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Small Felling Has Great Benefit

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Abstract

It is well known that forests have a major impact on global warming and economic efficiency, so how to manage forests is particularly important. This paper establishes a carbon sequestration model to estimate the carbon storage of forests and their forest products and establishes an improved and scalable stochastic environmental impact assessment model to determine forest management plans, and finally shows that deforestation has certain social benefits through carbon sequestration and economic benefits. The benefits should be considered in the management plan.

Keywords

Carbon Storage; STIRPAT Model; Grey Correlation Analysis.

1. Introduction

At present, global warming has become the biggest threat facing human beings. The main cause is the continuous increase in the concentration of greenhouse gases in the atmosphere, especially the concentration of CO_2, which has caused serious pollution to the environment and destroyed the balance of the earth's ecosystem. However, with the sustained and rapid economic development, the demand for energy such as oil and coal has also continued to increase. How to effectively deal with the world's climate change, control greenhouse gas emissions, and achieve sustainable development has received attention from all over the world. The sustainable management of forests is of great significance to promote forest carbon sequestration, increase soil fertility, increase species diversity, and improve community stability. Therefore, it is very important to apply more practical and efficient ways to regulate climate change to manage forests.

The carbon sequestration function of forest ecosystems can reduce the concentration of CO_2 in the atmosphere and effectively alleviate the problem of global climate change, which is an important guarantee for the ecological balance of the earth. We were asked to make forest management decisions in a variety of ways based on forest value and to predict how carbon dioxide will be absorbed by forests and their products 100 years from now. Finally, we will make some actionable recommendations for community forest management.

2. Carbon Stock Calculations: Modeling Carbon Sequestration

2.1 Calculation of Forest Carbon Stocks

By consulting relevant literature and FAO official website, we know that forest carbon storage includes five aspects: aboveground biomass carbon storage, underground biomass carbon storage, dead wood carbon storage, stand litter carbon storage and soil carbon storage. The underground biomass reserves include four aspects of carbon reserves of trees, shrubs, herbal layers, and forests.

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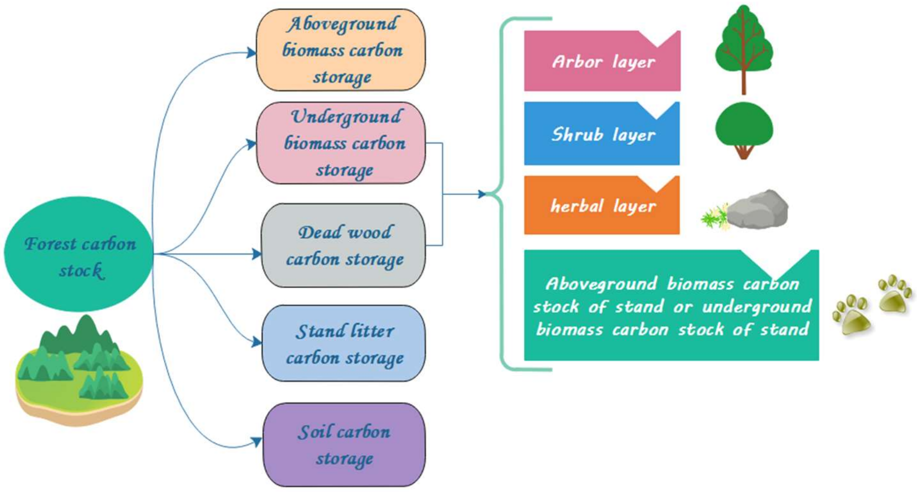

Fig. 1 Aspects of forest carbon stocks

We use the biomass method to calculate forest carbon storage, the formula is as follows:

$$\text{Forest carbon storage} = \text{aboveground biomass carbon storage} + \text{underground biomass carbon storage} + \text{dead wood carbon storage} + \text{stand litter carbon storage} + \text{soil carbon storage} \quad (1)$$

2.2 Calculation of Carbon Stocks in Forest Products

Based on FAO's definition and classification of wood forest products, wood forest products can be divided into three categories according to the whole process of wood harvesting, processing and utilization, and final decomposition and emissions: primary products (such as logs, fuelwood), intermediate products (such as sawn wood, wood-based panels, paper and cardboard, etc.) and end products (such as furniture, building materials, paper products, etc.). Due to the limitation of data and parameters, the calculation has uncertainty and complexity. To simplify the calculations, we only consider the carbon stocks of intermediate products and their changes, assuming that the carbon in the intermediate products decomposes at a fixed rate each year. The decomposition rate of different types of intermediate products is different, which is related to the service life of the intermediate products.

