Forest Carbon Sequestration Based on Time Series Analysis and Fuzzy Linear Programming Model

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Abstract: Forest ecosystems, as the largest carbon sink in terrestrial ecosystems, play an important role in global carbon cycling, climate regulation, and mitigating global warming. To alleviate the problem of the greenhouse effect, the relevant data are collected, then several models are established. Model I: remote sensing carbon sequestration model based on time series. Model II: fuzzy linear programming model based on simulated annealing algorithm. These models are brought into the Amazon forest for universality analysis, and it is estimated that the Amazon forest and forest products will store 17.5-69.3 billion tons of CO_2 within 100 years. As the optimal decision model to design the forest management plan, the models can be bought to different countries, times, and space.

Keywords: Carbon Sequestration; Principal Component Analysis; Time Series Analysis; Simulated Annealing Algorithm; Fuzzy Linear Programming Model

1. Introduction

With the rapid development of modern industry, its negative impact is also increasing day by day. The massive emission of CO_2 and other greenhouse gases has led to environmental problems that gradually surfaced. The harm caused by the greenhouse effect has seriously threatened our ecosystem, to alleviate this harm, we must not only limit the source but also block it through some ecological means[1]. Carbon sequestration has become one of the important ecological means at present. Using plants (especially large plants), soil, water resources can absorb CO_2 in the atmosphere and realize the idea of green and sustainable development[2]. The carbon cycle is showed in Figure1. Among them, forests play an important role in alleviating the greenhouse effect. Carbon sequestration in forests is not only reflected in living plants, but also plant products, such as wooden furniture, paper, etc. However, the carbon sequestration of forests cannot be separated from society. We must maximize the social and ecological values of forests, to provide global forest managers with a management guide worthy of reference.

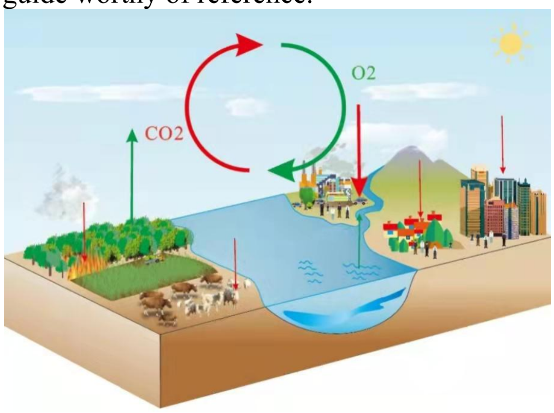

Figure 1. The Carbon Cycle

For the problem of forest carbon sequestration and forest management, after consulting a large number of literature, according to the current research situation at home and abroad, we determine our algorithm and model through reference.

Carbon sequestration: At home and abroad, three kinds of methods are often used to evaluate the carbon sequestration and carbon storage of regional or global forest ecosystems, including sample plot inventory method, model simulation method, and remote sensing estimation method. Here we use the remote sensing estimation method.

Forest management: In essence, it is an optimization model, because the uncertainty of forest data is large, and the difference is obvious, so we select the simulation degradation algorithm which is not sensitive to volatility, and the optimization model is combined with a fuzzy linear programming model. the forest management plan was designed.

We summarize the positive algorithms and models in and out of China, which are shown in the figure 2:

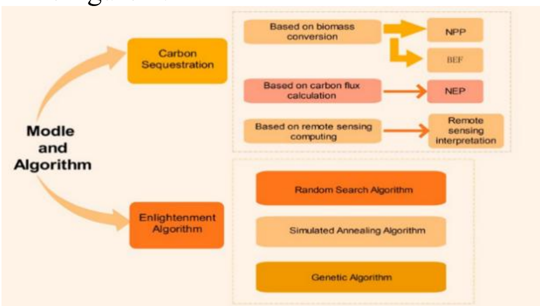

Figure 2. Literature Review

2. Model I : Carbon Sequestration Model

Global warming becomes more serious, CO_2 is the number one killer, in order to slow down the greenhouse gas harm to ecosystems and human health, it was found that plants will use photosynthesis to absorb CO_2 synthesis organic matter , for the mitigation of greenhouse gases that are cheap and efficient, so this kind of ecosystem carbon sequestration has become one of the important means of storage.

