The Application of Remote Sensing Technology in Returning Farmland to Forest

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Abstract. Since the 1980s, due to China's economic development, large tracts of forest trees have been felled, causing serious soil erosion and environmental pollution problems. But since the beginning of this century, China has started to convert farmland to forests and various vegetation restoration activities. The purpose of returning farmland to forest is to better protect the environment and prevent soil erosion. This paper introduces the use of remote sensing images to detect the implementation of the project of returning farmland to forest. Explain the method of sample selection and the steps of data collection. The plan on remote sensing monitoring of returning farmland to forest was introduced. At the same time, the help and continuous monitoring of remote sensing technology after returning farmland to forest was introduced. This article contains examples and analysis of scientists using GIS technology to assist in returning farmland to forests. Finally, it includes the prospect and expectation of GIS for the project of returning farmland to forest. And the future application of this technology in this project is prospected.

Keywords: Remote sensing technology; returning farmland to forest; GIS; soil erosion.

1. Introduction

For a long time, due to China's vigorous development of the basic, economy, deforestation, cultivation of steep slopes and decertified land, and agricultural production, China has caused serious soil erosion and sandstorm hazards in my country. The production and life of the masses are seriously affected, and the ecological security of the country is seriously threatened. Converting farmland to forest is to protect and improve the ecological environment, stop farming in a planned and step-by-step manner on sloping farmland that is prone to soil erosion, and plant trees and restore forest vegetation in accordance with the principle of suitable land and trees. The project construction of returning farmland to forest includes two aspects: one is the conversion of sloping farmland to forest; the other is afforestation of barren hills and wasteland suitable for forestry. In 1999, Sichuan, Shaanxi, and Gansu provinces took the lead in carrying out the pilot program of returning farmland to forest, which opened the prelude to returning farmland to forest in my country. On January 10, 2002, the Western Development Office of the State Council held a teleconference on the work of converting farmland to forest and decided to fully start the project of returning farmland to forest [1].

On April 11, 2002, the State Council issued "Several Opinions on Further Improving the Policy and Measures of Converting Farmland to Forests". The project of returning farmland to forest is an ecological construction system project with large investment and long construction period. It is one of the six major forestry key projects in the country [2].

The work of returning farmland to forests involves a wide range of areas, with strong policies, strict technical requirements, complex operating procedures, large amounts of engineering data, information, heavy workload, and long management time. Traditional forestry management methods can no longer meet the management requirements of the project. Chinese forestry scientists have conducted in-depth research on key technologies for remote sensing monitoring of forest resources and desertification control, natural forest protection, returning farmland to forests, "Three Norths" and the Yangtze River and coastal shelterbelts. GIS (Geographical Information System, geographic information system) is a comprehensive application system developed in the past ten years, which integrates computer science, surveying and mapping science, environmental science, space science, information science and management science. The emerging fringe science of multidisciplinary integration. It is a spatial information system that collects, stores, manages, analyzes, and describes the entire or part of the earth's surface (including the atmosphere) with the support of computer hardware and software systems related to space and geographic distribution. It is a high-tech technology that integrates computer graphics and databases to store and process spatial information. It organically combines geographic location and related attributes. According to the needs of users, the spatial information and its attribute information is accurate and true, and the pictures and texts are well Maodi outputs to users and makes various auxiliary decision-making with its unique spatial analysis function and visual expression function. GIS is widely used in various fields of national economy such as finance, telecommunications, transportation, national resources, electric power, water conservancy, agriculture and forestry, environmental protection, geology, and mining. In the field of forestry, it can be used for forest fire prevention, resource inventory, resource file management, afforestation management planning, felling area design, forestry planning, forest road design, disease and insect pest monitoring, forestry measurement and other topics.

The application of GIS technology to timely monitor, evaluate and supervise the progress of the project of returning farmland to forest can not only ensure the quality of project construction, but also effectively promote the modernization of forestry management methods, laying the foundation for the realization of "digital forestry"[1].

This paper mainly studies how to use remote sensing technology to assist the smooth implementation of the project of returning farmland to forest. Describe the important role of remote sensing technology in returning farmland to forest through data collection, planning projects, and analysis of existing examples. And finally put forward some relevant suggestions on returning farmland to forest and GIS.

2. Application of remote sensing monitoring technology for returning farmland to forest

This part mainly introduces the monitoring function of using remote sensing satellite images before and after the conversion of farmland to forests. It also explains how to select and handle the GFA map. The revised part details the plan before returning farmland to forest and the monitoring function of remote sensing satellite after returning farmland to forest.

2.1. Data collection and processing

2.1.1 Topographic map application

Scan the original 1:10000 topographic map and register it according to the earth's latitude and longitude coordinates to make a grid topographic map with geographic significance. Determine the scanning resolution of the topographic map. The scanning resolution is determined at 250-300dpi.

