ISSN 2616-5872 Vol.5, Issue 3: 49-54, DOI: 10.25236/AJEE.2023.050308

Research and management improvement of forest carbon sequestration

Shuo Sun#, Junyu Zhong#, Xiao Qi

Century College, Beijing University of Posts and Telecommunications, Beijing, 102101, China
#These authors contributed equally.

Abstract: *This article describes how increasing the amount of carbon sequestration in forests is important for improving the climate environment constituent. Forests seal carbon dioxide into living plants and trees, including wood products such as furniture, wood, plywood, and paper. These forest products isolate carbon dioxide throughout their lifetime. Some products have a short lifespan, while others are short and have the potential to exceed the lifespan of the trees they grow. How to give social value in a short lifespan. In the first step, we establish a hierarchical analysis model, determine the hierarchy, divide the goals of the decision, the factors considered (decision criteria) and the decision objects into the target layer, the criterion layer and the scheme layer according to the interrelationship between them, and draw a hierarchy diagram. Target Layer: Value of Forest Products for Carbon Sequestration, Criterion Layer: Age, Type, Geography, Topography, Scheme Layer: Benefits and Longevity of Forest Products.*

Keywords: *Decision model; Carbon sequestration; Forest management plans*

1. Introduction

As we understand, climate shifts pose a huge threat to life. To mitigate the impact of the climate, we need to take action to reduce greenhouse gas emissions. It is not enough to reduce greenhouse gas emissions [1]. Increasing the amount of carbon sequestration in forests is also crucial, through the biosphere or other means to increase the storage of carbon dioxide that we isolate from the atmosphere, mechanically [2]. This process is called carbon sequestration. Carbon dioxide in biosphere forests (especially large plants like trees), soils and water environments [3]. Forests are therefore an important part of any means of mitigating climate change.

2. The fundamental of analysis of fixed carbon content

2.1 Linear Regression Model of carbon sequestration

How can harvesting make carbon sequestration most efficient? The harvesting method of this model is interstitial logging, we take a linear fitting method and a least squares algorithm to solve this problem, due to the amount of felling we cannot crawl the data and find specific data, we did not hesitate to change the concept, by studying the life of the tree on the change of carbon sequestration, we will divide the life of the tree into(1) juvenile forest, (2)middle-aged forest, (3)near-mature forest, (4)mature forest, (5)over-mature forest, we found their area, as shown in the following Table 1[4]:

Table 1: Planting area for different age groups

Age group	Area(hm^2)
Juvenile forest	305976
Middle-aged forest	369193
Nearly ripe forest	56184
Mature forest	55942
Over-ripe forest	5203

Abscissa: We first calculate the data from the first set of data, (percentage = area of overripe forest/total), and second set of data = percentage x (total + 10000 hm^2).

Ordinate: The amount of carbon sequestration added after logging, in turn, increases by 10,000 hm^2.

ISSN 2616-5872 Vol.5, Issue 3: 49-54, DOI: 10.25236/AJEE.2023.050308

2.2 The determination of the number of carbon sequestration and on the amount of logging

1) Next, we need to draw a scatter plot of carbon sequestration and felling through MATLAB.

2) We made a series of algorithms for the horizontal ordinate coordinates as follows:

3) ordinate coordinate:

4) The amount of carbon sequestration of trees will be decided by the formula: carbon sequestration = aboveground biomass x carbon content.

5) HWP (wood forest products) carbon sequestration = total standing wood used to make HWP trees x 6% (average).

6) Next, we analyze the amount of carbon sequestration as follows:

7) Birch trees average 48.1%, larch 51.44%, coniferous mixed forests 39.26%, and average carbon content of 46.26%.

8) The aboveground biomass of young forests was 13.66 Tg (1 Tg =1012 g).

9) The aboveground biomass of 1 hm2 in young forests was 13.66 Tg/305976 hm2=0.00004464402 Tg/ hm2.

10) The carbon sequestration of 1 hm2 in young forests was 0.00004464402Tg/hm2 x46.26%=0.000002065233 Tg/hm2.

