

# Forest management schemes based on carbon sequestration models

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**Abstract.** This research requires the carbon sequestration model to determine the capacity of the forest and its products to sequester carbon and then to choose the most effective forest management plan in terms of sequestering CO<sub>2</sub>. we need to create a carbon sequestration model to assess how much trees and their products can absorb carbon dioxide. We compared how effective each forest management plan is at sequestering CO<sub>2</sub> after developing a dynamic model for accounting for physical quantities of carbon sequestered and oxygen released by forests, analyzing forest resource flows and stocks and determining the willingness to pay for carbon sequestration and oxygen release by forests using a benefit transfer approach. we selected Chinese forestry as a representative to give the results of a study on selective logging to promote carbon sequestration in temperate coniferous and mixed broadleaf forests in China at reasonable time intervals.

**Keywords:** Carbon sequestration model, accounting dynamics model, forest management measures, transition strategy extract

## 1. Introduction

### 1.1. Background

Climate change presents a massive threat to life as we know it. To mitigate the effects of climate change, we need to take drastic action to reduce the amount of greenhouse gases in the atmosphere [1] simply reducing greenhouse gas emissions is not enough? We need to make efforts to enhance our stocks of carbon dioxide sequestered out of the atmosphere by the biosphere or by mechanical means. This process is called carbon sequestration. The biosphere sequesters carbon dioxide in plants, soils, and water environments [2] thus, forests are integral to any climate change mitigation effort. At the global level, forest management strategies that include appropriate harvesting can be beneficial for carbon sequestration. However, overharvesting can limit carbon sequestration. Forest managers must find a balance between the value of forest products derived from harvesting and the value of allowing the forest to continue growing and sequestering carbon as living trees [3] in doing so, they must consider many factors such as age and types of trees, geography, topography, and benefits and lifespan of forest products [4].

### 1.2. Our Work

Task 1: Develop a carbon sequestration model to determine how much carbon dioxide a forest and its products can be expected to sequester over time.

There are two main methods to calculate carbon sequestration and oxygen release from forests. One is the carbon estimation method based on biomass data, i.e., biomass method; the other is the carbon estimation method based on forest stock data, i.e., stock method. Considering that forest ecosystem is a complex ecosystem, there are photosynthesis and respiration of plants, as well as apoplast; the amount of carbon sequestered is equal to the amount of carbon dioxide assimilated by the first productivity minus the amount of carbon dioxide released by respiration in the apoplast,[5]

and the amount of carbon dioxide emitted by respiration in the soil, which is converted into the physical amount of carbon sequestered based on the physical amount of carbon dioxide.[6]

After calculating the physical quantity of carbon sequestration, the price of forest carbon sequestration needs to be determined. Currently, there are many controversies in this area, including the artificially fixed carbon dioxide cost method, the silvicultural cost method, the carbon tax method, the variable carbon tax method, and the harmful cost method [7].

The amount of carbon sequestered by forests is the amount of carbon absorbed by forest biomass (leaves, branches, trunks, and roots) and the amount of carbon sequestered by forest soils. Carbon sequestration and oxygen release accounting studies result from a specific point in time, so they are static and not yet dynamic studies [8].

To have a clearer understanding of the functions of forest resources in carbon sequestration and oxygen release, it is necessary to account for the material and value of carbon sequestration and oxygen release of forest resources.

Task 2: The research should convince the local community that this is the best decision for their forest.

Our analysis found that evidence-based selective harvesting as part of good forest management can increase the carbon sequestration capacity of forests. However, the impact of forest management on carbon sequestration has not been quantified. Therefore, the carbon content of various organs was measured for 323 tree species, 247 shrubs, and 233 herbaceous species in 7 temperate coniferous and mixed broadleaf forests subjected to selective cutting for restoration times of 100, 55, 45, 36, 25, 14, and 6 years to explore the dynamics of carbon storage. The results showed different organs' biomass carbon distribution patterns: trunk>root>branch>leaf. As the restoration time increased, more carbon accumulated in other organs and soils.