2.1 Find Important Indicators

In forest carbon sequestration, plants ,soil and water environment absorb CO_2 that work together, because in this question we need to establish a model for carbon sequestration in the problem to determine the forest and its products over time to the accumulation of CO_2, so we should to determine the important indicators about influence of carbon sequestration, as we solve the problem of the clear some unnecessary obstacles.

The forest ecosystem is the main part of the terrestrial carbon cycle, we will take China as an example, for example, in 2020 the forest area is 220.4462 million hectares in China, the forest coverage rate was 23%, and the plantation area of 79.5428 million hectares of the world's first one, plays an important role in the global carbon cycle. Analysis of the influence factors of forest carbon sequestration correctly, can not only for Chinese forest resource management and provide an important scientific basis for forestry sustainable development, and to the global carbon cycle and carbon sequestration research is of great significance.

We will analyze the influence factors of carbon sequestration from two large Angle, natural and man-made [3,4], subdivide the first and secondary indicators, using Figure 3 to describe.

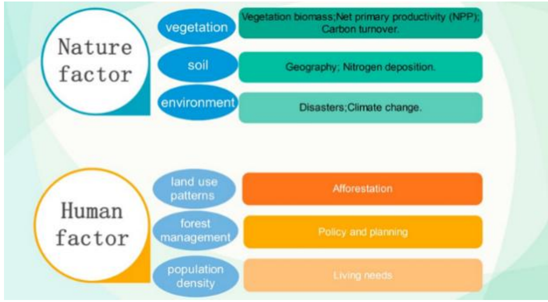

Figure 3. The First and Secondary Indicators about Carbon Sequestration

Before that, we list the influence index of the influence of carbon sequestration, but the impact index is too much, cause we can't very good mechanism analysis, so we will use principal component analysis (PCA), to analyze the important impact indicators.

According to the original data to write data matrix to standardize the original data processing[5], after calculating the variable coefficient matrix between the R:

$$R = \begin{pmatrix} r_{11} & \cdots & r_{1p} \\ \vdots & \ddots & \vdots \\ r_{p1} & \cdots & r_{pp} \end{pmatrix}, \tag{1}$$

where, R is the correlation coefficient matrix, that was the order and the original exchange coefficient matrix of the new matrix.

$$r_{ij} = \frac{\Sigma_{k=1}^{n}(x_{ki} - \overline{x_i})(x_{ij} - \overline{x_j})}{\sqrt{\Sigma_{k=1}^{n}(x_{ki} - \overline{x_i})^2 \Sigma_{k=1}^{n}(x_{ij} - \overline{x_j})^2}}, \tag{2}$$

where, r_{ij} are the correlation coefficients.

$$a_1 = \begin{pmatrix} a_{11} \\ a_{21} \\ \vdots \\ a_{p1} \end{pmatrix}, a_2 = \begin{pmatrix} a_{12} \\ a_{22} \\ \vdots \\ a_{p2} \end{pmatrix}, \cdots, a_p = \begin{pmatrix} a_{1p} \\ a_{2p} \\ \vdots \\ a_{pp} \end{pmatrix}, \tag{3}$$

where, $a_1, a_2, \cdots, a_p$ are the coefficient matrix feature vector.

Contribution rate:

$$\frac{\lambda_i}{\Sigma_{k=1}^{p}\lambda_k},(i=1,2,\cdots,p) \quad (4)$$

and total contribution rate:

$$\frac{\Sigma_{k=1}^{i}\lambda_k}{\Sigma_{k=1}^{p}\lambda_k},(i=1,2,\cdots,p) \quad (5)$$

where, $\lambda_1,\cdots,\lambda_p$ are the eigenvalues of the coefficient matrix.

Then write the main ingredients:

$$F_i = a_{1i}X_1 + a_{2i}X_2 + \cdots + a_{pi}X_p,(i=1,2,\cdots,p) \quad (6)$$

To calculate the contribution rates of the principal component, importance index can be calculated out, as Table 1 shows.

Table 1. The First Grade Indices Weight of Food System

First grade indices	Topography	Weather	Soil	Resources	Management
Weight	0.0998	01168	0.1056	0.1489	0.1354

Due to the limited space in Table 2, the general meaning of the indicators are given.