11) The corresponding area of juvenile forest planted under the over-mature forest is 5203hm2, which corresponds to the amount of carbon sequestration.

12) 0.000002065233 Tg/hm2 x5203 hm2 =0.107Tg.

13) Daxing'anling has a total of 10,670,000 hm2, and the total savings of living standing wood are 8.873x108m3.

14) The total accumulation of 1hm3 living standing wood is 8.873x108m3/10670000 hm2=83m 3/hm2.

15) China's HWP (Wood Forest Products) carbon reserves are 6% of the total forest reserves.

16) The area of the new species juvenile forest is 5203hm2, which accounts for about 6% of the total area 6%, the total amount of standing wood 431849t.

17) The amount of carbon sequestration in HWP was 431849tx6% = 25910.94 tons.

18) The total amount of carbon sequestration added is 107000t+25910.94t=132910.94t.

19) After the harvesting, the total carbon sequestration of the entire forest was 1940217172.94t.

20) For every 10,000 hm2 increase in forest area, 66 hm2 of young forest area is added, and 66 hm2 of overripe forest is cut down, and this operation is increased by each 10,000 hm2 total area of 66 hm2 of young forest added carbon sequestration per hectare

21) 132910.94t/5203 hm2 is about 26t, and the carbon sequestration of 66 hm2 is 1716t.

22) Ordinate coordinates: The lowest value is the amount of carbon sequestration added after logging, and the carbon sequestration of the total forest area increases by 1716t for each additional 10000 hm2

23) Finally, we came up with ten sets of data on carbon sequestration (Table 2).

Table 2: Ten sets of data on carbon sequestration

132910.94t	134626.94t	136342.94t	138058.94t	139774.94t	141490.94t	143206.94t	144922.94t	146638.94t	148354.94t

Abscissa:

To adapt to the world's major forests, we consider many factors. First, we found that overripe forests had a reduced amount of carbon sequestration, so we cut them down and planted young trees to maximize carbon sequestration. Let's first calculate the data from the first set of data, (percentage = area of overripe forest / total), and the second set of data = percentage x (total + 10,000 hectares) [5].

Finally we came up with ten sets of data on the amount of logging (Table 3):

ISSN 2616-5872 Vol.5, Issue 3: 49-54, DOI: 10.25236/AJEE.2023.050308

Table 3: Ten sets of data on the amount of logging

132910.94t	134626.94t	136342.94t	138058.94t	139774.94t	141490.94t	143206.94t	144922.94t	146638.94t	148354.94t

2.3 The establishment of simulation model

A scatter plot of carbon sequestration and felling is drawn through matlab. We made a series of algorithms for the ordinate coordinates and abscissa.

2.4 Analysis of experimental results

Finally, we brought twenty sets of data into the MATLAB software, and we came up with a scatter plot that gave us a look at the trend (Figure 1).