**1.3. Abbreviation and Definitions**

We begin by defining a list of nomenclature (symbols) used in this article, cf. Table 1.

**Table 1.** Nomenclature.

Variable Name	Meaning/Unit
Plaques edge density (DE)	Complexity of the perimeter shape of patches in the landscape
Maximum plaque index (Ip)	Proportion of the largest patch area in the landscape to the total area
Plaques density index (Ipp)	Number of patches per square kilometer
Aggregation Index (Ix)	The degree of randomness or aggregation of different patch types in the landscape
Aroma uniformity index (IsHE)	Measure the uniformity of the distribution of landscape patches in terms of area
Value	Trillion
Area	billion h m <sup>2</sup>
Carbon sink	pg cyr-1

**2. The GAME Model**

Now, we are to state our model in detail.

Model Assumptions

Based on now, the data information we collected may have errors with the actual, assuming availability and reference in the ideal state. It is assumed that unforeseen large-scale man-made environmental damage is not considered. Assume that each region has a complete ecological civilization system. It is assumed that the resources will not be used up in the short term. There are no influential human activities.

## **2.1. Data Preparation**

### **2.1.1 Definition of forestry resource data**

Data and information have specific differences and connections. "Data" is the carrier of "information." "Information" is the abstract content in the "data" and is valuable to the user—conceptual content. [9]For example, the national forest resources survey results in digital form are data. In contrast, the area, accumulation, and cover of forest resources are information expressed by the values of the survey data.

Forestry resources data is a type of data. From the perspective of data flow in the process of forestry resources management, forestry resources data refers to the data obtained from systematic observation, measurement, analysis, and evaluation of forest, desert, wetland, and biodiversity resources within a specific spatial and temporal range by using various data collection, transmission, exchange, aggregation, processing, storage and analysis techniques, which can effectively reflect these four types of forestry resources entities and their history, status quo, dynamics, and trends. And trends of these four types of forestry resources. The core is to highlight the process and Spatio-temporal variation characteristics of forestry resource data and emphasize the flow process and law of forestry resource data [10].

### **2.1.2 Sources of forestry resource data**

Forestry resource data are forestry data, and forestry data are composed of source data. Therefore, this study tries to make a preliminary analysis of the leading forestry business in the context of the overall governmental objectives of forestry.

Based on the classification of forestry business, forestry data can be divided into two major categories:

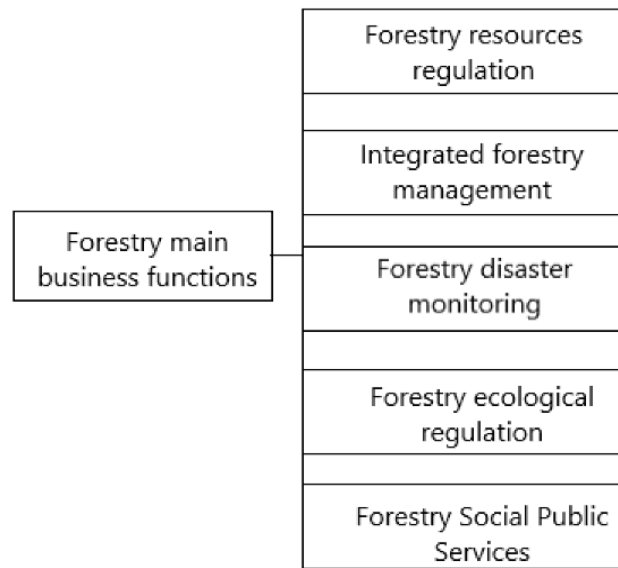
1) Forestry resource data, mainly from forestry resource supervision business, including forest resource, desert, wetland, and biodiversity resource data.

2) Forestry business data mainly comes from four other types of business processes other than forestry resource supervision, including forestation data, ecological engineering data, etc. Based on the intrinsic connection between forestry data and forestry business, this study designed a forestry data loop with forestry resource data as the core.