Topographic map scanning. The Engineering Scanner can be used, or it can be divided into multiple scans, and then stitched into a raster topographic map with the image processing software photoshop. Grid topographic map registration. Provide accurate geographic coordinate information of control points. The control point coordinate information can be obtained from the topographic map frame, or it can be obtained by GPS (Global Satellite Positioning System) on-site positioning.

The most basic control point for each image is four, which can also be increased appropriately to improve the accuracy. The more control points, the more precise the image. Digitization of raster topographic map. The digital topographic map can be created on the screen according to the registered raster topographic map by manual drawing, human-computer interaction vectorization, automatic vectorization, and other methods.

2.1.2 Forestry area demarcation line entry

The division of county-level forestry is generally five-level division of county-township-village-forest class (-management class)-small class. The boundaries between classes and operating classes are drawn and saved. The divisional forest class and management class should be consistent with the recent "Class II" survey. Create a "second-class" investigation sub-class layer file. The number of sub-classes in the “Type II” survey is large, and the boundaries of sub-classes should be entered by scanning [4]. After registration, vectorization, and the method of topological area construction, each sub-class area is generated and then a digital map is made. Input of the design drawing of the small class for returning farmland. The method of scanning and inputting is adopted, that is, the small classes on the work map of returning farmland to forests are drawn on clean drawing paper, and the graphs of the small classes are entered into the computer through scanning, and then digital maps are made after registration and vectorization, which is suitable for the large number of small classes of returning farmland to forests. However, there are many processes, and it is easy to cause incorrect registration and human error. The design drawing relates to the design database of returning farmland to forest [5]. For each small class that requires the design drawing, there is a record corresponding to it in the Returning Farmland to Forest database. On the contrary, for each record on the Returning Farmland to Forest database, there is only one small class corresponding to the design drawing, and this correspondence is unique. So far, the basic data collection and input of the GIS management system for returning farmland to forests has been basically completed. Fig 1 is a sequence and process of using GIS remote sensing data collection and processing.

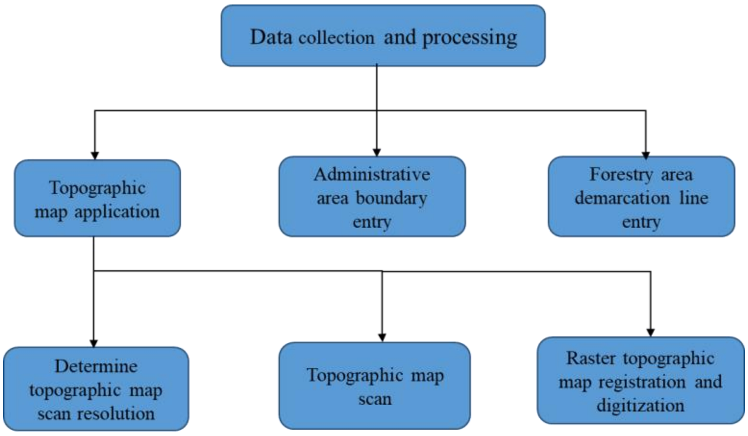

Fig. 1 Flowchart of data collection and processing

2.2. Make scientific planning for the area of returning farmland to forest based on remote sensing images

With the support of ERDAS software, the land use status map of the study area is formed. Through the GRID terrain analysis module in the ARC/INFO software, the contour topographic map of the vector data is converted into a three-dimensional terrain model to form a digital elevation model (DEM) [6]. Extract the information of sloping farmland to make zoning for returning farmland to forest [10]. Based on zoning the area of returning farmland to forest and grasping the current situation of returning farmland to forest and the quality of cultivated land, the suitability evaluation of cultivated land based on "general soil erosion equation" is carried out. Xing et al. proposed: According to the evaluation results, a reasonable plan for returning farmland to forest land should be formulated according to the evaluation results in four grades: highly suitable, moderately suitable, lowly suitable, and unsuitable [7]. Li started from the fusion of SPOT-5 data itself and the fusion of SPOT-5 and ETM+ data, and used HIS transform, BROVEY transform, and HPF transform commonly used in remote sensing applications to explore the A fusion method for vegetation identification. The results show that HPF transformation is the most favorable for visual interpretation, followed by BROVEY transformation method and HIS transformation method; the visual effect of SPOT-5 data fusion is better than that of SPOT-5 and ETM+ data fusion; the fusion of SPOT-5 itself. The images were visually interpreted, and then through field verification, the weighted accuracies of HPF transformation, BROVEY transformation and HIS transformation were obtained as: 82.99%, 79.01%, 71.02%, respectively [8]. Wang and others enhanced the tree canopy information of the converted farmland by using QuickBird remote sensing image data processing and analysis [9]; They used the object-oriented image information extraction technology to extract the tree canopy information of the converted farmland to forest, which provided scientific information for the planning and management of returning farmland to forest accurate basis. Fig. 2 shows a DEM color image of China's Yan'an area for returning farmland to forests [10].

