulations require that ecological and environmental problems along the road should be solved at the design stage, the original topography and landform should be maintained, and the vegetation and natural ecosystem of the road should be protected [4]. To protect wild animals and plants have also been put in place, and protection of the natural wetland landscape protection planning, road in the entire construction process are required to strictly abide by the law, pay attention to the natural ecosystem and landscape protection for some unavoidable influence the suitable ecological landscape compensation measures, such as creating new biological community, improve the function of the existing community consider deeply damaged landscape characteristics and inherent quality, diversity, to restore the near natural expressway landscape to minimize the influence of road construction on the natural environment, the load is very high conservation value construction of "ecological bridge" or the location "Green bridge" is in a lot of the road traffic, road collection of rain water into the river before entering the tank first purification of engineering projects such as subgrade pavement, roadbed, Bridges, culverts, curtain wall and drainage facilities, noise protection facilities, etc. The corresponding environmental protection measures, the maximum possible to reduce or avoid the negative impact of the highway construction on the ecological landscape, etc. [5].

Japan has also done a lot of work in the research and development of road ecological technology, and has accumulated rich experience in natural protection and restoration, road slope vegetation restoration and

greening technology, the creation of biological habitats by using the space on both sides of the road, the protection of natural regional environment, and the restoration of roadside wetlands, etc. [6]. In terms of road greening, although Japan is 20 to 30 years later than the United States, its rapid development, high level of technology and great influence of ideas have always been the focus of attention of the world [7]. Japanese road greening is based on the concept of ecological landscape restoration and reconstruction. To promote ecological landscape construction of expressway, Japan was established in January 1992, the special committee, the committee consists of insects, birds, animals, fish, vegetation and other experts, road construction group together with the government, its main function is to research the present situation of the ecological landscape along the expressway, ecological landscape road construction Suggestions, minimize damage, to restore natural [8]. In recent decades, in the historical process of land development from desolation to greening, the theoretical and technical system of ecological landscape restoration in Japan has been continuously developed and increasingly mature, becoming a model of global ecological landscape restoration and greening design [9].

Therefore, this paper studies and evaluates the geographic information system based on the highway ecological landscape. The identification of road area by gis technology provides the principle guidance and operable method for the construction of ecological landscape of highway. This paper studies the unsupervised classification method of remote sensing images in road domain and the spatial superposition analysis based on GIS, which improves the rationality and accuracy of ecological information extraction, classification and analysis, and provides strong technical support and methods for the objective, comprehensive and accurate analysis of ecological changes before and after highway construction. On the basis of summarizing and analyzing the diagnosis approaches and methods of the degree of ecosystem degradation at home and abroad, the strategy and process of the diagnosis of the degree of ecosystem degradation in the road area are put forward, which lays a foundation for establishing a reasonable diagnosis system.

2. RESEARCH ON GEOGRAPHIC INFORMATION SYSTEM

Geographic information system can dynamically collect, manage, analyze and output a variety of geographic information in space, and it is a modern data management and analysis tool [10]. For gis, remote sensing technology is an important external information source and an important means of data updating. Highway is a belt-like project, which has a wide range of influence on ecological landscape. Therefore, it is necessary to combine the dynamic data of coverage provided by satellite remote sensing with gis. In turn, gis can provide some auxiliary data required by remote sensing image processing to improve the information and resolution of remote sensing images. At the same time, gis can combine the non-remote sensing data obtained from field survey with remote sensing data, thus improving the accuracy of remote sensing image processing and interpretation [11]. For more remote and inaccessible areas, usually it is difficult to conventional methods to conduct a comprehensive investigation and study, and using GIS technology, not only to the current situation to conduct a comprehensive understanding, but also the ecological status of the past, can provide expressway road ecological identification with a large number of integrated, macro, dynamic and rapidly updated information, just make up for the defects of the conventional methods for the ecological degradation of situation has a comprehensive and accurate grasp of. This has greatly promoted the development of impact assessment of highway ecological landscape [12].

