A Quantitative Study on Carbon Sequestration - An Analysis of Changbai Mountain Forest Example

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Abstract. 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]. Most informed analysts now believe that the climate is warming. First, we engineer an ideal model, which the forest in the theory is a healthy, expanding forest free of fire and other natural calamities, and the plant biome remains intact. The carbon sequestration of the forest per unit area is considered to be A, implying that the total carbon sequestration of the forest is *C1=A*S* without any tree removal. we divide into two parts, one is exceeding cut of forests, and the other is cutting half of the forests. Then, we can calculate the total of the carbon storage. In addition, we design two specific models——the age of trees and types in Changbai Mountain forest. By using existing data, we can make several line charts, and we can know the concrete ranges, which could find the best forests' managemant. Through this way and our model, we can know what is the spectrum of management plans that your decision model may suggest? Are there any conditions which would result in a forest that should be left uncut. Are there transition points between management plans that apply to all forests? How are characteristics about a specific forest and its location used to determine transition points between management plans.

Keywords: carbon storage carbon sequestration Excel, trend.

1. Introduction

Nowadays, 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. Most informed analysts now believe that the climate is warming. The global social costs would be so high that major efforts are needed to halt this warming trend [2]. Some experts suggest that they consider the potential of disruptive scale, and it is necessary to change this situation by valid methods. In order to decrease the harm, now we have two possible solutions: cut emissions at the source, like fossil fuels, or reduce their presence in the atmosphere, through carbon sequestration. 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 (especially large plants like trees), soils, and water environments. Thus, forests are integral to any change mitigation effort [3].

While the seas store enormous amounts of carbon, their absorption capability is being harmed by heat and acidification, which kills the same algae that absorb CO_2. Wetlands, particularly coastal wetlands, provide extra potential, but their impact is limited and difficult to influence by human intervention. Their preservation, on the other hand, is a top concern. Given these circumstances, trees provide our best chance of capturing and storing carbon dioxide (CO_2), the primary GHG [4]. Furthermore, forests sequester carbon dioxide in living plants and in the products created from their trees, including furniture, lumber, plywood, paper, and other wood products. These forest products sequester carbon dioxide for their lifespan.

In a word, it's time to engineer an accurate carbon sequestration model to control this situation. And in this model, we should consider some other facts, which can influence the carbon sequestration and

forest management, like population, benefits, climate, human culture and so on. Thus, we need to add these impacts into our model.

2. Changbai Mountain Forest Model

2.1. Basic Model

The carbon sequestration of the forest per unit area is considered to be A, implying that the total carbon sequestration of the forest is *C1=A*S* without any tree removal.

It is believed that trees with an area of S may be processed into three distinct types of goods with equal volume, and that the carbon sequestration of each product is A_1, A_2, and A_3. Assuming that the three products use the same amount of forest resources, the total carbon sequestration of these products is:

$$C_2 = (A_1 + A_2 + A_3) * (S / 3) \tag{1}$$

If the forest is over-cut, that is, assuming that all trees are turned into products, the total carbon sequestration is

$$C_3 = (A_1 + A_2 + A_3) * (S' / 3) \tag{2}$$

If just half of the trees are felled and the other half continue to grow, the total carbon sequestration is

$$C_4 = A * (S' / 2) + (A_1 + A_2 + A_3) * (S' / 6) \tag{3}$$

2.2. Changbai Mountain forest——Tree age

We discovered that the amount of forest stock carbon is proportional to the age of the forest. The general forest can be divided into young forest, middle forest, near mature forest, mature forest and overmature forest according to their ages. The carbon sequestration rate is the largest in the middle forest ecosystem, while the carbon absorption and release of mature forest/overmature forest are basically balanced because their biomass basically stops growing. The age structure of forests depends not only on the development and evolution of forests but also on the influence of external disturbance. The higher the frequency of disturbance, the larger the composition of young forest, the less its carbon sequestration. In the process of the development of the whole forest succession, according to the circumstances of the carbon, can put the forest carbon dynamics is divided into four stages, namely the carbon sequestration rate lower initial stages or interference from renewable, carbon sequestration rate of the biggest logistic growth stage, carbon sequestration rate of decline in mature stage, and the decomposition of carbon into the soil forest death phase. Thus, the carbon dynamics of forests are largely determined by their age-level changes [5].