Table 2. The Second Grade Indices Weight of Food System

Second grade indices	Products	Water	Longitude	Population
Weight	0.0063	0.0049	0.0045	0.0034
Second grade indices	Latitude	Harvesting	Humidity	Light
Weight	0.0046	0.0146	0.0056	0.0058

2.2 Based on the Time Series of Remote Sensing Model for Carbon Sequestration

According to determine the important indicators, in section 2.1 we believe that the forest ecosystem absorbs carbon mainly from four aspects, plants, soil microbes, water resources, forest litter, from a biological perspective, the metabolism of forest carbon sequestration is divided into two opposing processes, namely, carbon sequestration and carbon, carbon absorption is plant photosynthesis, absorb CO_2 generated organic matter; Carbon discharge is respiration in plants and some leaves and rotting matter the decomposing process of CO_2, the net primary productivity (NPP) of a plant is referred to absorb carbon minus the discharge of carbon, which is an important process of the ecosystem carbon cycle and is also an important index of evaluation of carbon sequestration ability[6].

In northeast China, this paper studies the northeast China in 115033' to 135008' E, 38032' to 53045' N, located in the northeast of China, and is located in the east coast in northern Eurasia in mid-high latitude, is of the highest latitude in China, and also is the core region of northeast Asia[7]. The overview of forest and scenery in northeast are shown in Figure 4-5.

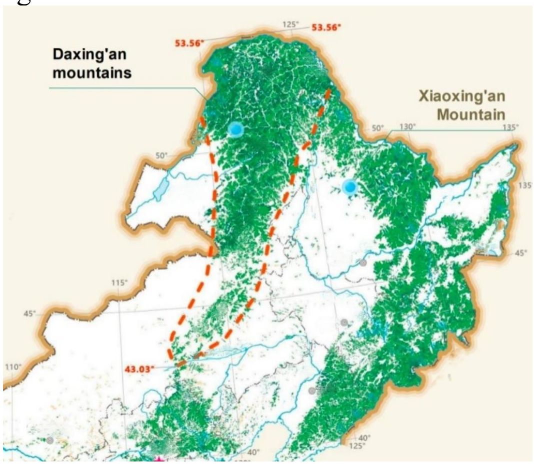

Figure 4. Overview of Forest in Northeast China

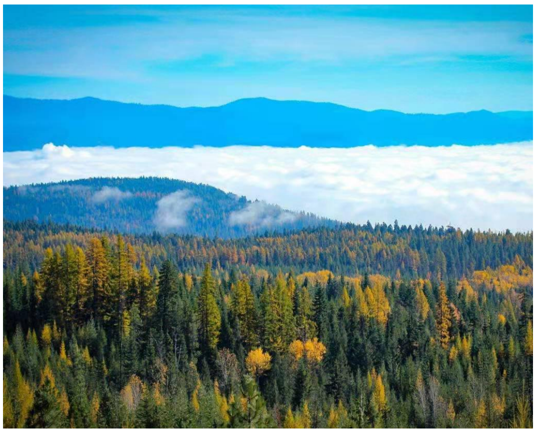

Figure 5. The Northeast Forest Scenery

Our important index by 2.1 the basic situation of the northeast area of forest, as Figure 6 shows.

Figure 6. The Basic Situation Forest

Because more factors that affect forest conditions, volatile, so we will use the light energy utilization model based on remote sensing data model (CASA), it can be well simulated spatial distribution changes of regional scale *NPP*, *NPP* monitoring and various space scales, its accuracy has been verified, so that we need't do verification again.

The determination of CASA model parameters

$$NPP = f_{APAR} \cdot PAR \cdot \varepsilon^* \cdot T_\varepsilon \cdot W_\varepsilon, \quad (7)$$

where plants absorb tube and effective radiation (APAR), ε^* is the largest light energy utilization, T_ε is the Temperature stress factor and W_ε is Water stress coefficient, *NPP* is that's function, It is expressed as the above equation, For photosynthetic active radiation (PAR) the proportion of absorbed by plants f_{APAR}, NDVI estimation by remote sensing data The largest light energy utilization (ε^*) the biggest effect on *NPP*, It will with the difference of forest vegetation types are different. Because our research scope is wide, the data correction, the correction of *NPP* interannual variation drives the carbon cycle model of the process.

$$\varepsilon_a^* = \varepsilon^* \times \frac{NPP_0}{NPP_m(\varepsilon^*)}. \quad (8)$$

We set up based on time series of remote sensing model for carbon sequestration, NDVI estimate the carbon sequestration through remote sensing data.