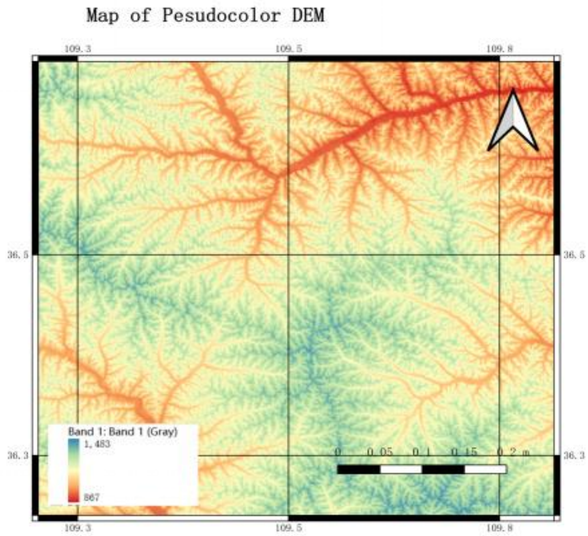

Fig. 2 Map of Pseudo color DEM in part of Yanan

2.3. After returning farmland to forest, macro acceptance and monitoring of forest protection

At present, the quality inspection of the project of returning farmland to forest is mainly carried out through the three-level inspection methods of county-level self-inspection, provincial-level reinspection, and national verification. These inspection methods are basically based on manual field investigation and measurement. In addition to the county-level self-inspection, which is a comprehensive inspection, the other two-level inspection methods are random inspections, and the proportion of inspections is less than 30% [10]. The county-level self-inspection is sometimes subject to a certain degree of subjectivity, and even in a few cases, false reports and concealment occur, which makes it difficult to ensure the quality of inspections and affects the country's macro-decision-making.

Many experts and scholars in China have done a lot of research on the monitoring of returning farmland to forests [11-15]. Yang Yongchong et al. [15] applied the "3S" technology to take advantage of the multi-sensor and multi-temporal characteristics of remote sensing and used the remote sensing data of different phases in the same area before returning farmland to forest and after returning farmland to forest and obtained time through absolute registration and image difference enhancement. Ratio image (ie change information), and then use the spatial analysis technology in GIS to regularly obtain the area of the area that has been converted to forest, and at the same time to evaluate the effect of returning farmland to forest. Use the management function of GIS to manage the analysis results of each period, which can be used for decision-making and inquiries of related departments. Zhang Jinshui et al. [14] used the change vector analysis method to composite the two kinds of information of spectrum and texture to calculate the change intensity and used the support vector machine method to extract the change and non-change information. Complete the dynamic monitoring of land use and coverage. The dynamic monitoring of land use and cover changes in Haidian District from 1997 to 2004 was carried out to verify this method. Compared with the post-classification comparison method, this method reduces the accumulation of errors and the conversion of error types to a certain extent. The total accuracy of the extracted change information reaches 93.1%, and the Kappa is 86.2%; The accuracy of land use and cover change information extracted by the change vector analysis method (total accuracy 90.2%, Kappa 80.4%) has been improved to a certain extent. Shi Liangshu, Du Jishan, Tan Bingxiang, etc. in Jialequan Township, Gujiao City, Shanxi Province, used SPOT-5 image data of 10, 5 and 2.5 m3 to classify and monitor the area of converted farmland to forest. The two schemes adopted are: one is to divide the types of land objects into seven categories, returning farmland to forest land as a separate category, to carry out computer automatic classification and manual interpretation of 2.5m image data for the three types of image data; The design drawing of returning farmland to forest, segmenting the image of the returning farmland to forest, and supervised classification of the returning farmland to forest land and the non-returning farmland to forest land. Accuracy verification shows that, in the first scheme, the classification accuracy of the 25m fusion image is less than 50%, and the overall classification accuracy of the three types of image data in the second scheme is greater than 90% [12].

