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Analysis of Forest Carbon Sequestration Management Plan Based on Neural Network Algorithm

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Abstract: In order to predict the future forest carbon sequestration content, local forest managers can make better transition decisions for appropriate forest management plans, so that the trend of forest carbon sequestration content can be stabilized and ecological balance can be better made. In this paper, a linear regression analysis using matlab software was used to estimate the carbon stocks of the United States, Brazil, Indonesia, and the Democratic Republic of Congo for the past 30 years, and then a RBF neural network model was used to predict the forest carbon stocks of the four countries 100 years in the future. This paper applies the model to these four countries to obtain forest management plans suitable for forest development in these four countries, completing the transition between the old and new forest management plans within ten years, and the future forest carbon stocks will remain balanced and stable after the implementation of the plans.

1. Introduction

The global warming problem has led to a series of ecological, economic, and social problems that are becoming increasingly serious and have triggered great attention from the international community. This paper uses RBF neural network algorithm to predict the future trend of carbon sequestration content of local forests, and the results from this model are combined with local conditions to design an intervention about forest management plan to accomplish a better transition. To achieve the improvement of local economic benefits and the implementation of ecological construction.

2. Carbon Sequestration Content Prediction Model

2.1. RBF neural Network Algorithm

The RBF God will network is a three-layer neural network [1, 2], including an input layer, a hidden layer, and an output layer.

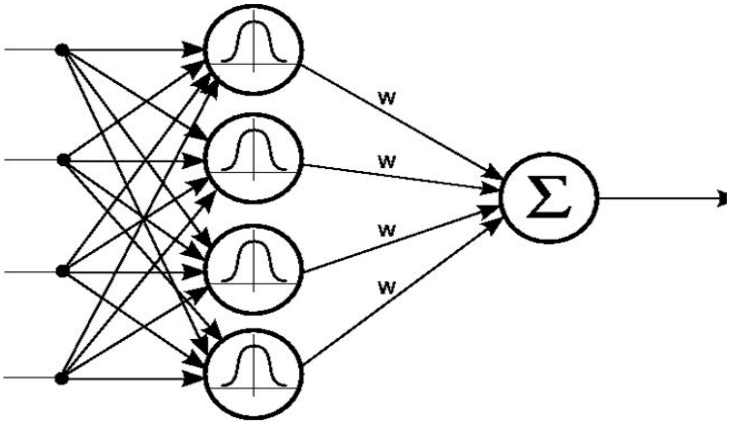

Figure 1: Neural network algorithm three-layer transformation process

The hidden layer space is formed with the "base" of the hidden units of the RBF, so that the input vector can be directly (not connected by weights) mapped to the hidden space. When the center point of the RBF is determined, the mapping relationship is also determined. The mapping from the hidden layer space to the output space is linear (note that this place distinguishes the relationship between linear mapping and nonlinear mapping), that is, the network output is the linear weighted sum of the output of the hidden unit, and the weight here is the network adjustable parameter.The node activation function of radial basis neural network adopts radial basis function, which defines the monotonic function of Euclidean distance from any point in space to a certain center point.

The activation function of the radial basis neural network can be expressed as:

$$R(x_p - c_i) = exp(-\frac{1}{2\sigma^2}\|x_p - c_i\|^2) \tag{1}$$

where xp is the pth input sample, ci is the i-th centroid, h is the number of nodes in the hidden layer, and n is the number of samples or classifications in the output. The structure of the radial basis neural network yields the output of the network as:

$$y_j = \sum_{i=1}^{h} w_{ij} exp(-\frac{1}{2\sigma^2}\|x_p - c_i\|^2)\ j = 1, 2, \cdots, n \tag{2}$$

Of course, using the least squares loss function representation:

$$\sigma = \frac{1}{P}\sum_{j}^{m}\|d_j - y_j c_i\|^2 \tag{3}$$

For the application of Jinhong Zhang's using RBF neural networks [3], the RBF network is able to approximate arbitrary nonlinear functions because the algorithm uses a local activation function. There is a maximum response near the centroid, the closer the centroid is the maximum response, and away from the response becomes exponentially decreasing, which is equivalent to each neuron corresponding to a different perceptual domain. Therefore, the RBF neural network algorithm can handle the regularities within the system that are difficult to resolve, has good generalization ability, and has a fast learning speed. In this paper, a neural network algorithm is used to predict the future forest predicted carbon sequestration content.