2.3 Analysis of Forest Carbon Sequestration Capacity and Amount of Carbon Sequestered

According to the characteristics of the northeast forest, we put the vegetation is mainly divided into four kinds to mechanism analysis, the evergreen coniferous forest, mixed needle leaf and deciduous broad-leaved forest, deciduous coniferous forest[8].

Evergreen coniferous forest *NPP* annual maximum basic was the highest in the whole study area of forest vegetation *NPP*, but evergreen coniferous forest in *NPP* range is the largest, and it changes has no rules, according to the statistics in recent years its minimum value is 0.58 × 104 KTC/a, a maximum of 1.83 × 104 KTC/a. Mixed needle in *NPP* minimum value higher than that of two kinds of coniferous forest, maximum *NPP* appeared in 2001. Deciduous broad-leaved forest change much over time, there is no regularity, because enough rain in 2016, the growth of *NPP*, but little growth, as Figure 7 shows.

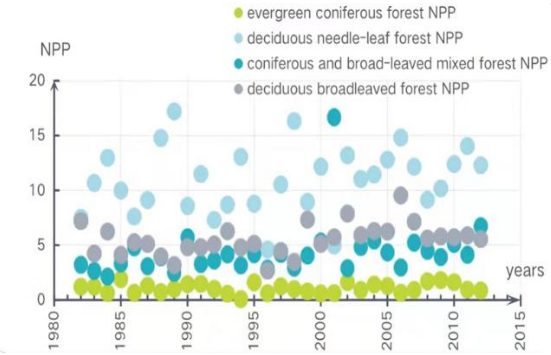

Figure 7. Comparison of Annual NPP for Different Forest Types

Spatially, the *NPP* value of the evergreen coniferous forest is lower than the normal value. In recent years, its *NPP* value has changed drastically, but the change in the southeast is not very obvious. It can be concluded that evergreen coniferous forest is more sensitive to the impact of human beings, the deciduous coniferous forest has obvious polarization with the geographical location, the human influence on the coniferous mixed forest changes less, and the deciduous broad-leaved forest has a higher *NPP* value in the northwest region than other regions.

Evergreen coniferous forest in changbai mountain area negative correlation with meteorological factors, The southern part of the Xiaoxingan Mountains is positively correlated with meteorological factors and the correlation is relatively strong, Deciduous broadleaf forests were negatively correlated with meteorological factors in most areas, and the correlation was relatively weak.

2.4 Interpretation of Result

Here we only consider the carbon sequestration value of forests, and in 2.1 we identify the important indicators affecting carbon sequestration. In terms of CO_2 sequestration per unit area, the multi-year sequestration is ranked from large to small as coniferous mixed forests > deciduous broad leaf forests > evergreen coniferous forests > deciduous coniferous forests, and in terms of total annual carbon sequestration, it is ranked from large to small as deciduous coniferous forests > deciduous broad leaf forests > coniferous mixed forests > evergreen coniferous forests. For Northeast China, more mixed coniferous and deciduous coniferous trees are planted in the forests to enhance carbon sequestration.

3. Mode lI: Decision Model

The forest community is rich in resources. Photosynthesis absorbing CO_2 and alleviating the Greenhouse Effect is only a small part of the forest value. In our daily life, the paper and part of the furniture used belong to forest products. Most parts of the world develop forests into scenic spots, which not only promote economic development but also let us feel the miraculous craftsmanship of nature. The evolution process of the forest is relatively long, so each forest contains different stories and enriches the world culture, to better protect the forest, we will analyze and design the forest management plan.

3.1 Best Use of Forests

There are a variety of forest values. We use the value evaluation method to transform the service function of the forest ecosystem into the form of currency for analysis and use the direct market method to evaluate the value.

Forests slow down the Greenhouse Effect through carbon sequestration, each 1cm of forest growth absorbs 850kg CO_2 and releases a lot of O_2, which can maintain the dynamic balance of CO_2 and O_2. At the same time, forest ecosystem carbon storage is up to half of the global carbon, which plays an important role in purifying air quality, and is cordially become the lungs of the earth by people all over the world. At the same time, the forest provides animals with a living environment and sufficient food and protects biodiversity. Under the influence of environmental changes and some unexpected conditions and other factors in forest evolution, genes will mutate to produce new organisms, which not only protect but also promote biodiversity.

