ISSN: 2664-9640

Computer Land Quality Evaluation Model After Returning Farmland to Forest and Grassland by Big Data Analysis

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Abstract

It is pointed out that the project of returning farmland to forest and grassland has been implemented in China for more than 10 years, soil erosion has been curbed, the effect of wind prevention and sand fixation has been remarkable, and the ecological environment has been restored, and remarkable results have been achieved. At present, the evaluation of the project of returning farmland to forest and grassland basically tends to unilateral qualitative evaluation, and the specific and quantitative methods and indicators for evaluating the ecological benefits of the project have not been formed. This paper evaluates the soil quality indexes such as soil physical and chemical properties and soil microbial status, so as to reasonably reflect the restoration status of aboveground vegetation, so as to provide reference for reasonably evaluating the land quality after the project of returning farmland to forest and grassland.

Keywords

Loess Hilly Region, returning farmland to forests and grasslands, evaluation of land quality.

1. Introduction

The Loess Hilly Region, with fragmented terrain, is the most serious area of soil and water loss in China and even the world[1]. As a key measure to control soil erosion, vegetation plays an important role in controlling soil erosion in this area. China put forward the policy of returning farmland to forest and grassland in 1999. After more than ten years of vigorous implementation of the project of returning farmland to forest and grassland, the vegetation in the Loess Plateau has been effectively restored, the vegetation coverage has been greatly improved, and the ecological environment has been significantly improved. In the process of returning farmland to forest and grassland in the Loess Plateau, Robinia pseudoacacia is regarded as a pioneer tree species for vegetation restoration and reconstruction[2]. It is planted in large areas in all regions. Even in some areas, the afforestation proportion of Robinia pseudoacacia is as high as more than 85% of the total afforestation area, which plays an important role in maintaining water and soil and improving the environment. After more than ten years of returning farmland to forest and grassland project, in order to consolidate the achievements of ecological civilization construction, scholars need to reasonably evaluate the effect of returning farmland to forest and grassland project and feed back the soil quality status in time. The most important

thing is to formulate a series of standard evaluation methods to evaluate the soil quality status and ecological feedback effect of aerial planting Robinia pseudoacacia at that time.

2. Evaluating indicator

Soil is the most important carrier for vegetation growth, and the restoration of soil quality is an important content of ecological reconstruction. Soil quality affects and even determines the ecological benefits of vegetation restoration and reconstruction of the project of returning farmland to forest and grassland to a great extent. The soil quality evaluation index system includes soil physical attribute index, soil chemical attribute index and soil biological attribute index[3], which jointly affect the ecological benefits of the project and provide a direction for the rational evaluation of the soil quality of the project.

2.1. Soil physical and chemical property index

Soil physicochemical properties are one of the main environmental factors affecting vegetation growth. In the soil vegetation system, there is mutual feedback effect between soil and vegetation. The process of vegetation restoration is to increase the input of underground organic matter by increasing the decay of surface litter, and finally affect the soil physicochemical properties[4]. On the contrary, the change of soil physicochemical properties will also affect the restoration of aboveground vegetation through root absorption and utilization. Especially in the Loess Plateau, due to the particularity of soil physical and chemical properties, soil physical and chemical properties have become the main limiting factor for vegetation restoration of the project of returning farmland to forest and grassland[5]

Soil physical properties can indirectly reflect the process and effect of aboveground vegetation restoration. The reduction of soil bulk density and the enhancement of aggregate stability can improve soil water holding capacity and infiltration performance[6], and promote the restoration of soil physical properties and aboveground vegetation. As an indicator of soil quality and health, soil bulk density can indirectly reflect the restoration of aboveground vegetation[7]. Soil aggregate is the basic unit of soil structure, which can affect the movement and transportation of nutrients, water and air required for plant growth. Its stability and corrosion resistance are closely related to the status of vegetation.

As an important factor directly affecting plant growth, soil chemical properties can directly reflect the state and process of vegetation restoration to a great extent. The change of soil chemical properties is reflected in the change of soil C, N, P and other elements. Soil C, N, P and other elements can be directly absorbed by plant roots and affect vegetation restoration and growth. Soil organic matter is an important index to measure soil fertility. Soil nitrogen is one of the necessary nutrient elements for plant growth. The content of soil total phosphorus plays an important role in the distribution of vegetation species[8]. The change of the content of these elements plays an important role in vegetation growth and can reflect the restoration of aboveground vegetation. Wen Zhongming et al.[9] found that with the development of vegetation succession process, the content of soil total phosphorus showed a gradually increasing trend. Zhou Houcheng et al.[10] found that with the increase of returning farmland years, the amount of vegetation litter showed an increasing trend, and the contents of soil nitrogen and soil phosphorus showed an increasing trend in varying degrees, which further promoted the development of vegetation restoration. Similarly, a large number of studies show that in the process of vegetation restoration, the content of soil nutrients and organic matter show a gradual increase trend, and the improvement of soil nutrient status will further promote the process of vegetation restoration[11]. The above studies show that the restoration of aboveground vegetation will affect the changes of underground soil physical and chemical properties. The changes of underground physical and chemical properties can not only reflect the change law of soil quality, but also indirectly reflect the restoration of aboveground

vegetation, which provides a strong support for the rational evaluation of the benefits of the project of returning farmland to forest and grassland.