2.1 Research methods and basic routes

On the basis of the investigation by conventional means, based on the theoretical basis of existing research and practice achievements, refer to the state administration of environmental release of "ecological environment evaluation specification on a trial basis" (HJ/T192-2006, with WanPing highway near the intersection of yu shan area for a long period evaluation, using GIS technology, the ecological environment quality assessment along the highway research [13]. It mainly includes three parts: determination of evaluation region, selection of evaluation index and comprehensive evaluation of ecological and environmental quality of regions along the highway [14]. The research method and technical route (figure 1) are as follows:

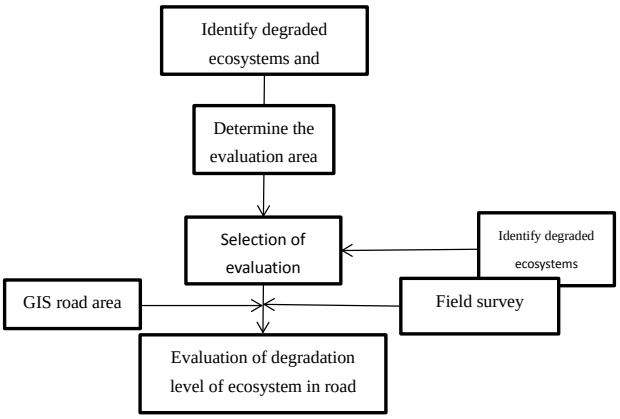

Figure 1: Steps of the overall study

(1) According to remote sensing data and local conditions, 2007 is selected as the year of degraded ecosystem, and 04 is selected as the year of reference system [15].

(2) the typical topographic section centered on the highway was selected as the research area. Specifically, one-eighth of the SOPT5 images in two periods were selected, and the central coordinate of the scene was 33.42 n. East longitude 111.2. Near [16].

(3) the weighted composite comprehensive index model was adopted, and the biological abundance index, vegetation coverage index, water network density index, land degradation index and environmental data index were selected as the basic evaluation indexes, and the ecological environment condition index was the overall evaluation index [17].

(4) using GIS technology to study the impact of wanping expressway on the ecological landscape along the road.

(5) combined with field investigation and collected data, the degradation degree of ecosystem in the road area was evaluated [18].

This study USES GIS technology, mainly including data source selection, road remote sensing image preprocessing, highway ecological landscape supervision and classification, highway ecological landscape classification data conversion and adjustment, spatial analysis of several main steps [19]. As shown in figure 2, the core step is the supervision and classification part, which directly affects the accuracy and efficiency of the research. The most tedious step is the conversion and adjustment of highway ecological landscape classification data.

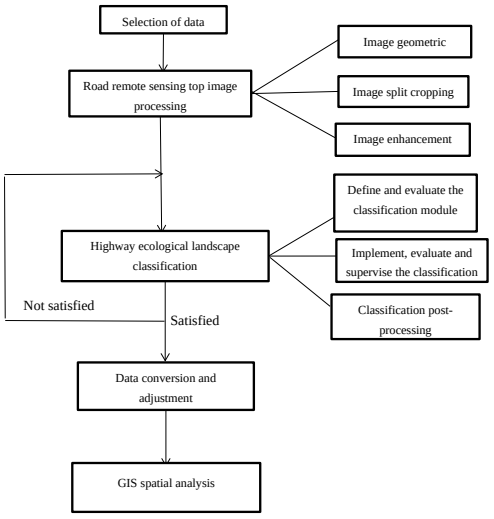

Figure 2: Research flow of ecological identification of highway road area

2.2 Selection of path data source and processing software

2.2.1 Path data source

In today's highway subject related study, remote sensing image to its absolute advantage to become the most important data sources, combined with a variety of ground investigation data or special statistical data, to obtain the image preprocessing, spectral remote sensing data statistical analysis, supervised classification, such as processing, can be automatically extracted information resources and the ecological environment factors and change information, and the dynamic monitoring of regional resources and ecological environment change and the development trend of [20].

This paper mainly compares the remote sensing images before and after highway construction to study the influence of highway landscape. According to the actual situation, two French SPOT5 satellite images in 2004 and 2007 were selected as the basic data source. The interpretation scope was 10KM on both sides of the highway, with an area of about 900KM2. The auxiliary data included professional maps and data of local geology, geomorphology, hydrology and soil, and the main parameters were shown in table 1.