The forest has fresh air and beautiful scenery. Some parts of the world have developed forests into scenic spots, which let people experience the beauty of nature up close, and at the same time bring considerable income to the local economy. According to statistics, the income of the Daxing'an Mountains forest in northeast China is as high as 5.4 billion through tourism. At the same time, the forest is also a kind of renewable resource, which can provide us with wooden raw materials for the things we need.

Because we need to analyze the value of the life of forest products. It requires us to collect a life range of common forest products. The longer the life span, the higher people's sense of experience and promote people to buy forest products, and then enhance the economic value of forest products. At the same time, the longer the life of forest products, the more CO_2 absorption. We have counted the life data of forest products of several tree species with the largest proportion of forests in the world in recent years, and after the data are pre-processed by interpolation, we fit the data, such as Figure 8, we can clearly see that the life of forest products is on the rise.

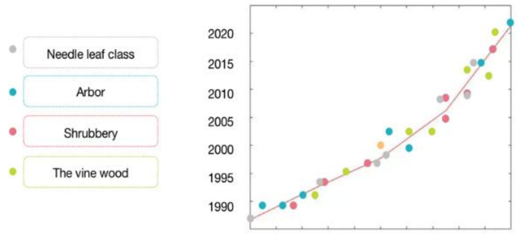

Figure 8. Changes in the Life Span of Forest Products

The reason for the rise of the curve is that with the development of industrialization, people realize that the life of forest products is defective, not durable, and can no longer meet people's needs, so people use chemical and physical methods to extend the life of forest products. For example, the use of chemical agents sealing layer can prevent the entry of water, to slow down the decomposition of forest products. This treatment not only meets the needs of people, but also makes some forest products live longer than the living plants in the original forest, thus increasing the amount of carbon sequestration.

According to statistics, the global carbon sequestration ofwood products increases by 140Mt every year, which is equivalent to absorbing 2% of the CO_2 released by the burning of all fossil fuels in the world, which plays an important role in biological carbon sequestration. The carbon sequestration in some wood products will combine with the carbon of living trees in young forests, thus improving carbon storage capacity, so proper deforestation and production of forest products will promote carbon sequestration.

3.2 Construction of Decision Model

In order to improve the utilization rate of resources and promote the sustainable development of forests, we will carry out rational development of forests based on forest protection. Here we will combine various factors to determine a forest management plan. We will determine the plan in terms of tree age, tree type, geography, topography, benefit, and life of forest products, economic level of regional countries, people's values, and climate factors.

There are two sides to everything. Carbon sequestration in forests plays an important role in mitigating the Greenhouse Effect, but the situation to meet the environment is not necessarily suitable for society. With the development of society, forest products have been appearing in our daily life in various forms, and now human daily life is inseparable from forest products. Since neither of them can be abandoned, this problem can not be avoided after all. therefore, we should consider how to alleviate this problem to achieve a dynamic balance to maximize forest value, both to meet the environment and society.

We need to find a balance between the value of forest products from logging and the carbon sequestration value of forests as living trees and sustainable growth, that is, a balance between forest sustainability and economy. As forests are indispensable, we will consider whether there are conditions in forests that can avoid logging and whether society can lack forest products. Here we use 0-1 programming for analysis:

$$T_{i1} = \begin{cases} 1, \text{Do not cut down the forest} \\ 0, \text{Cut down the forest} \end{cases}, \quad (10)$$

$$T_{i2} = \begin{cases} 1, \text{Human beings do not need the forest} \\ 0, \text{Human beings need the forest} \end{cases}, \quad (11)$$

The linear programming model of cutting is as follows:

$$\begin{cases} A_1 + A_2 \le A_1 \\ \eta T_{i10} > \eta T_{i11} \\ \varphi T_{i10} > \varphi T_{i11} \\ T_{i2} = 1 \end{cases}, \quad (12)$$

A_1 represents the amount of forest carbon storage, A_2 represents the amount of carbon storage of forest products, η represents the coefficient of economic benefits, φ represents the coefficient of sustainable value. Because there is no solution in the above formula, forest cutting is inevitable, and forest cutting will bring positive effects.

Since deforestation is inevitable, we will analyze the circumstances under which dynamic balance can occur from the perspectives of tree age, type, geography, topography, benefit, and life span of forest products, and analyze and answer several questions.