The forestry data loop consists of a small loop and a large loop:

1) forestry resource supervision calls for historical monitoring data to carry out various forestry resource management activities on the one hand and continuously updates forestry resource data through resource monitoring activities; on the other hand, forming a spatial and temporal sequence of resource data, which constitutes a small loop of forestry resource data and forestry resource supervision business.

2) Forestry resource data provide data foundation and support for other four types of business outside of forestry resource supervision. Conversely, these four types of business processes will add, modify and delete various types of forestry resource data, which becomes another primary source of forestry resource data, constituting a large circle of forestry resource data and forestry business data. The forestry data can be continuously accumulated and updated, constituting the main forestry resource data in a large loop and forestry resource data in the forestry business process.



**Fig 1.** Forestry major business classification.

**2.2. Model Description**

The model of forest resource dynamics was developed by choosing the mathematical model of economic cybernetics. The physical quantity of forest carbon sequestration was combined with the dynamics of forest resources to establish the regression equation between forest carbon sequestration and the amount of carbon sequestered by forest land, forest resources, and other resources that depend on forest resources and to estimate the total amount of carbon sequestered. The price of forest carbon sequestration is determined in the form of willingness to pay by the beneficiaries. If the beneficiaries are willing to pay a high price, the forest carbon sequestration is significant. In contrast, if the beneficiaries are not willing to pay any money or pay little money, the forest carbon sequestration is less critical, i.e., it has a lower value [11].

The stochastic model theory is used to develop a dynamic prediction model of forest resources by diameter level based on the mechanism method:

$$\begin{aligned}
 Fv_{(t+1)} &= A(q^{-1})Fv_{(t-m)} + B(q^{-1})U_{(t-m)} - C(q^{-1})W_{(t-m)} + \varepsilon_{(t+1)} \\
 Fv_{(t+1)} &= (Fv_{1(t+1)}, Fv_{2(t+1)}, Fv_{3(t+1)}, \dots, Fv_{i(t+1)}, \dots, Fv_{k(t+1)}) \\
 Fv_{(t-m)} &= (Fv_{1(t-m)}, Fv_{2(t-m)}, Fv_{3(t-m)}, \dots, Fv_{i(t-m)}, \dots, Fv_{k(t-m)})
 \end{aligned}
 \tag{1}$$

Where:  $Fv_{(t+1)}, Fv_{(t-m)}$  is the state vector of forest resources by diameter level at time  $Fv_{(t+1)}$  and  $Fv_{(t-m)}$ , respectively,  $A(q^{-1}), B(q^{-1}), C(q^{-1})$  are operators;  $Fv_{i(t+1)}$  is the forest stock at diameter level at time t-m;  $Fv_{i(t-m)}$  is the forest stock at diameter level at time t-m?

$U_{(t-m)}$  is the afforestation vector;  $W_{(t-m)}$  is the forest resource depletion vector.

$$W_{(t-m)} = (W_{1(t-m)}, W_{2(t-m)}, W_{3(t-m)})
 \tag{2}$$

$W_{1(t-m)}, W_{2(t-m)}, W_{3(t-m)}$  are the logging vector, harvesting vector and natural and anthropogenic forest loss vectors at time t a m, respectively

$$W_{1(t-m)} = (W_{11(t-m)}, W_{12(t-m)}, W_{13(t-m)}, \dots, W_{1i(t-m)}, \dots, W_{1n(t-m)})
 \tag{3}$$

$W_{1i(t-m)}$  Is the amount of interval harvesting at the i-th diameter class at time t-m.

$$W_{3(t-m)} = (W_{31(t-m)}, W_{32(t-m)}, W_{33(t-m)}, \dots, W_{3i(t-m)}, \dots, W_{3n(t-m)})
 \tag{4}$$

$\varepsilon_{(t-1)}$  is the model noise vector, without loss of generality, it may be assumed that  $\varepsilon$  is the white noise with zero mathematical expectation for the convenience of data processing.

$$Fv_{(t+1)} = A(q^{-1}), B(q^{-1}), C(q^{-1}), Fv_{(t-m)}, U_{(t-m)}, -W_{(t-m)}^T + \varepsilon_{(t+1)} \quad (5)$$

When the observations of  $t = k + 1, k + 2, k + 3, \dots, k + i, \dots, k + m$  are obtained, the least-squares estimation algorithm is used to obtain the least-squares estimate of the operator  $att = k + 1, k + 2, k + 3, \dots, k + i, \dots, k + m$ .