At the IPCC Expert Meeting held in Dakar in 1998, four measurement methods were identified for how to estimate the carbon stock of wood forest products: IPCC default method, stock change method, production method and atmospheric flow method. The latter three methods are compared with the IPCC default method in relevant standards such as , technology and policy. The main difference between these four methods is how to determine the boundary of the system and deal with import and export trade in the estimation process. After comparison, we chose the stock change method to estimate the carbon stock of forest products. Its calculation formula is:

$$\text{Changes in carbon stocks} = (\text{carbon sequestration in forest growth} - \text{carbon emissions from felling residues} - \text{carbon storage in wood production}) + (\text{carbon storage in consumer wood products} - \text{carbon emissions in decomposition or combustion of domestic wood consumption}) \quad (2)$$

3. Forest Social Benefit Assessment Model

Peter said: "Forest is an integral part of the natural environment, it can regulate the climate, beautify the environment, it is our homeland." When we discuss forest management decisions about forest value, we first select the indicators for its analysis. We selected eight indicators to expand the STIRPAT model, including the benefits of water conservation, soil consolidation and fertilizer conservation, soil improvement, carbon sequestration and oxygen generation, biodiversity protection, environmental purification, forest recreation, and forest product import and export value. The expanded STIARPAT model is:

$$V = aW^{\alpha_1}F^{\alpha_2}T^{\alpha_3}I^{\alpha_4}D^{\alpha_5}J^{\alpha_6}Y^{\alpha_7}L^{\alpha_8}e^{\varepsilon} \tag{3}$$

Among them, V is the overall benefit of the forest, W is the benefit of water conservation, F is the benefit of soil consolidation and fertilizer conservation, T is the benefit of soil improvement, I is the benefit of carbon sequestration and oxygen production, D is the benefit of ecological diversity protection, J is the benefit of purifying the environment, Y is the forest recreation benefit, L is the import and export value of forest products, and ε is the random error term. Among them, $\alpha_1,\alpha_2,\alpha_3,\alpha_4,\alpha_5,\alpha_6,\alpha_7,\alpha_8$ represents the benefits of water conservation, soil consolidation and fertilizer conservation, soil improvement, carbon sequestration and oxygen generation, ecological diversity protection, environmental purification, forest recreation, and the elasticity coefficient of the import and export value of forest products. Compared with the traditional STIRPAT model, the improved model is more in line with the actual situation.

Taking the natural logarithm on both sides of the above formula and transforming the model into a linear regression model can reduce the heteroscedasticity phenomenon existing in the index data of each variable, namely:

$$\ln V = a + \alpha_1 \ln W + \alpha_2 \ln F + \alpha_3 \ln T + \alpha_4 \ln I + \alpha_5 \ln D + \alpha_6 \ln J + \alpha_7 \ln Y + \alpha_8 \ln L + \varepsilon \tag{4}$$

When using the multiple regression equation to analyze the main influencing factors of forest value, due to the different units used for explanatory variables or influencing factors, the size of the data is often very different, which is not conducive to comparison with the same standard. In order to eliminate the influence of different dimensions and orders of magnitude, this paper standardizes the sample data, selects a linear normalization function, and linearly maps each dimension feature to the target range [a, b], that is, the minimum value is mapped is a, the maximum value is mapped to b, and it is mapped to the [0,1] interval.

$$x' = \frac{x - \min(x)}{\max(x) - \min(x)} \tag{5}$$

4. Conclusion

Starting from the carbon sequestration of forests and their products, we found that carbon sequestration is not only related to stand area and biomass, but also to the yield of forest products. For forests with low BEP values, mature and overripe trees are felled. Instead, it increases the amount of carbon sequestered. Secondly, after evaluating the social benefits of forests, we found that the benefits of forests in terms of water saving, soil consolidation and fertilizer conservation, soil improvement, carbon sequestration and oxygen production, ecological diversity protection,

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environmental purification, and the value of forest products import and export, etc. And forest recreation benefits Among these eight factors, the import and export value of forest products and forest recreation benefits play a decisive role, so appropriate deforestation development can effectively improve social benefits.

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