Plants have photosynthesis and respiration due to their metabolism, and photosynthesis requires photo catalysis only in the daytime, the process of which is to absorb CO_2 from the air to synthesize organic compounds. Respiration is carried out all the time, and its process is to absorb O_2 and release CO_2. The absorption and discharge of carbon elements become an opposite process. Because of the need to purify the air, the intensity of photosynthesis is greater than respiration in the carbon cycle of forest trees. Only in this way can the recovery of CO_2 in the air be realized. The difference between photosynthesis and respiration CO_2 is the plant net primary productivity (NPP) mentioned in our model I, so we initially consider it. When the net primary productivity (NPP) of forest vegetation is bigger than 0, the plants are preserved, and when the net primary productivity (NPP) of forest vegetation is less than 0, the plants are cut down. Of course, only considering the amount of carbon sequestration is one-sided, we will further analyze the age and type of forest vegetation to determine which kind of trees should be felled, and we will define trees that are worth more than living plants as trees that should be felled. The true selection of logging is of great significance to the sustainable development of forests.

Due to the great differences in the types of vegetation grown in each forest, we will select a forest for analysis and analyze the mechanism of the global forest according to the analysis results. We use the Tabu search algorithm to optimize cutting.

As the types of vegetation grown in each forest are very different, the regional values are different, and the demand for forest products is also very different, so we will select a forest to analyze according to the collected data and experience, and analyze the mechanism of the global forest according to the analysis results.

Here we select the forest of Changbai Mountain in Northeast China to analyze the main vegetation. A Broad-leaved forest is a forest composed of broad-leaved trees, which is mainly distributed in tropical and subtropical broad-leaved forests. It is an economic forest. In addition to producing wood, it can also produce woody grain and oil, dried and fresh fruits, and so on. In addition, the leaves of its Fagaceae vegetation can also feed silkworms.

Coniferous forest is a general term for all kinds of forests composed of coniferous species. It is cold and drought tolerant, but it likes humidity and temperature, and its growth life is relatively long, among which spruce and larch generally have a life span of 200-400 years. Giant sequoia can even live for more than 4000 years, which is generally distributed in mountainous areas and plays an important role in dealing with bad weather. Because this kind of vegetation has a long life span, the main branches are thinner and have more thin branches. So its forest value is greater than the value of forest products.

The Broad-leaved forest and coniferous forest are shown in Figure 9 and Figure 10. Among them, young trees, middle-aged trees, near-aged trees and mature trees are collectively referred to as immature trees, and overmature trees are called mature trees.

According to Table 3-4, we can see that the young trees have a strong carbon storage capacity, while the old trees only serve as a carbon pool, and their ability to absorb CO_2 decreases. According to statistics, the general carbon sequestration cycle is 20-60 years, that is to say, the carbon sequestration capacity of trees decreases significantly after 60 years old, but old trees can develop their commercial value after being cut down, and new trees can be planted after felling, which will increase the growth rate of trees.

Figure 9. Broad-leaved Forest

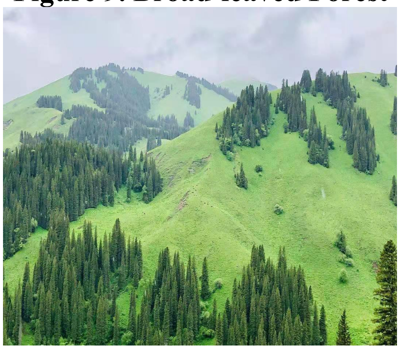

Figure 10. Coniferous Forest

Table 3. The Range of Age in Different Age-Classes

Forest Type	Young forest	Mid-age forest	Near-mature forest	Mature forest	Over-mature forest
Broad-leaved softwood	<20	20-35	36-50	51-65	>65
Broad-leaved hardwood	<40	40-55	56-80	81-110	>110
Pinus massonian	<10	10-20	21-35	36-60	>60
Cunninghamia	<10	10-20	21-25	26-40	>40

Table 4. Stand Volume Per Unit Area of Various Age-classes

	Young forest	Mid-age forest	Near-mature forest	Over-mature forest
1990	12.66	52.01	72.23	82.96
1996	7.99	44.55	64.66	69.15
2005	19.63	38.61	66.66	89.59
2011	25.20	64.31	82.33	94.55

Forest cultivation plays an important role in forest resources and ecological protection. Only by strengthening forest cultivation can we make forest sustainable development, cultivate seedlings scientifically, establish forest protection areas, and young trees have high efficiency in carbon storage. Therefore, young trees should be cultivated, mature forest areas should be protected, and new seedlings should be cultivated after rapid treatment of felled soil. Lest the gap affects the growth of other vegetation.