2.2. Soil microbial index

As an important part of soil ecosystem and an important indicator of soil quality evaluation, soil microorganisms can not only decompose mineralized organic matter, animal and plant residues, but also promote the formation of humus and aggregates, and play an important role in maintaining the balance of soil ecosystem[12], The monitoring of soil microorganisms can feed back the effect of vegetation restoration and facilitate the timely evaluation of vegetation restoration[13]. As an important indicator of soil microorganisms, soil microbial diversity and activity are the key to measure soil quality. Soil microbial biomass represents the storage of soil active organic matter to a large extent[14], which can effectively feed back the restoration of aboveground vegetation. Therefore, understanding the diversity, activity and biomass of soil microorganisms can better understand the role of soil microorganisms in vegetation growth and nutrient cycle, which is of great significance for the project of returning farmland to forest and grassland and vegetation restoration and reconstruction in the Loess Plateau.

Previous studies often ignored the impact of changes in soil microbial diversity on vegetation restoration, largely because it is very difficult to directly control the species diversity, richness and functional groups of microbial communities. However, a large number of studies have shown that the community structure and functional diversity of soil microbial community play an important role in the nutrient cycle of ecosystem, thus affecting vegetation restoration to a certain extent. Soil microbial diversity refers to the diversity of all microbial species, genes and their interaction with the environment in the soil ecosystem. It is generally believed that soil microbial diversity exists in four levels: gene, species, population and community. It is not only a basic life feature of soil ecosystem, but also a function of time and space. Soil microbial biomass is the active part of soil nutrients , which plays an active role in promoting the material nutrient cycle. It is the source and sink of plant nutrition. In addition, it can also reflect the number of microorganisms regulating soil material energy cycle and organic matter transformation. Microbial biomass carbon and nitrogen are important indicators to characterize active organic carbon and nitrogen in soil. They are extremely sensitive and rapid to the change of soil state. They are used as indicators to evaluate soil biological quality to reflect the restoration of aboveground vegetation.

3. Evaluation method

3.1. Sample plot selection and sample collection

According to the gradient change of hydrothermal environment and the zonal difference of vegetation types, the artificial Robinia pseudoacacia forest community and local plant community (grassland area, forest grassland area and forest area) are selected as the research objects in each vegetation area, and the artificial Robinia pseudoacacia forest planted by artificial aerial seeding is compared with local plants, It is convenient to reasonably evaluate the ecological benefits of the project of returning farmland to forest and grassland in different vegetation areas. At the same time, with the change of vegetation gradient, the artificial Robinia pseudoacacia Forests in three different vegetation areas are compared and analyzed to reasonably evaluate the ecological benefits of the project of returning farmland to forest and grassland among different vegetation and provide support for subsequent vegetation restoration

In each vegetation area, at least 3 sites with similar site environment (slope position, slope direction, etc.) shall be selected 20×20m Robinia pseudoacacia forest community sample plot and its one-to-one corresponding local plant community sample plot to ensure the stability and

correctness of the data. Soil sample collection in the sample plot: remove the surface plant residues and stones, select five soil samples at the same depth in an "s" shape, and mix them evenly into one sample. Select soil samples from different depths of soil layers, screen them for 2mm, put them into sterile sample bags, refrigerate them in ice boxes and take them back to the laboratory. Some of them are used for the determination of physical and chemical properties after air drying, so as to provide a basis for better reflecting the changes of soil physical and chemical properties; One part is stored in 4℃ refrigerator for the determination of soil microbial functional diversity, and the other part is stored in -80℃ ultra-low temperature refrigerator for the determination of soil microorganisms and community structure. The study of soil microorganisms provides a basis for evaluating the restoration benefits of the project of returning farmland to forest and grassland.

3.2. Determination of soil physical and chemical properties

It mainly measures total carbon (TC) and total nitrogen (TN), total phosphorus (TP), soil PH value and soil moisture content (SMC) were used to characterize soil physical and chemical properties. For the specific determination method, refer to the book of soil physical and chemical analysis[15].

3.3. Determination of soil microbial diversity

The functional diversity of soil microorganisms was determined by biologeco microplate method[16]. The specific steps refer to the articles of Li Chaoran et al[17].

The determination of community structure mainly includes three steps: soil macrogenomic DNA extraction, PCR quantitative analysis, sequencing data processing and analysis. Among them, soil macrogenomic DNA is extracted by MP kit, and the extraction method refers to the instructions of the kit. The subsequent PCR quantitative analysis and sequencing data processing shall be handed over to the sequencing company for processing.

3.4. Determination of soil microbial biomass carbon and nitrogen

After adjusting the water content of the fresh soil sample to 60% of the saturated water holding capacity, place the soil sample in a wide mouth bottle, seal it with fresh-keeping film, and culture it in a 25 ℃ constant temperature incubator for 7 days, and then determine the microbial biomass carbon and nitrogen.

The microbial biomass carbon and nitrogen were extracted by CHLOROFORM FUMIGATION leaching method, the microbial biomass carbon and nitrogen were extracted by potassium sulfate, the organic carbon in the extraction solution was determined by automatic organic carbon analyzer, and the conversion coefficient was 0.38; The total nitrogen in the extract was determined by Kjeldahl digestion automatic nitrogen determinator.

4. Conclusion

The research on Vegetation Restoration in the project of returning farmland to forest and grassland in the loess hilly region began in 1999. Because returning farmland to forest and grassland is the key to vegetation reconstruction, it is still the research hotspot of many scholars. In recent years, remarkable achievements have been made in vegetation restoration in the loess hilly area, soil and water loss has been effectively curbed, and vegetation growth has been restored. In the past, the method to evaluate the effect of returning farmland to forest and grassland project was to test the soil quality of the returning farmland to forest land with soil physical and chemical properties, and there was no relevant attention to microorganisms. However, this paper believes that soil microorganisms can also well reflect the soil quality, It should also be considered when evaluating its ecological benefits. It is necessary to comprehensively evaluate the soil quality after the project of returning farmland to forest and

grassland. Therefore, it is very necessary to find a comprehensive evaluation method and index to evaluate the soil quality after the implementation of the project.

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