But we don't think it's absolute. We discovered valuable data from the Changbai Mountain forest for future investigation. We are looking for the Korean pine, larch, spruce, ZhangZi tree, stinky pine, manchurian ash, walnut, yellow pineapple, hu linden, oak, elm, color of 15 kinds of typical in the changbai mountains forest trees, respectively for their young forest volume per volume, mid-maturation forest unit, nearly cooked Lin unit volume, mature forest volume per volume, overripe Lin unit.

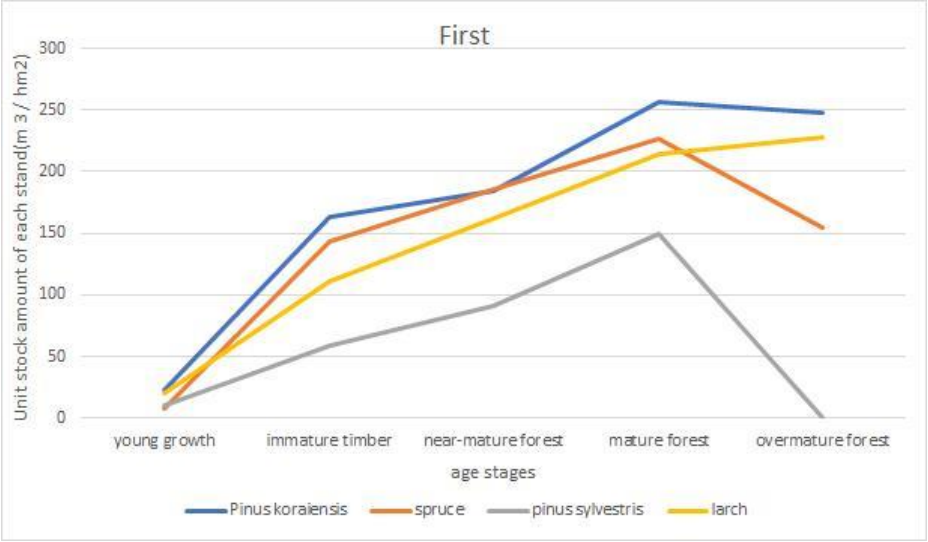


Figure 1. Changes in Pinus koraiensis, spruce, pinus sylvestris, larch

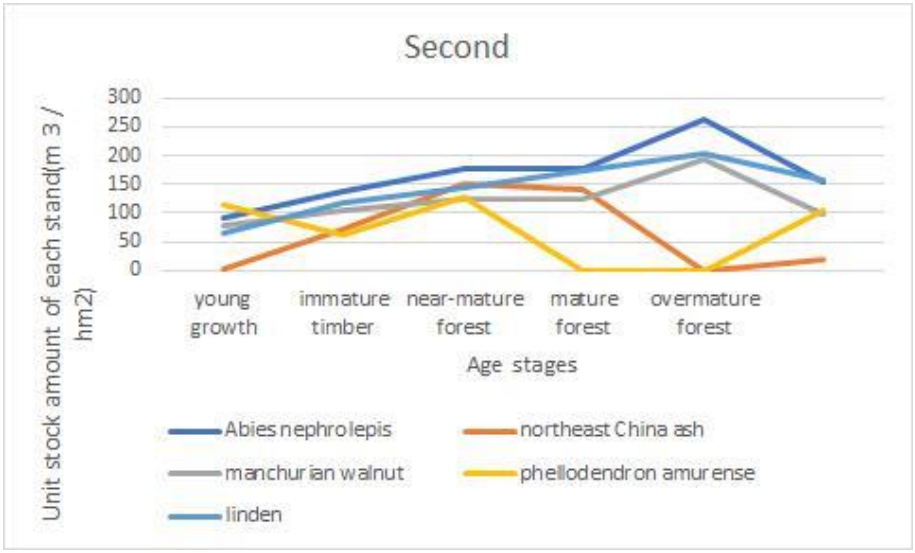


Figure 2. Unit volume changes in Abies nephrolepis, northeast China ash, manchurian walnut, phelloderdron amurense, linden