First of all, we should strengthen the legal publicity of forest protection, refuse deforestation, and make clear the importance of sustainable forest development. secondly, forest protection must be carried out, such as fire prevention, pest prevention, and other natural disasters. Strictly control the forest area can only be more, not less, restrict the use of wood, we can develop other renewable resources to alleviate the pressure of forest, and return farmland to forest. Plant vegetation on abandoned mountain forests and land.

Because it is restricted by the local economy, policies, and land resources, the area of forest can not be expanded indefinitely, so for forest managers, we should pay attention to the improvement of forest quality.

3.3 Design a Forest Management Plan

Forest management is an important means to realize the sustainable utilization of forest resources. we regard the design of a forest management plan as an optimization problem and establish an optimization model, but because the forest ecosystem is complex and the regularity of change is not obvious. with a strong sensitivity to some influencing factors and in the process of continuous change, the conventional model is difficult to solve the results with high accuracy. So we will use a heuristic algorithm to improve the model, based on the forest data jump is relatively large, combined with the advantages and disadvantages of various heuristic algorithms, we finally choose the heuristic algorithm as a simulated annealing algorithm. A simulated annealing algorithm[9] does not have high requirements for data and can avoid the errors caused by some irregular beating dynamic data. The selected model is a fuzzy linear programming model. In synthesis, we will establish a fuzzy linear programming model based on a simulated annealing algorithm[10-12] to make a forest management plan. Figure 11 shows the algorithm flow.

```
Algorithm 1:Simulated annealing algorithm
Let s = s_0
Input: J(x), neighbour (), Y(x1, x2)
For k = 0 through kmax (exclusive)
  T ← temperature (1 − (k + 1)/ kmax )
  Pick a randomneighbour, snew ← neighbour (s)
  if Y(J(s), J( snew ), T) ≥ random (0, 1)
    s ← snew
  end if
End for
Output: the final states
```

Figure 11. Simulated Annealing Algorithm

The general form of fuzzy linear programming is as follows:

$$\max q = c_1 x_1 + \cdots + c_n x_n$$

$$\begin{cases} a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n \le b_1 \\ a_{21}x_1 + a_{22}x_2 + \cdots + a_{2n}x_n \le b_2 \\ \cdots \\ a_{m1}x_1 + a_{m2}x_2 + \cdots + a_{mn}x_n \le b_m \\ x_j \ge 0, j = 1, 2, \cdots, n \end{cases} . \quad (13)$$

Let q_0, q_1 be the optimal value of general linear programming, where $d = (d_1, d_2, \cdots, d_m)^T$ is the expansion of linear programming. q_0, q_1 correspond to two extremes, neither of which is what we want. For this purpose, a fuzzy target set is constructed.

The optimal solution is:

$$z^* = \sum_{j=1} c_j x_j^* . \quad (14)$$

Because the country is located and the degree of development of the country is different, forest products come from willing wood, so the quantity of forest products is positively related to forest savings. We divide the country into wood importing countries. And timber exporting countries: Russia, the United States, Malaysia, Australia, Chile, New Zealand, Germany, and other timber importing countries: China, Japan, South Korea, Sweden, Finland, Italy, Canada, Austria, and so on.

We do not consider the impact of differences in national deforestation policies here, it is considered that the import of wood is a choice made at the balance point of forest carbon storage in our country.

The forest management methods of timber importing countries are as follows[13]: expanding forest area, strengthening the protection of original forests, implementing fire prevention and pest prevention, establishing forest protected areas, strictly forbidding deforestation, and paying attention to the cultivation of seedlings. We mentioned the problem of deforestation, which can be used as a reference to formulate a national forest management plan according to the country's forest characteristics.

To improve the global utilization of resources and promote the sustainable development of forests[14], we will establish a national pairing of friendly supply of forest products, and use the Dijkstra algorithm to calculate the shortest path. As there is competition for resources between countries, we will use game theory for predictive analysis.