Table 1: Main parameters of remote sensing images

satellite	SPOT5
Track no	274-283
The product type	FUSION
The product level	1A
Pixel size	2.5m
The sensor	T+N
The data format	GEOTIFF

2.2.2 RS software selection

In this study, ERDAS IMAGINE9.1, a professional remote sensing image processing and geographic information system software developed by ERDAS, is mainly applied in the processing of satellite images. The main functional modules include data input and output module, data preprocessing module, thematic map drawing module, image interpretation module, image library management module, image classification module, vector modeling module, radar image processing module, virtual GIS module, orthophoto correction module, and various other functional extension modules [21]. Can integrate and use a variety of data types, 2d, 3d display, data input, sorting and management, map registration, thematic mapping and simple analysis functions.

2.2.3 GIS software selection

GIS software is the core of geographic information system, which is related to its performance and function. This study selected the GIS software developed by the American institute of environmental systems (ESRI)00, which has the strongest function and the highest market share among similar GIS software. Can complete any from simple to complex GIS analysis and processing operations, including data editing, geocoding, data management, projection transformation, data conversion, metadata management, geographical analysis, spatial processing and mapping output.

3. EVALUATION RESULTS OF GIS

3.1 Evaluation of research methods and basic routes

In today's highway subject related study, remote sensing image to its absolute advantage to become the most important data sources, combined with a variety of ground investigation data or special statistical data, to obtain the image preprocessing, spectral remote sensing data statistical analysis, supervised classification, such as processing, can be automatically extracted information resources and the ecological environment factors and change information, and the dynamic monitoring of regional resources and ecological environment changes and development trend. Remote sensing is a comprehensive application technology based on physical means, mathematical methods and geological analysis. Satellite remote sensing is the only and most effective tool for investigating and studying these topics. Its advantage lies in: can quickly carry on the large-scale, three-dimensional vegetation ecological environment research. So that we can overcome the limitations of ground monitoring and field of vision, make people on the whole macro to study the ecological environment factor, for the ecological environment and its change, the mutual relationship between ecological environment phenomenon observation more shows its superiority, especially for large area and dynamic monitoring of ecological environment is very favorable. The information obtained is wide and efficient. This is also an important reason for people to pay attention to remote sensing technology. Remote sensing information fully reflects all kinds of ecological element information in a large area, and creates conditions for the establishment of ecological environment data model, which is highly adaptable and can obtain information that cannot be obtained by other research methods. It can be applied to areas where people cannot conduct routine research and ground work is difficult, for example, it provides a rapid monitoring method for the study of vegetation ecological environment in alpine mountainous areas, virgin forests, swamps, deserts, frozen soil, ice, oceans and other areas, and can be used for dynamic research. An area can be repeatedly imaged to obtain the latest and accurate dynamic data of ecological environment, and a large range of ecological environment can be studied periodically.

3.2 Selection and evaluation of path data sources and processing software

It can be seen from the table of main parameters of remote sensing images in table 1 that the purchased satellite images are spectral initial correction fusion image data. This can not be directly used in the study of highway ecological identification. Before the supervision and classification of highway ecological landscape, the original data should be preprocessed. The main processing work includes image geometric correction, image splitting cutting and image enhancement processing.

(1) Geometric correction of remote sensing images in the road area. In this study, remote sensing images before and after were compared to study the impact of ecological landscape, and the original data could not meet the research needs in terms of coincidence accuracy. This is because in the imaging process of remote sensing images, due to the imaging projection mode, the change of the external orientation element of the sensor, the uneven sensing medium, the curvature of the earth, topographic relief, earth rotation and other factors, the remote sensing images have certain geometric deformation. Geometric deformation refers to the difference between the coordinates of the image element in the image coordinate system and its coordinates in the reference coordinate system such as the map coordinate system. The process of eliminating such difference is called geometric correction. It USES the ground control point GCP to carry out mathematical simulation of the geometric distortion process of the original remote sensing image through GCP data, establish the corresponding relationship between the original image and the ground plane, and then use this correspondence to rearrange all the pixels in the original image to achieve geometric correction. However, this study only requires that the two images are relatively coincident to complete the before and after comparison. Therefore, this study takes the 2004 image as the base image and adjusts the 2007 image to make the two images coincident to achieve the contrast accuracy. The basic steps of geometric correction with software are to display the image file, start the geometric correction module, start the control point tool, collect the ground control points, calculate the conversion model, resample the image, and check the correction results. Among them, the key is related model parameter setting and control point selection. The factors that affect the effect of geometric correction are mainly reflected in the number, distribution and positioning accuracy of GCP. In addition, the accuracy of image correction varies with different correction methods. The selection and parameter setting of geometric calculation model are shown in function table 2.