In Table 2,  $a_{ij}$  represents the portion of forest resources added during the operation period and reduced during the operation period;  $b_{ij}$  represents the new addition during the operation period that constitutes the resource stock during the operation period;  $d_{ij}$  represents the portion of forest resources stock at the start of the operation period that is reduced during the operation period; and  $s_{ij}$  represents the portion of forest resources stock at the start of the operation period that is converted.  $f_{voi}$  is the stock of forest resources at the start of the operation period;  $f_{vli}$  is the stock of forest resources at the conclusion of the operation period. Is the stock of forest resources at the end of the management period, from the horizontal row?

$$f_{vli} = \sum_{j=1}^n (b_{ij} + s_{ij}) \quad (6)$$

**Table 2.** Stock-flow of forest resources in term of forest class.

	Flow during the period					Total	Opening flow			Closing stock	
	$V_1$	$V_2$	$V_3 \dots$	$V_i \dots$	$V_n$		$Vf_1$	$Vf_2$	$Vf_3 \dots$	$Vf_i \dots$	$Vf_n$
$W_1$	$a_{11}$	$a_{12}$	$a_{13} \dots$	$a_{1i} \dots$	$a_{1n}$		$d_{11}$	$d_{12}$	$d_{13} \dots$	$d_{1i} \dots$	$d_{1n}$
$W_2$	$a_{21}$	$a_{22}$	$a_{23} \dots$	$a_{2i} \dots$	$a_{2n}$		$d_{21}$	$d_{22}$	$d_{23} \dots$	$d_{2i} \dots$	$d_{2n}$
$W_3$	$a_{31}$	$a_{32}$	$a_{33} \dots$	$a_{3i} \dots$	$a_{3n}$		$d_{31}$	$d_{32}$	$d_{33} \dots$	$d_{3i} \dots$	$d_{3n}$
Total							$d_1$	$d_2$	$d_3 \dots$	$d_i \dots$	$d_n$
$Vf_1$	$b_{11}$	$b_{12}$	$b_{13} \dots$	$b_{1i} \dots$	$b_{1n}$	$b_1$	$s_{11}$	$s_{12}$	$s_{13} \dots$	$s_{1i} \dots$	$s_{1n}$
$Vf_2$	$b_{21}$	$b_{22}$	$b_{23} \dots$	$b_{2i} \dots$	$b_{2n}$	$b_2$	$s_{21}$	$s_{22}$	$s_{23} \dots$	$s_{2i} \dots$	$s_{2n}$
$Vf_3$	$b_{31}$	$b_{32}$	$b_{33} \dots$	$b_{3i} \dots$	$b_{3n}$	$b_3$	$s_{31}$	$s_{32}$	$s_{33} \dots$	$s_{3i} \dots$	$s_{3n}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$Vf_i$	$b_{i1}$	$b_{i2}$	$b_{i3} \dots$	$b_{ii} \dots$	$b_{in}$	$b_i$	$s_{i1}$	$s_{i2}$	$s_{i3} \dots$	$s_{ii} \dots$	$s_{in}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$Vf_n$	$b_{n1}$	$b_{n2}$	$b_{n3} \dots$	$b_{ni} \dots$	$b_{nn}$	$b_n$	$s_{n1}$	$s_{n2}$	$s_{n3} \dots$	$s_{ni} \dots$	$s_{nn}$
Opening stock							$f_{v01}$	$f_{v02}$	$f_{v03} \dots$	$f_{v0i} \dots$	$f_{v0n}$