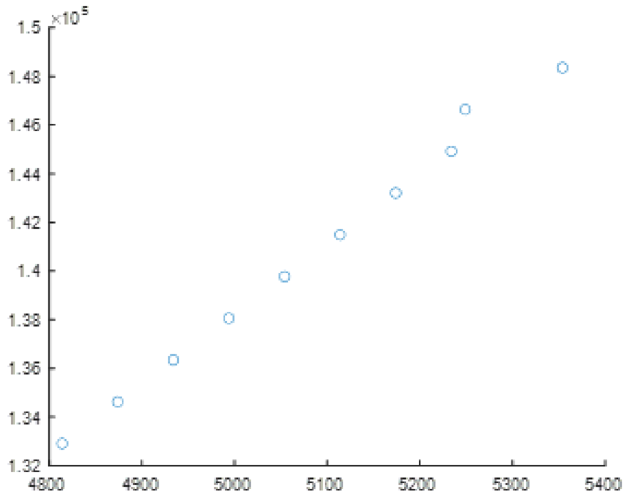

Figure 1: scatter plot of the amount of deforestation and carbon sequestration

The final solution is to cut down the overripe forest and plant the young forest, so as to ensure the maximum carbon sequestration. (The carbon sequestration capacity decreases after the over making period of some tree types) According to the different total areas of each forest and the proportion of different tree types in different total forest areas, the amount of new carbon sequestration and the amount of new carbon sequestration generated are also different (based on our model data, taking the Da xinganling forest area as an example, the total area is 10670000 hm2 The area of the felling was 5203 hm2 [the area of thinning is smaller than the area of the felling, here is the largest area of the felling], and the new carbon sequestration is 132910.94t).

3. Conclusions

3.1 Purpose and Effect

(1) Purpose of forest thinning

1) Realize early use and increase the total utilization of wood

Because care and thinning utilizes sparse and naturally withered trees with smaller diameter stations and defective parts of the upper tree, production units can obtain part of the wood in its infancy, thus allowing it to grow and grow in a very short period of time Accumulate some capital. To a certain extent, this helps to overcome the difficulties caused by the long forestry production cycle and development. At the same time, timely felling and utilization of dead trees can improve the overall utilization rate of wood. Tending and pruning can reduce the damage of forest stands to wind and snow disasters, improve the health of forest stands, enable forest stands to thrive, and enhance the resistance of forest stands to pests and diseases. The specification and quality of wood have been improved, and economic production has been improved. Increase total production from deforestation.

2) The impact of tending and nurturing on biodiversity

ISSN 2616-5872 Vol.5, Issue 3: 49-54, DOI: 10.25236/AJEE.2023.050308

In general, the greater the thinning intensity, the richer the vegetation types, the higher the density and cover. Different thinning intensities not only have obvious effects on vegetation type, but also have a greater impact on vegetation structure. Increasing the thinning intensity not only increases the species of shrubs and shrubs, but also increases the height and cover of each species and increases the number of vegetation and shrubs. The strength of 20%~30% has a beneficial effect on improving stand structure and tree growth.

3) Improve the growth conditions of forests and reduce the density of forest stands

In order to maintain the appropriate age density, with the increase of thinning intensity, canopy density decreases, light intensity increases, atmospheric relative humidity decreases, promotes soil biological activity, accelerates litter decomposition, and improves soil fertility. Create the right space for the remaining wood to grow. Through thinning, harmful trees are cut down, secondary tree species are eliminated, and an ideal structure is formed, thereby improving the resistance of forests to pests and diseases, reducing the occurrence of pests and diseases and forest fires, thereby promoting forest growth. The multiple benefits of forests enhance the overall functioning of forest ecosystems.

4) Remove inferior forests, improve stand quality, and shorten the timber life

By cutting down inferior trees, inferior trees and non-target trees, the number of trees was reduced, and the nutrient space and root vegetative area of trees with high growth potential, good stem shape and good material quality were increased. At the same time, as the felling intensity increases, the canopy can be enlarged, and the average leaf area per plant increases, thereby improving the overall stand quality. Among them, with the decrease of density, the increase in diameter increases, which greatly shortens the cultivation time. Often, the maturity of a mature technology can shorten an age group. With the increase of tending intensity and diameter, the bottom area of a single plant increases, and the volume of a single plant increases correspondingly, which is proportional to the increase of tending intensity.

(2) Analysis of the effect of forest tending and harvesting

1) Give full play to the effect of a variety of forests

In forest tending and harvesting management, suitable stand structures can be constructed by combining local climate characteristics and regional characteristics, so as to give full play to the role of various trees in ecological maintenance. With appropriate management measures, tree density can be controlled and tree species can be divided into different areas, so as to optimize the allocation of forest resources and further improve afforestation efficiency. Therefore, forest tending and harvesting are of great significance in forest management. With the help of forest tending and harvesting strategies, the height of trees can be managed through different harvesting methods to further improve the overall quality of trees.