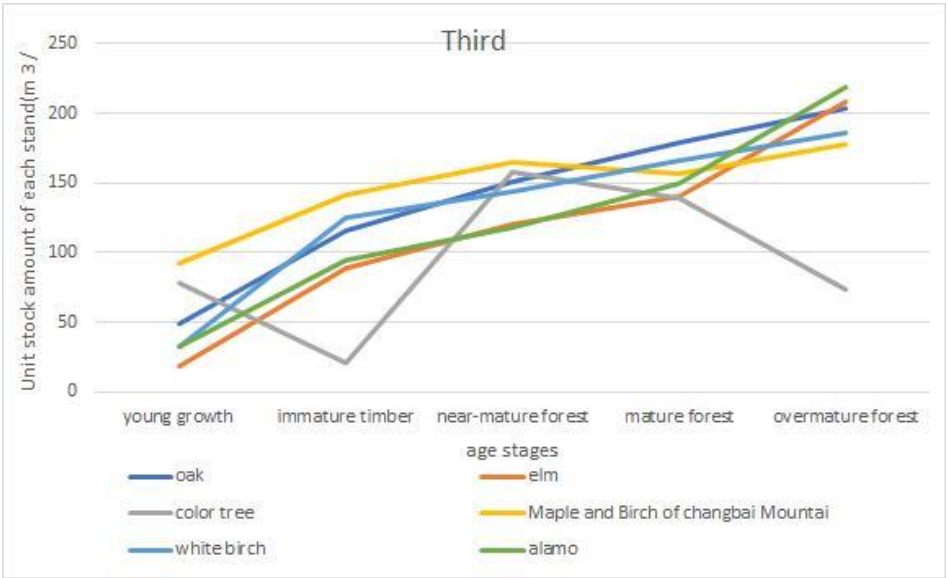


Figure 3. Unit stock changes in oak, color tree, white birch, alamo, slm, Maple and Birch of changbai Mountain

The unit stock quantity of most tree species peaked in near-mature and mature stands, according to the Figure 1-3. If the government chooses to tear down mature trees, trees that achieve their apex near maturity emit carbon, resulting in a waste of resources; If the government decides to chop trees in the near mature forest, the trees that reach their peak in the mature forest do not trap any carbon during the transition period from the near mature forest to the mature forest, which is also a waste of resources. As a result, we believe that the forest should be cut down in the middle of the period between the nearmature forest and the mature forest, so that tree species that reach the peak in the mature forest have time to sequester carbon and tree species that reach the peak in the near-mature forest do not release more carbon. Felling should mostly consist of mature and overripe fruit, so that the forest can be kept in its mid-age state following felling. It is worth mentioning that there is a minimal value for tree species in the middle age stage, therefore it is important to exercise caution when cutting tree species in the middle age to near age stage after cutting. as a result, the quantity of carbon sequestration in the Changbai Mountains will continue to rise as the two cutting tactics are implemented [6].

2.3. Changbai Mountain forest——the Types of Tree

Because of the differences in temperature and soil conditions in each place, the appropriate tree species vary. Our group chose tree species in changbai district forest for research, and we selected 15 trees, Pinus koraiensis, spruce, pinus sylvestris, larch, Abies nephrolepis, northeast China ash, manchurian walnut, philodendron amurense, linden, oak, color tree, white birch, alamo, slm, Maple and Birch of changbai Mountain. We examined and incorporated the indicators for each tree in a methodical manner, as shown in Figure 4:

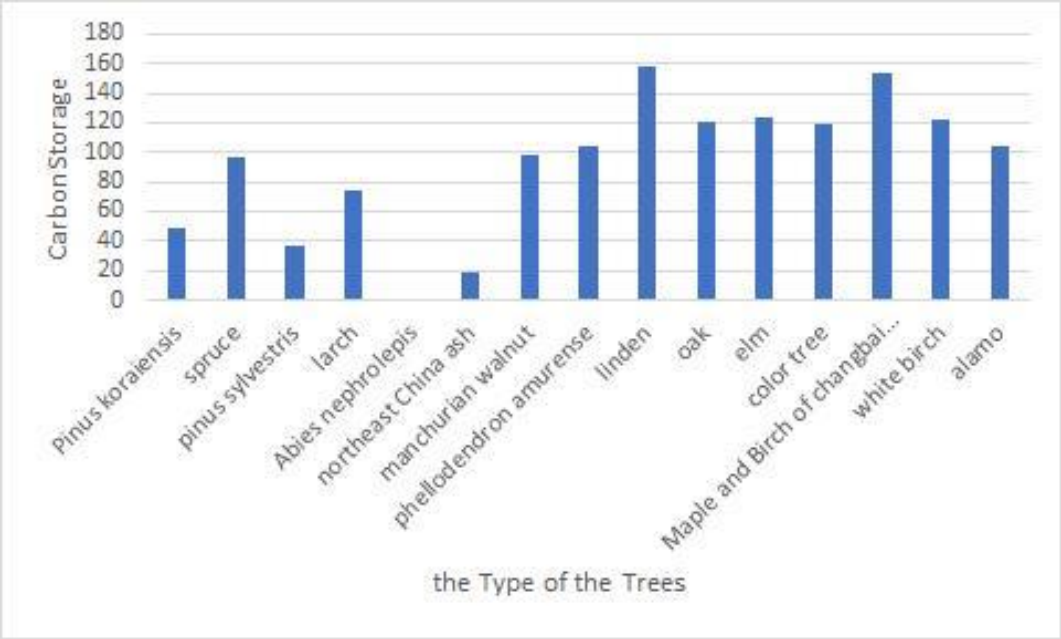


Figure 4. Expected carbon sequestration per unit area of each tree

We found the percentages of different stands in each tree and used statistical knowledge to calculate the expected amount of carbon sequestration per unit area of each tree, the results are more scientific. We found that linden trees are the best carbon sequestrators, We use the expected value of carbon sequestration per unit area of linden tree as a measurement standard, and we believe that tree species that can achieve 60% of the expected value of carbon sequestration per unit area of linden tree are beneficial to forest carbon sequestration in the Changbai Mountain area, the species that meet our criteria are spruce, apinol, manchurian walnut, linden, phellodendron amurense Rupr, oak, color tree, white birch, alamo, slm, and Maple and Birch of changbai Mountain. Especially, although Pinus koraiensis, pinus sylvestris sylvestris, and larch did not meet our specified standards, this does not imply that these three tree species are unsuitable for forest planting in Changbai Mountain; however, the first few trees contribute more to carbon sequestration in Changbai Mountain forest. We must

appreciate nature and conserve ecological forests; it may plant more trees that make a significant contribution. Of obviously, it cannot give up trees that contribute little.

3. Changbai Mountain Model Analysis

3.1. Scope of management plan according to the Decision model

The changbai Mountain Forest we chose is in the southeast of Jilin Province, China, and is in the medium temperate zone. The temperate deciduous broad-leaved forest belt is its comparable forest belt. Climate and soil conditions varies slightly at the same latitude and longitude. We chose the Changbai Mountain forest to symbolize a type of woodland at the same latitude. As a result, our decision-making model recommends temperate deciduous broad-leaved forest as a forest belt.

3.2. The Conditions of Uncutting

When the net carbon sequestration of the whole forest is greater than 0 and the carbon sequestration rate is at a relatively high level, the forest can have a good carbon sequestration effect without being felled. Take the changbai mountain forest we studied as an example, When the forest is nearing the perished-forest stage, it is not chopped down because carbon sequestration is greater and the rate of sequestration is faster.

3.3. The amount of CO2 sequestered

We compute the expected and average unit volume of each stand of diverse tree species in the Changbai Mountain forest, and the yearly unit volume is 109.7022m3/hm2.We assume that in the future 100 years, the annual unit volume of forest in Changbai Mountain is in a state of dynamic balance, and the forest area is also in a state of dynamic balance. The forest area in Changbai Mountain is 170877.8 hectares. After 100 years, the carbon sequestration amount of changbai mountain forest is *109.7022 * 170877.8 * 100 = 1874567060 m³*.