Expressed in matrix form as:

$$\begin{aligned}
 fv &= (S + B)e \\
 fv &= (fv_{11}, fv_{12}, fv_{13}, \dots, fv_{1i}, \dots, fv_{1n}) \\
 S &= (s_{ij})_{n \times n}; B = (b_{ij})_{n \times n} \\
 e &= (1, 1, 1, \dots, 1, \dots, 1)^T
 \end{aligned} \quad (7)$$

From the vertical row:

$$f_{v0i} = \sum_{j=1}^n (b_{ij} + s_{ij}) \quad (8)$$

Expressed in matrix form as:

$$\begin{aligned}
 f_{v0} &= (S^T + D)e \\
 D &= (d_{ij})_{n \times n}
 \end{aligned} \quad (9)$$

The following regression equation was developed based on the ability of forest resources to sequester carbon from all resources, including forest land, and the least squares estimation method was used to estimate the parameters:

$$FC_{u(t+1)} = FC_{i(t+1)}FC_{i(t+1)} + \zeta_{i(t+1)} \quad (10)$$

Where  $FC_{i(t+1)}$  is the parameter to be estimated?

$$FC(t+1) = \begin{bmatrix} FC_{1(t+1)} & 0 & 0 \dots & 0 \dots & 0 \dots & 0 \\ 0 & FC_{2(t+1)} & 0 \dots & 0 \dots & 0 \dots & 0 \\ 0 & 0 & FC_{3(t+1)} \dots & 0 \dots & 0 \dots & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 \dots & FC_{i(t+1)} \dots & 0 \dots & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 \dots & 0 \dots & 0 \dots & FC_{n(t+1)} \end{bmatrix} \quad (11)$$

The amount of forest carbon sequestered is multiplied by the amount of carbon sequestered per unit at different diameter levels. A model for measuring the number of forest resources by diameter level is established.

Calculation of the relationship between forest resources and carbon stocks at the path level, in order to facilitate computer processing.

$$f(vv_{i(t+1)}) = fv_{i(t+1)}f(t_{i(t+1)}) \quad (12)$$

### 2.3. Collection

As a function of forest resources, forest carbon sequestration must be defined as an environmental service and an environmental role. Environmental service is a process of economic flow, while an ecological part is the concept of a biological system or ecosystem of flow. It isn't easy to talk about environmental services accepted by society or the market without ecological functions [12] many economic papers clearly distinguish between the values or benefits of natural resources and environmental quality. Environmental quality is an essential component of environmental services, while ecological functions often support the production of natural resources. Therefore, environmental services are often considered an economic term. At the same time, ecological processes can support economic goods and services. There is no need to separate environmental services from environmental goods and services in considering the internalization of the value of ecological functions [13].

Based on the precise definition of environmental functions and utility of forest resources, the evaluation of forest resources environment should be the evaluation of forest resources services and the evaluation of the ecological utility of forest resources rather than the evaluation of environmental functions of forest resources. People who gain utility from them can use some functions, which are difficult to recognize, so people are not willing to pay a particular cost to buy or protect these functions. The environmental assessment methods currently used for forest resources are designed based on ecological services and utility. People's willingness to pay or accept compensation for environmental degradation or adopt market substitution prices is based on utility [14].

In China, there are few studies on forest carbon sequestration, and a large amount of money is needed to determine the willingness of beneficiaries to pay. The benefit transfer approach is to "transfer" the environmental and resource benefits or costs from the site where the study has been conducted to the site where the study is needed, called the "study site" and the site where the study is required, called the "policy site. The site where the study has been conducted is called the "study site" and the site where the study is needed is called the "policy site." The benefits transfer approach involves first finding study sites where environmental and resource assessments have been conducted and finding as many study sites as possible to identify case study sites that are similar to policy sites; firstly, comparing the differences in the degree of similarity and "marketability" between study sites and policy sites; and secondly, determining how and to what extent the environmental and resource benefits of the study sites will be transferred to policy sites. Transfer methods include transferring average benefits or costs, adjusting unit costs or benefits, and transferring demand or benefit functions.