2) Improve the growth environment of trees

Through the tending and felling of forests, the density of forests can be controlled, and a good space and environment can be provided for the growth of various trees. Therefore, forest tending and harvesting can improve the growth environment of trees, optimize the density of young forests, and play a good role in controlling the distribution of trees. Only enough space for tree growth can ensure that the forest has enough nutrients during the growth process, and can also solve the problem of natural forest thinning. Through effective forest management, such as the use of ecological + characteristic forest planting models, red bean trees and other valuable tree species, healthy and colorful forests can be appropriately increased. On the basis of maintaining the ecological diversity of forest areas, it is also of great significance to the sustainable development of forestry in China to further improve the beauty of forest landscape and promote the economic benefits of forest resources through tending and logging.

3) Improve the quality of forests

In the tending and harvesting work, the effective management of forest resources can be achieved through advanced management methods, so that the sparsity of artificial forests can meet the needs of forest growth, promote the rapid growth of trees, and create a good growth environment for forests. Therefore, forest management is also an important part of the forest management system. Through a reasonable forest management model, the growth cycle of trees can be effectively shortened, and large-scale forest death and other problems can be avoided. In the process of tending and felling, the forest density can be reasonably adjusted, the trees can be thinned, and some competitive wood materials can be effectively preserved, so as to further improve the use value of trees. Therefore, forest tending, and harvesting is also an important prerequisite for ensuring forest quality, which can promote the further improvement of forest yield and quality, and have positive significance for improving the efficiency of forest planting.

3.2 What is the scope of the management plan that your decision model might suggest?

The model we have established is a temperate forest area represented by the Daxinganling Forest Area. Are there any conditions that would prevent forests from being deforested? In the study of the forest management plan taking Daxinganling as an example, we found that there are many kinds of trees whose carbon sequestration increases with time, such as: birch trees, etc. When the amount of carbon sequestration in the managed forest increases with the time of rising, we can consider that the forest does not need to be cut down.

Are there transition points between management plans that apply to all forests?

How do you find transition points between feature management plans for a particular forest and its location?

The forests managed are classified by tree type to determine the biomass of different tree types and age and their carbon content, and the amount of live wood in different tree types and the HWP carbon stock are a few percent of the total standing trees (range typically 4.75%-8.42%)）.

The total amount of carbon sequestration can be derived using the model we have studied. And using the management plan we studied, we can derive the amount of carbon sequestration added after logging and the amount of carbon sequestration that increases or decreases by different areas (we plot every 10,000 hectares of forest area).

Apply your model to a variety of forests. Determine the forest recommendations that your decision model will use to incorporate harvests into their management plans. How much carbon dioxide will this forest and its products hold for more than 100 years?

Using the models we have designed and the corresponding management plan will be stored 1940217172.94 tons of carbon dioxide for more than 100 years.

What forest management plan should be used for this forest? Why is this the best approach?

Why do we use this plan: We have designed a forest management plan that increases the amount of carbon sequestration in forests over time?

Why this is the best way to do it?

Because we maximize the amount of carbon sequestration produced by forests while also taking into account the greatest benefits for society. (The total amount of carbon sequestration from forest products produced by logging plus planting after felling is the largest)

3.3 Methods used in our models.

Using some models, which are Decision model Linearly fit the mode A model based on factor analysis.

3.4 Applications of our models

Forest management plans can be applied to the Da Xing'an ling forest.

In the study of the forest management plan taking Daxinganling as an example, we found that there are many kinds of trees whose carbon sequestration increases with time, such as: birch trees, etc. When the amount of carbon sequestration in the managed forest increases with the time of rising, we can consider that the forest does not need to be cut down.

3.5 Future work

Forest management project proposal

Background: Climate change poses a physical danger to everyone's body, and now there is a problem of carbon dioxide absorption that makes people entangled with diseases, so we need to store and absorb carbon dioxide, and we make a forest management plan, which mainly describes how our forest management model can be applied to forests around the world.