Table 2: Geometric correction and model functions

Model	Function
Affine	Image affine transformation
Camera	Aerial image orthophoto correction
Landsat	Landsat Satellite image orthophoto correction
Polynomial	Polynomial transformation
Rubber Sheeting	Nonlinear, nonuniform transformation
Spot	SPOT Satellite image orthophoto correction

In these six correction models, Camera, Landsat and Spot are the correction methods of corresponding model sensors. Rubber sheeting is based on GCP at 3 points and transforms in the triangle area, with high local accuracy, but strict requirements on the accuracy and quantity of GCP and local deformation. Affine compared with Polynomial, don't do projection transformation, Polynomial is the use of multiple Polynomial average sex transformation, according to all the GCP using Polynomial power number (Order) for 3 Polynomial Polynomial transformation correcting, completely meet the accuracy requirement, this study so that at least 10 control points.

(2) remote sensing images in road area are segmented and cropped. The two remote sensing images are not completely overlapped. In order to research the need of contrast, the images need to be cropped. According to ERDAS, the image splitting cutting process is realized, which is divided into two types: regular splitting cutting and irregular splitting cutting. Regular splitting cropping refers to that the boundary of the cropping image is a rectangle. The cutting position of the image can be determined by the upper left and lower right coordinates. The whole cutting process is relatively simple. Irregular pattern clipping refers to that the boundary range of the clipping image is an arbitrary Polygon, which cannot be clipped through the upper left and lower right coordinates. Instead, a complete closed Polygon region must be generated in advance, which is generally an AOI Polygon or a Polygon Coverage of ArcInfo.

(3) road remote sensing image enhancement processing. Image enhancement is to highlight relevant thematic information, improve the visual effect of the image, so that the analyst can more easily identify the image content, extract more useful quantitative information from the image. Image enhancement can be divided into spectral enhancement and spatial enhancement. Spectral enhancement corresponds to each pixel and is independent of the spatial arrangement and structure of the pixels, hence also known as point operation. It enhances and transforms the spectral features of the target - pixel contrast and the brightness ratio between bands. Spatial enhancement mainly focuses on the spatial features of the image, taking into account the relationship between each pixel and the brightness of its surrounding pixels, so as to make the spatial geometric features of the image, such as edges, shape, size and linear features of the target object, prominent or reduced. In this study, contrast enhancement and histogram equalization are mainly used in spectral enhancement.

4. CONCLUSION

This paper mainly research on the basis of the investigation by conventional means, and practice based on the theoretical basis of existing research results, with two issue of remote sensing image as the basic data source, refer to the state administration of environmental release of the ecological environment evaluation specification (try out) "(HJ / 192-2006, using the remote sensing technology, geographic information system platform, to WanPing highway near the intersection of yu shan area for a long period evaluation, establish image interpretation signs, then into the remote sensing image classification, the thematic map and remote sensing classification data, get the thematic map and remote sensing classification data, for expressway ecosystem degradation degree evaluation research provides the basis. At the same time, on the basis of the analysis of relevant research at home and abroad, the research objectives are defined and described, and the influence of highway construction on the ecosystem and landscape of the road area is systematically analyzed, providing technical reference and technical basis for the unified definition of the ecosystem of the road area and the ecological impact of the road area in China. Although this paper systematically studies the gis-based expressway ecological landscape technology, the harmony between highway construction and ecosystem needs to be further deepened, improved and supplemented in some theories and methods.

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