## 3. Carbon sequestration potential of various forest management measures

### 3.1. Reducing the rate of deforestation

Deforestation and conversion of forested land to other land use types such as agricultural and industrial land are the greatest threats to global forest resources[15], and forest destruction (especially

of tropical rainforests) has become the second largest source of increased atmospheric CO<sub>2</sub> emissions after fossil fuel combustion.[16]

### 3.2. Increase in forest area

Reducing deforestation can be seen as a "flow control" measure to reduce the release of CO<sub>2</sub> while increasing forest area, increasing forest cover, and fixing CO<sub>2</sub> in the atmosphere with the higher carbon storage density of forest ecosystems are "open source" measures to increase CO<sub>2</sub> absorption. [17]The increase of forest area, forest cover, and carbon storage density of forest ecosystem to fix CO<sub>2</sub> in the atmosphere is the "open source" measures to increase CO<sub>2</sub> absorption. There are two main ways to increase forest area: first, to restore abandoned land, agricultural land, or other land types suitable for afforestation into forests, mainly suitable for tropical regions and some developed countries in Europe and the United States; second, to plant forests on barren land ideal for afforestation, primarily ideal for temperate and boreal developing countries [18].

### 3.3. Strengthen the management of existing forests for nurturing

As a dynamic carbon reservoir, the capacity of forests to store carbon depends not only on the area of the woods but also on the quality of the forest, i.e., the carbon density of the forest per unit area. Forests worldwide are degraded to varying degrees due to fertilizers, fires, pests and diseases, and irrational harvesting practices [19]

### 3.4. Replace fossil fuels with biofuels such as fuelwood

Since the CO released from the combustion of fuelwood is the CO that is fixed from the atmosphere during the growth process [20] the use of fuelwood does not result in net emissions of atmospheric CO from the whole life cycle of fuelwood generation to consumption, so replacing fossil fuels with renewable fuelwood is the only long-term solution to reduce global carbon emissions.

**Table 3.** Carbon sequestration potentials of major forest management methods in the world (2000~2050).

Carbon sequestration measures	Methods	Carbon sink	Importance and implement regins
Reducing forest falling	Field investigate, forest inventory, scenario analysis	0.3~1.6	Important method, generally practice, most useful for tropical regions
Afforestation and reforestation	Fickd investigate, for inventory, model, soe nario analysis	0.12~1.2	Important method• much practice, most use fulfor all ove rthe world
Nutrient fertilization	Semi-experiential model ctimate, model	0.12~1.6	practice most useful for North America and Europe
Fire management	Semi-experiential model cstimate, model	0.11~1.13	General method. possible practice most use ful for North America and Russia
Pest management	Semi-experiential model cstimate, model	0.04~1.2	General met bdd, possible practice, most use ful for all over the world
Substitute for fissile fuels	National inventory, s cenario anal- sis, model	0.2~1	Important method, generally practice with technical problem, most use ful for all over the world

## 4. Discussion

The model established in this paper, taking into account several factors and data, has undergone systematic theoretical analysis, and the algorithm is stable and the calculation results are more accurate. The accuracy of the model developed in this paper will be significantly reduced when there are large changes in national policies and force majeure such as natural disasters, therefore, the model can be optimized by considering national policies and natural disasters. Due to the time and financial constraints, we have not yet obtained the data related to soil carbon sequestration, especially the dynamic data processing, which needs further study.

The forestry model we give in this paper, the specific assessment scheme, etc., when put into use in real life, together with the comprehensive consideration of other factors in reality, can provide a good reference for urban management and national environmental management, and can be extended to more regions to help solve ecological and environmental problem.

Based on the modeling of the carbon **sequestration model**, we present our regional planning model for the current ecological situation in New Zealand.