2.4. Using high-resolution remote sensing images to monitor the growth of newly planted forests in abandoned farmland

Identify the newly planted young forests in the abandoned farmland, quantitatively estimate the vegetation coverage, and obtain data such as the area of the abandoned farmland, the type of the land, and the unforested area. It is helpful to understand the vegetation growth status and the quality status of returning farmland to forest land in time and is of great significance to evaluate the construction effect of the project scientifically and comprehensively. Huang and others from the Institute of Resource Information of the Chinese Academy of Forestry used the QuickBird remote sensing images with a resolution of 0.6 m in the Zhangjiakou abandoned farmland to monitor the growth of newly planted forests in the abandoned farmland [11]. First, the orthophoto correction is performed on the Kuaishou image, and Gaussian filtering is used to enhance the image to reduce noise and enhance the tree canopy information of the abandoned farmland. The object-oriented image information extraction technology is used to extract the canopy information of the land converted from farmland to forest, count the canopy area, and calculate the survival rate of the converted farmland to forest. According to the error test of the actual measured data, the average error of the canopy area automatically extracted from the remote sensing data is 0.763m2, and the calculated survival rate accuracy is 89.837%, which provides a scientific and accurate basis for the planning and management of returning farmland to forest.[13] The object-oriented image analysis technology solves the problem of quickly extracting information from high-resolution remote sensing image data. This technology adopts a novel and unique image multi-scale segmentation technology, starting from a pixel object and combining regions from the bottom to the top. The purpose of image segmentation is to describe the image objects with the meaning of the real world. For complex ground object coverage, more than two segmentations are used to realize the classification of ground objects of different scales, and the first classification result is used as the second meaningful segmentation. Input to generate image polygon objects with similar attribute information at any scale. For different image object layers, the membership function is used for classification. Since the shape features, adjacent relationships, and inter-class features of image objects are considered, it has great advantages over conventional classification based on pixel-dependent spectral features [14].

3. Suggestions on the application of GIS technology in returning farmland to forest

3.1. Superimpose the design map of returning farmland to forest and the classification

Map of remote sensing images to conduct quick area verification. Area verification is the most important part of the inspection and monitoring of returning farmland to forests. Using remote sensing technology, with the help of the local design map of returning farmland to forest and superimposing it with the classification map of remote sensing images, it is possible to supervise the completion of returning farmland to forest. Through the comparison and statistics, not only can the high precision completed area of returning farmland to forest be obtained, but it can even be specifically implemented into each design patch of returning farmland to forest, so that people can clearly understand, and the area can be checked conveniently and quickly.

3.2. Consider the price of remote sensing imagery

At present, the price of high-resolution remote sensing images such as QuickBird on the market is nearly 200 yuan·km 2. If it is applied to the monitoring of large-scale conversion of farmland to forests, the cost will be very large. This loses the original intention of using remote sensing to monitor the conversion of farmland to forests. Therefore, SPOT-5 data is a more suitable remote sensing data source for monitoring the conversion of farmland to forest by county-level units. Because the resolution of SPOT-5 can reach full (Pan) 2.5m, multi-spectral (Ms) 10m, its price is only 8.3 yuan·km-2, its cost performance is greater than QuickBird.[10] The area of each scene of SPOT-5 is 3600km2, which can be covered by SPOT-5 images of one general county scene. In addition, although the resolution of ETM+ data of Landsat-7 is slightly lower, it has greater price advantage and multi-spectral characteristics [15]. Get more terrain information.

4. Conclusion

GIS has powerful analysis functions. The application of GIS technology to the project of returning farmland to forest is innovative to a certain extent and realizes planning automation. Today's implementation of forestry projects provides scientific guarantees and can save a lot of manpower, material, and financial resources. The popularization and application of this technology will be of great significance to the implementation of the western development strategy and the promotion of the sustainable development of the national economy and society.

In general, remote sensing technology can better monitor the implementation of the conversion of farmland to forests. After the implementation of the project of returning farmland to forest, the vegetation has recovered well, the soil erosion has been greatly slowed down, the vegetation area has been expanded, and the environmental protection work has been successful. Remote sensing technology and the application fields of this project are not extensive and comprehensive enough, and have been gradually improved and developed in recent years. The government and relevant departments are also gradually promoting the application of this remote sensing satellite image in the project of returning farmland to forest. Remote sensing technology can not only monitor the topography of the area, but also monitor the implementation of the conversion of farmland to forest, and timely detect the negative reaction of returning farmland to forest. In this way, personnel from relevant departments can stop it in time and re-plan the area. Compared with the previous situation where only on-the-spot investigation was possible, remote sensing technology can better monitor the implementation of the project of returning farmland to forest. And in the future, the project will use more remote sensing technology to make the implementation of the project more efficient.

The area where the project of returning farmland to forest will be implemented will become larger and larger, and remote sensing technology will also reflect its advantages such as wide coverage, high efficiency, and manpower saving. Finding effective application technology, accurately and objectively monitoring the situation of returning farmland to forest and ensuring the smooth implementation of the project are problems that scientific and technological workers need to work hard to solve. The project of returning farmland to forest has a long period of implementation, a wide area, and a great impact. Using remote sensing satellite technology to assist can play a very positive role. Remote sensing satellite technology will also be more widely used in the future.

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