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Analysis of Forestry Carbon Sequestration based on Grey Prediction

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Abstract: Forest is an important factor to improve climate. Trees absorb carbon dioxide in the air and seal it in the form of carbon. Compared with the benefits of carbon sequestration without deforestation, the carbon sequestration method combining forest products and regenerated forests can store more carbon dioxide over time, and has a sustainable prospect of carbon sequestration. Therefore, the optimized forest management strategy should find a balance between the value of forest products generated by deforestation and the value of carbon dioxide sequestration that allows the forest to continue to grow, so as to achieve the best benefits. In this paper, the improved grey prediction model is used to predict the carbon sequestration stock, and the best calculation method is determined according to the principle of minimum sum of squares of errors, so as to improve the accuracy of prediction. In order to determine the best carbon sequestration strategy, three indicators, namely phytolith carbon, average forest carbon sequestration and forest litter, are selected to calculate the average carbon sequestration rate of different types of forests according to the three indicators, and formulate the corresponding optimal forest management plan according to the average carbon sequestration rate.

Keywords：Carbon sequestration；Gray prediction；Forest management

1. Problem background

In recent years, a large number of CO2 emissions have led to rapid climate change, which has had a great impact on the global environment. Forest management plan is an important way of carbon dioxide storage in the biosphere. Its main content is to determine which tree species to cut down, which tree species to retain, the time schedule for cutting down trees and how to regenerate forests. In order to realize the dual benefits of nature and society, when formulating the forest management plan, in addition to the benefits of carbon sequestration and forest products, it is also necessary to consider many factors, such as potential carbon sequestration, protection of biodiversity, recreational uses, cultural background, etc.

2. Carbon sequestration prediction model

In order to predict how much carbon dioxide the forest and its products can store over time, this paper uses the improved grey prediction model to predict. In order to better introduce the model, 24 provinces and municipalities in China are taken as the research objects to predict their carbon sequestration. Carbon sequestration is partly the carbon dioxide fixed by forest vegetation, and the other part is the carbon dioxide absorbed by forest products, which should be predicted and superimposed respectively. The following steps are for the model.

2.1 Carbon sequestration of forest vegetation

Taking Beijing as an example, the above model is established and solved. Firstly, the total carbon sequestration of forest vegetation in Beijing from 2003 to 2017 (known) is selected, and then the carbon sequestration in Beijing in the next five years is predicted by rolling prediction. Among them, the size of the sum of squares of errors determines which prediction calculation method is selected. The specific steps are as follows.

Step1.Quasi exponential test

First, calculate the smoothing ratio of each year. The calculation results show that the data with smoothing ratio less than 0.5 accounts for 85.7143%. Except for the first two data, the remaining data with smoothing ratio benefit of 0.5 accounts for 100%. If it meets the standard, it passes the test, so GM(1,1) can be used for prediction.

Step2.Select the predicted value according to the square sum of errors

The sum of error squares of the three prediction methods are 14.0655, 14.0666 and 9.468 respectively. Since the sum of error squares of metabolic GM (1,1) model is the smallest, its prediction results are used.

Step3.Result analysis

By using metabolic GM (1,1), the total carbon sequestration of forest vegetation in each of the five years can be predicted, as shown in the following figure.

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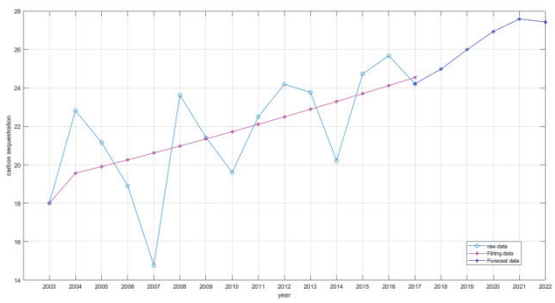

Figure 1 forest carbon sequestration forecast

Similarly, the carbon sequestration of forest vegetation in each province can be calculated, and the following comparison chart can be drawn.

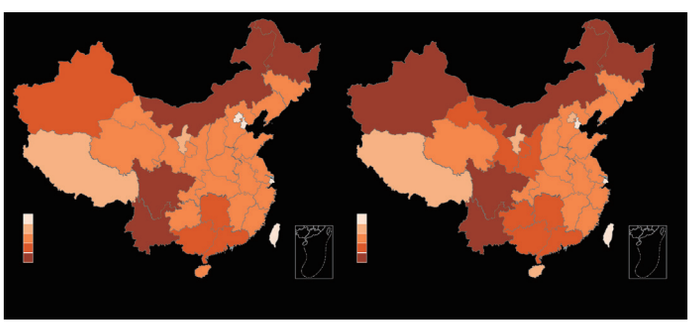

Figure 2 Comparison of forest vegetation before and after carbon sequestration

As can be seen from Figure 2, the total amount of forest carbon sequestration in China has increased significantly from 2003 to 2022.

2.2 Carbon sequestration of forest products

Using the same prediction method, the following comparison chart of carbon sequestration of Chinese forest products can be obtained.

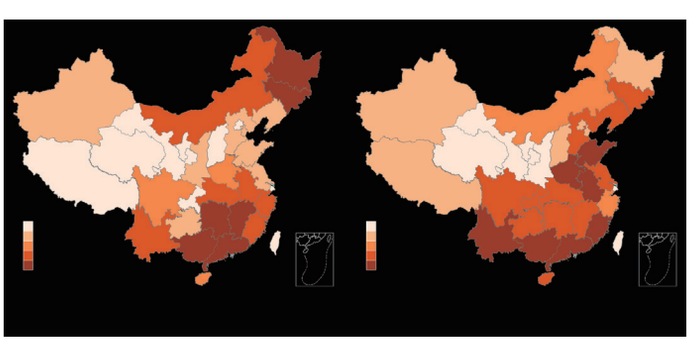

Figure 3 Comparison of forest products before and after carbon sequestration

It can be seen from Figure 3 that China's timber production shifted from the northeast to the coastal areas in 2003-22. The trees in the coastal areas have the characteristics of fast growth, which can produce enough timber products quickly. However, the temperature in the northeast is low, and the growth rate of trees is generally lower than that in the coastal areas. Excessive logging will cause irreversible damage to the ecosystem.

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