3.4. The best management method in forests

Cutting down mature and overripe trees every few years, and planting younger ones, puts the age composition of the forest at a stage where carbon sequestration rates are higher. Make some artificial rain, Precipitation can promote plant growth and increase plant productivity and biomass, so precipitation can promote carbon sequestration in forest ecosystems. It is necessary to prevent forest fire. In the process of forest fire, it not only directly causes the carbon emission of forest ecosystem, but also destroys the structure and function of the original forest ecosystem, thus changing the carbon fixation, distribution and circulation of the whole forest ecosystem, and affecting the gas exchange with the atmosphere. It is mainly manifested in the following aspects: fire directly burns forest vegetation, resulting in the reduction of forest productivity and wood loss, which directly reduces the carbon sequestration capacity of forest ecosystem vegetation; Fire reduced the carbon pool and accelerated the decomposition of litters by directly affecting the number of litters and indirectly affecting the decomposition rate of litters. The effects of fire on forest soil carbon pool include increasing decomposition of soil organic matter, increasing carbon release from soil respiration, decreasing carbon input from aboveground vegetation and increasing carbon sink function of black carbon [7]. As a result, the management plan of the Changbai Mountain forest includes a number of actions such as managing the age composition of the forest, improving precipitation, and avoiding forest fires.

Assume that the ideal management strategy involves a harvest interval that is ten years longer than current practice in forests. The manner in which a plan for transitioning from a current timeframe to a new one is considered is attentive to the needs of forest managers and everyone who utilize the forest.

Without taking into account natural disasters, the main factors influencing the rate of carbon sequestration of forest age in this part of the extra time, so we think group discussion, in this period of

transition, can be planted a number of young trees to alleviate the forest age composition, through artificial rainfall, to improve the forest carbon sequestration ability again, making this not a waste of time.

Some people think we shouldn't cut down any trees, and you find a forest that should be included in its management plan for harvesting. Write a one - to two-page non-technical newspaper article explaining why your analysis is sure to include harvesting in the management of this forest, rather than leaving it intact. Ultimately, your article should convince the local community that this is the best decision for their forest.

4. Conclusion

Forest regeneration and felling is not only for the rational exploitation and utilization of forest resources, so as to obtain wood to meet the needs of national economic construction, but also to cultivate the forest, highlighting the forestry reproduction of a business mode. Cutting the importance and give attention to both ecological benefit at the same time, in the case of serious damage to the ecological environment is not final felling, update deforested, cultivating young trees, timely for tending cutting, adjusting forest density, promote the growth of trees, and to stand transformation of low-quality forest, secondary forest, improving forest, in order to improve the forest land productivity. Cutting can not only obtain wood, but also promote forest regeneration and tree growth, and create necessary conditions for sustainable and healthy development of forestry. The key lies in the correct choice of cutting mode and regeneration mode. Rational cutting and timely updating will not only not cause the destruction of forest resources, but also be beneficial to forest growth and forest cultivation. If unreasonable cutting technology and cultivation measures are adopted, the ecological environment will deteriorate [8].

The natural occurrence, development, decline and decay, and regeneration of forests are caused by population rivalry, such as improper cutting and exploitation, which results in a significant loss of forest resources. When trees reach a particular maturity, they can be used to regenerate forests. Harvest and utilize as soon as possible, and then foster the next generation of forests through afforestation or natural regeneration. Through the combination of harvesting and breeding, as well as timely updating, every year will become over-ripe trees cut down, obtaining some economic benefits, but also may make the ecological environment maintain a good state, giving full play to the forest's ecological and social benefits. The regeneration logging concept states that logging does not disrupt, or as little as possible affects, the forest ecosystem and does not cause damage to the structure and function of the forest ecosystem. Logging design takes into account not just wood collection but also the preservation of the forest's natural biodiversity, species composition and collocation, forest facies and forest landscape, and t hose that are threatened. This is the primary distinction between this notion and typical logging methods. Forest cutting is an efficient strategy for artificially reducing stand density and improving light in the forest from the standpoint of tree cultivation. Only removing a portion of the trees and enhancing light can encourage the development of maintained trees and enhance stand quality in a stand with excessive canopy density [9, 10].

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