ISSN 2616-5872 Vol.5, Issue 3: 49-54, DOI: 10.25236/AJEE.2023.050308

Environmental analysis

We through factor analysis and SPSS analysis system, extracted the common factor climate, we will through 10 different climates around the world to do separate investigations, our temperate monsoon climate of the Daxing'an Ridge to example, Daxing'anling, the northernmost part of China, long winter and short summer, especially in the Moher and Lugo River areas, winter is more than 7 months, and the sunshine time is very short, only about 2 months in summer, but from June to August every year, the sunshine time is as long as 17 hours.

The Greater Khingan Mountains are also important climatic zones. The summer marine monsoon is hindered by the eastern slope of the mountain, with more precipitation on the eastern slope and arid western slope, but the climate of the entire mountainous area is humid, with annual precipitation of more than 500 km. The northern part of the mountain range is the coldest in eastern China, with severe winters (average temperature -28°C) and large areas of permafrost.

It is necessary to plant suitable vegetation types in suitable areas, temperate deciduous broadleaf forest belts with temperate monsoon climates, tropical rainforest belts suitable for tropical evergreen trees and deciduous broadleaved trees, etc.

Carbon sequestration analysis

Recently, the "2020 National Eco-meteorological Bulletin" released by the China Meteorological Administration [4] From the overall change trend of the country from 2000 to 2020, the national hydrothermal conditions in 2020 were generally better than those in 2019, the ecological quality and carbon sequestration of vegetation reached the highest since 2000, the surface became "green", and the carbon sequestration capacity was significantly enhanced.

In the past 20 years, 93% of the annual average temperature of the country has shown an increasing trend, 81% of the annual precipitation has shown an increasing trend, the hydrothermal conditions in most areas are conducive to vegetation growth, the national vegetation net primary productivity and vegetation coverage have increased by 3.6 grams of carbon/square meter and 0.28 percentage points per year on average, respectively, and the ecological quality of vegetation in 2020 reached the best state since 2000. Vegetation biomass increased from 909 g/m² in 2000 to 1159 g/m2 in 2020, and the carbon sequestration of vegetation increased by 27.5% compared with 2000, and the amount of vegetation carbon sequestration reached the highest since 2000.

We intend to reduce trees with low carbon content to a minimum during a specific tree growth period by cutting down overmature forests in the future, i.e. cutting down trees in the overripe stage (for some tree types) to plant juvenile forests of relative area and tree type, so that the carbon sequestration is maximum

References

[1] Sabina Burrascano and William S. Keeton and Francesco M. Sabatini and Carlo Blasi. Commonality and variability in the structural attributes of moist temperate old-growth forests: A global review[J]. Forest Ecology and Management, 2013.
[2] Calvo Rodriguez Sofia, Sánchez Azotemia G. Arturo, Durán Sandra M., Do Espiritu Santo Mario Marcos, Ferreira Nunes Yule Roberta. Dynamics of Carbon Accumulation in Tropical Dry Forests under Climate Change Extremes [J]. Forests, 2021, 12(1).
[3] Rawat Sushma, Nagar Bhavesh, Adhikari Bhupendra Singh, Pandey Rajiv, Palatal Juha M. Biomass loss in village ecosystems in Western Himalaya due to wild monkey interactions: A case study[J]. Environmental Challenges, 2021(republish).
[4] Wei Linage Tida, Zhu Zhenke, Luo Yu, Yang Yuanhe, Xiao Mouliang, Yan Zhifeng, Li Yu Hong, Wu Jinshui, Kazakov Yaakov. Comparing carbon and nitrogen stocks in paddy and upland soils: Accumulation, stabilization mechanisms, and environmental drivers [J]. Geoderma, 2021, 398.
[5] Vega-Ortiz Carlos, Arenado -Petronila Francisco, Richards Bryony, Sorcha Rasoul, Torres-Barragán Leonel, Martínez-Romero Nestor, McLennan John. Assessment of carbon geological storage at Tula de Allende as a potential solution for reducing greenhouse gas emissions in central Mexico [J]. International Journal of Greenhouse Gas Control, 2021, 109.