We divide the space into elevation and latitude to establish the forest management plan. For altitude, the higher the altitude, the more difficult the cutting, and the higher the cost, so to balance sustainability and economy, we restrict the cutting of high-altitude vegetation, lowaltitude vegetation we will only allow mature trees, for high-altitude forests, we can consider the establishment of nature reserves and development scenic spots. This will bring considerable income. For latitude, the difference of forest vegetation species affected by temperature needs to be paid attention to. According to the above picture, rational distribution of tree types, protection of young forest trees, the establishment of forest nature reserves, and attention to forest protection. We mentioned the problem of deforestation, which can be used as a reference to formulate spatial forest management plans according to local conditions combined with the characteristics of different spatial forests.

Reasonable time order can provide an important basis for forest management decisionmaking. Before this, we divided the vegetation in the forest into two categories: immature trees and mature trees according to their age. for immature forests, scientific protection is very necessary to establish forest reserves and restrict the cutting of immature trees. For mature trees, we can cut down reasonably, and the problem of gap after felling is worthy of our attention. Because plants carry out photosynthesis under the catalysis of enzymes, general plants normally carry out photosynthesis at 10-35 degrees, the optimum temperature is 25-30, and 40-45 basically stops, so summer cutting has little effect on carbon sequestration. We mentioned the problem of deforestation, which can be used as a reference to formulate a time-related forest management plan according to the characteristics of time and forest according to local conditions.

4. Application of Model

In this work, we establish a fuzzy linear programming model based on a simulated annealing algorithm to determine the forest management plan, because we all take the forest of a certain place in China as an example, to enhance the analysis of contrast and relevance, we will bring our model to the Amazon forest of South America for universality analysis.

The Amazon forest is known as the "green heart", and its importance in the earth's ecosystem can be imagined. Covering an area of 7 million square kilometers, the Amazon forest is located in the tropical rainforest of the Amazon basin in South America, spanning eight countries. The Amazon forest accounts for half of the world's rainforest and 20% of the world's forests, which are rich in animals and plants.

In section 2, Model I is established for calculating the CO_2 sequestration of forests and their products:

$$100\times 0.25\times 7=175(10^{8}\,tons), \tag{15}$$

$$100\times 0.99\times 7=693(10^{8}\,tons), \tag{16}$$

So the sequestration of CO_2 in the Amazon forest within 100 years is 175-69.3 billion hectare tons.

The Amazon forest suffers from serious deforestation. According to statistics, 2/3 of the CO_2 emitted by Brazil each year comes from the deforestation and burning of the Amazon forest. The Amazon forest is degraded at an alarming rate. In the decade from 1990 to 2000, the Amazon forest has been destroyed two areas of Portugal, so to stop the Amazon forest from being deforested, we have made the following plan:

(l) Establish relevant policies for the protection of Amazon forests and establish nature reserves;

(2)Use laws to prohibit indiscriminate felling;

(3)To protect the environment, according to meteorological forecasts, Amazon forests are being degraded due to climate problems[15].

(4)The drought in the Amazon has pushed forests into desertification, planting crops that do not require high water requirements and strengthening the protection of immature trees.

(5)Trees with luxuriant branches and leaves should be preserved. Big trees will form huge gaps after being cut down, which is difficult to restore.

The Amazon forest spans eight countries and has made inestimable contributions to global climate regulation and carbon sequestration, so protecting the Amazon forest is what human beings all over the world should do. Protect the environment, green travel, reduce CO_2 emissions, lighten the burden on forests, strengthen the protection of Amazon forests, and severely punish lawbreakers who destroy forests, not only Amazon forests, we should have a sense of protection and protection measures for every forest in the world, to balance sustainability and economy, to make our global village more and more beautiful.

In this Model, we only analyze the absorption of CO_2, the main component of greenhouse gases, and slightly improve the model, which can also study the absorption and treatment of other components in greenhouse gases.

5. Conclusion

Forests have various values, among which carbon sequestration and forest products are the most prominent. In order to meet the sustainable development and economic benefits of forests, and improve resource utilization, a CASA model is established combined with important indicators to estimate the net vegetation productivity, and a time series model is established to remote sensing carbon sequestration based on biomass conversion. Based on the simulated annealing algorithm, a fuzzy linear programming model is established. As the optimal decision model to design the forest management plan, the models can be bought to different countries, times, and space.

In this article, the relationship between age and whether logging should be carried out was only elaborated. In actual investigations, through analysis of tree species, forest composition, climate, population, interests, values, etc., it can also be concluded that appropriate logging is beneficial for forests. So appropriate logging is beneficial for improving resource utilization and promoting sustainable development of forests.

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