2.2. Future Trends in Forest Carbon Sequestration Content

Combining data from the Food and Agriculture Organization of the United Nations [4], based on the carbon sequestration content of national forests for each year from 1985 to the present as the test set and input layer of the model, we go through an error-correction learning process by following the sample set to obtain the network centers and other weight parameters that satisfy the supervision requirements, and to test the applicability of the prediction model, we choose the RBF neural network algorithm to assist us in calculating the prediction from different forests in four countries to obtain the predicted carbon stock of the forest after 100 years:

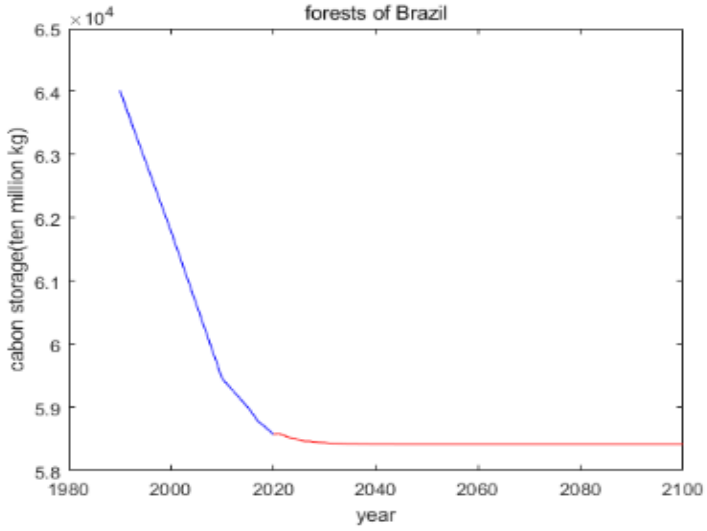

Figure 2: Brazil carbon storage projection curve

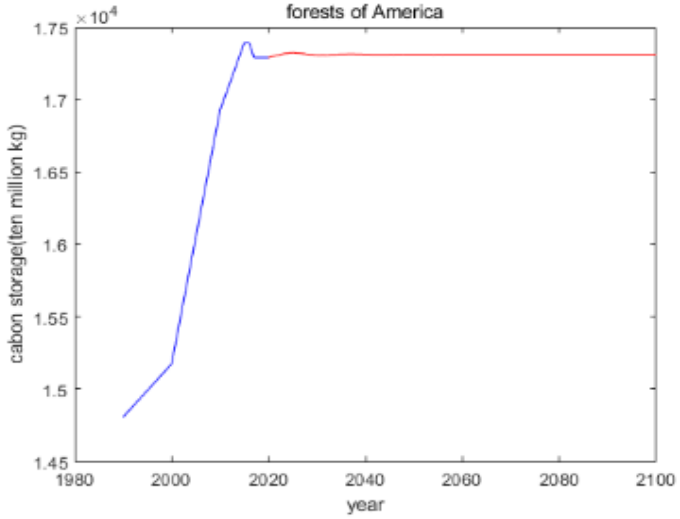

Figure 3: America carbon storage projection curve

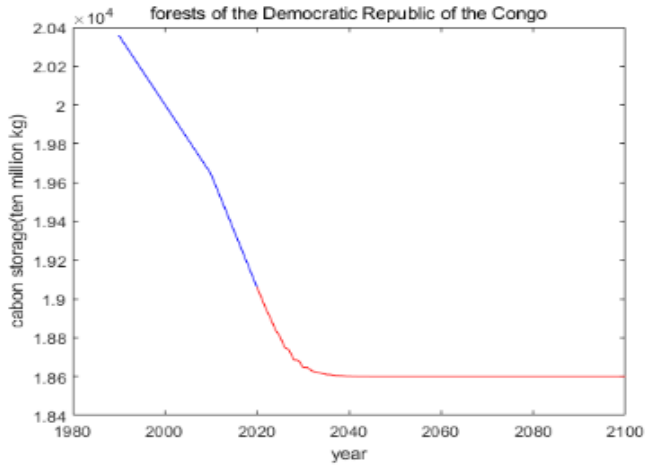

Figure 4: the Democratic Republic of the Congo projection curve

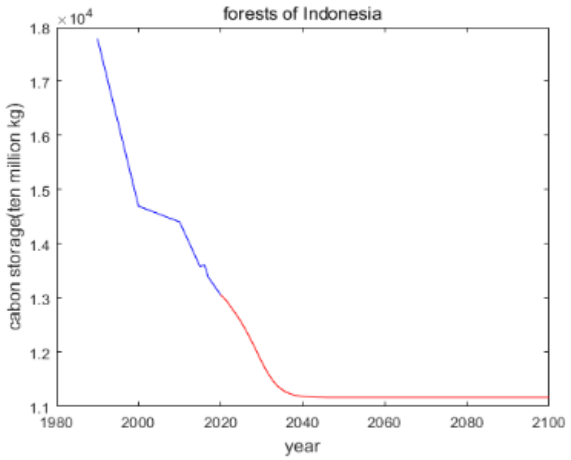

Figure 5: Indonesia carbon storage carbon storage projection curve

3. National Forest Management Plan Analysis

3.1. Brazil Forest Management Plan

According to Yupeng Fu [5], it can be known that, as in the United States, forest management in Brazil involves three different agencies at the governmental level, where the weekly environmental departments are responsible for setting policies and forestry standards, while the state environmental agencies are responsible for the conservation licensing of forest activities, regarding timber import operators are strictly regulated, and the management rules of primary forests are more stringent than those of planted forests.

Combined with Brazilian laws, our forest management plan should be limited to plantation forests only. According to their local culture and folklore, it is more difficult to intervene manually in their primary forests, so our management focus is on the global planning of plantation forests, whose processes will be severely restricted as well as cumbersome tax activities due to the need to obtain legal harvesting rights in Brazil. That is, the woody forest products economy is more difficult to develop.

3.2. America Forest Management Plan

After inquiring about the U.S. forest management plan, we found that the U.S. ecosystem management policy belongs to cross-sectoral cooperation [6], and there is a need for integration between various sectors, so the forest management plan needs to be constantly tried and updated, and the starting point is human, and more human factors need to be considered, so the focus should be on the balance of human-land relationship. Combined with the Northwest Forestry Plan of the United States [7]: the plan forest land is divided into seven types, such as original conservation forest area, adaptive economic area, etc., and emphasizes the watershed as a unit to protect and manage the original forest. Combined with the Northwest Forestry Plan in the United States, our forest management plans need to be implemented separately, for example, in timber harvesting areas the age of the trees is used as a reference for harvesting efforts, while in adaptive management areas, the focus of the plan is biased towards people's interests primarily, focusing on implementing economic efficiency measures such as developing the woody forest products economy.