### 4.1. "Problem-based" rather than "area-based" management:

The core management philosophy in regional planning is to establish specific management objectives, policies and approaches around "problems". The division of land in the district plan is not based on the nature of the land, as in traditional zoning, but on the characteristics and importance of the natural and man-made environment that exists in different parts of the city, and the level of protection that ensures its healthy development. The zoning plan creates a system of "natural areas" management covering the entire city, and regulates development that may have an impact on natural resources and the ecological environment through the "natural areas ordinance". [21]The "natural areas" include six types of zoning districts, each with different natural resources and environmental characteristics, and similar problems (Table 1). This approach of using "problems" rather than "zones" as the base for management and control allows urban resource and environmental issues to receive as much attention as possible, so that regional planning can develop more targeted and effective control measures.

### 4.2. Assessing the impact

Even if the international community achieves all of its current emission reduction commitments and targets, global warming by the end of the 21st century is still expected to be 3°C above pre-industrial levels [22]. Even if the international community meets all of its current emission reduction commitments and targets, global warming is still projected to be 3°C above pre-industrial levels by the end of the 21st century. Under the current policy scenario, New Zealand's GHG emissions are projected to decrease over the next few decades, but not at a rate sufficient to meet the 2030 target set out in the Paris Agreement. New Zealand's climate will change profoundly, with temperatures expected to rise across New Zealand, drought and wildfire risks increasing in many places, and extreme precipitation becoming more common [23] Extreme events that are rare for contemporary people may become the new normal in the future. Even if the future does not produce more CO<sub>2</sub> emissions, there will be no return to an undisturbed climate, or even to the climate to which we were once accustomed.

## 5. Conclusion

Optimal rotation periods, based on the above, have been shown to increase the carbon sequestration capacity of forests as part of good forest management. However, the effect of forest management on carbon sequestration has not been quantified. Therefore, carbon content of various organs was measured for 323 tree species, 247 shrubs, and 233 herbaceous species in 7 temperate coniferous and broadleaf mixed forests subjected to selective cutting restoration times of 100, 55, 45,

36, 25, 14, and 6 years to explore the dynamics of carbon storage. The results showed that the biomass carbon distribution pattern of different organs: trunk > root > branch > leaf. As the restoration time increased, more carbon was accumulated in different organs and soils. Interestingly, when the restoration time exceeded 50 years, the carbon stock of the ecosystem was greater than that of the soil. It is interesting to note that the carbon stock of the ecosystem is greater than that of the 100-year-old native forest when the restoration time is longer than 50 years, indicating that a reasonable selective cutting interval can increase forest carbon sequestration. The average diameter at breast height (DBH) was significantly and positively correlated with forest carbon stock, and when the average DBH of a stand exceeded 15, the carbon stock of selectively harvested forest exceeded that of the original forest. Therefore, the average diameter at breast height (DBH) of forest can be used as an indicator for the combination of sustainable forest management and forest carbon sequestration. In addition, the classical coefficients of 0.45 and 0.50 for estimating carbon sequestration values are underestimated by 2.65% and overestimated by 8%. In recent decades, China has implemented six major national ecological restoration projects that have significantly increased carbon sequestration, equivalent to 50-70% of the annual sink of all major terrestrial ecosystems. However, China is still under considerable pressure to reduce carbon emissions and aims to increase its forest stocks by  $4.5 \times 10^9 \text{m}^3$  by 2030, compared to 2005 levels. Sustainable management practices can be used to enhance forest C storage. Sustainable management practices can be used to enhance forest C stocks. Selective harvesting, which is the periodic and repeated harvesting of trees in specific areas, is a key harvesting method for sustainable management of China's natural forests. Appropriate selective cutting intensities and intervals are estimated to promote forest growth and regeneration and to enhance its carbon sequestration.

In terms of vegetation, there were significant differences in the carbon stocks of trees, shrubs and herbaceous plants across all measured sites. Trees stored the most, followed by shrubs and herbaceous plants ( $P < 0.05$ ). The order of C storage in trees with increasing restoration time was  $55 > 100 > 45 > 36 > 25 > 14 > 6$  years. As expected, C storage in trees was greater than in the original forest when the restoration time exceeded 50 y. C storage in different tree organs was in decreasing order of trunk > root > branch > leaf.

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