3.3. The Democratic Republic of the Congo Forest Management Plan

Only in 2002 was the forest law enacted in Congo, however, forest protection plans of national interest are still developed by national government departments. Forest concessionaires sometimes clash with local populations because local populations with traditional authority are not aware of the regulations related to the forest law. Nowadays, through Ming Xiangrong's information [9], it can be known that the situation is now alleviated and calls for the conservation and utilization of forests in DRC. Meanwhile, the DRC has lost the second largest area of deforestation in recent years, and the world has called on various countries to start reforming their deforestation plans and the protection of forest resources, so there has been a revision of deforestation contracts in Congo [8].

In the context of the Congo and its long history of colonization, the implementation of forest management plans is difficult and requires a lot of human resources to maintain the policy. Forest managers need to popularize forest-related knowledge at this stage to make local people aware of scientific forest management, and then gradually implement forest management plans.

3.4. Indonesia Forest Management Plan

From 2000 to 2015, the forest area and forest cover decreased by 8.399 million hectares and 4.4%, respectively [9], through the appeal of Yi [10], so the development of forest management plans is urgent, and corresponding measures such as sound forest management mechanisms, expansion of community participation, rational use of forest resources, and establishment of forest certification and timber legality systems are in the initial stage of implementation.

In the light of local laws and forestry conditions in Indonesia, forest protection and forest area expansion are the main thrust of forest management plans, and there are not enough prospects for economic development of woody forest products, and more initiatives should be directed towards protecting the ecological environment.

4. Conclusion

In this paper, we start from the RBF neural network algorithm, and use the previous forest carbon sequestration content as the training set to predict the future forest carbon sequestration content trend of four countries. In the computation, RBF has good classification ability, fast

convergence during learning, parallel information processing, strong robustness, memory, nonlinear mapping ability, and strong self-learning ability, which will make it easier to predict future trends, but the RBF neural network does not have the ability to explain its own inference process and inference basis, and needs to collect a large number of data sets to participate in the training, otherwise the neural network Therefore, this paper is slightly lacking in the amount of data. By predicting the trend of forest carbon sequestration content and combining the local forest management plan situation and legal requirements, this paper suggests suitable modifications and suggestions for local forest managers to make a better transition to the best forest management plan, so as to create suitable economic and ecological benefits for the whole forest, the whole region and the whole world with good ecological construction.

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