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Research on Changes of Soil Organic Carbon and Soil Total Carbon in Abandoned Homestead of Weibei Tableland Area After Land Remediation---Taking Chengcheng County, Weinan City, Shaanxi Province, China as an example

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Abstract. Through sampling and analysis, the changes of soil organic carbon and soil total carbon contents before and after the land consolidation of abandoned residential land in Chengcheng county were compared, and the differences of soil organic carbon and soil total carbon contents between newly added cultivated land and mature cultivated land after the land consolidation were analyzed. The possible reasons for this change was discussed. The result shows that: ①The total soil carbon content of abandoned house sites in the weibei tableland was 18.25g/kg, 17.45g/kg, and 17.51g/kg in three layers of 0-20cm, 20-40cm, and 40-60cm respectively. ②After 10 years of cultivation, the soil in the 0-20cm layer has the highest total carbon content, which is 23.44g/kg. The total carbon content in each layer is 0-20cm>40-60cm>20-40cm. The total carbon content increased by 20-40cm>40-60cm>0-20cm, of which 0-20cm presented a decreasing trend compared with five years ago ③The average soil total carbon content of mature cultivated land in Chengcheng county was 20.74g/kg, 28.60 g/kg, and 15.18 g/kg in three soil layers, respectively. Compared with mature cultivated land, the total carbon content of soil in 20-40cm layer had the greatest potential to increase.

1. Introduction

With the deepening of global environmental change research, terrestrial ecosystem carbon cycle has attracted increasing attention from the scientific community [1-6]. Soil is the core of terrestrial ecosystem, and soil carbon pool is the largest carbon pool in terrestrial ecosystem. Accurate estimation of soil carbon pool changes is of great significance to correctly evaluate the role of soil in terrestrial ecosystem carbon cycle, global carbon cycle and global environmental change. Since the 1950s, many scholars at home and abroad began to study the global soil carbon pool, and many achievements have been made. However, for a long



time, the research on soil carbon pool focuses on soil organic carbon, while the research on soil inorganic carbon and soil total carbon pool in the form of carbonate is relatively rare. Even the study on soil total carbon change only focuses on spatial variation [7]. Reports on linkage analysis of soil organic carbon and total carbon change are rare. The author once discussed the organic carbon change in the renovation project of abandoned rural house sites in the Weibei tableland [8], trying to carry out the research on the change of soil organic carbon by the reclamation of abandoned rural house sites.

Since the reform and opening, in order to meet the needs of urban development and new rural construction, China land arrangement of a series of policy, rural abandoned land is a management priority, rural waste land became the first choice of reserve cultivated land resources, therefore, abandoned land reclamation for farmland soil carbon effect also gradually become the hot topics in the study of the social from all walks of life. At present, most reports on land remediation focus on evaluation [9-11], and there are also studies reflecting soil carbon and nitrogen cycle from soil enzyme activity and other aspects [12]. Studies on soil organic carbon change are mostly about the addition of exogenous organic carbon [13-14], and there are few reports on the relationship between soil organic carbon and total carbon change. This paper is based on the existing research results, through 10 years before and after the renovation and abandoned land farming linkage analysis, carbon and organic carbon changes in total soil organic carbon on rural waste land soil total carbon and organic carbon to study the change rule, explore the rural homestead waste reclamation on soil carbon stock changes, in order to scrap the homestead land management provides the theory basis for carbon sequestration potential research, and strive for land reclamation project on Chinese soil carbon library accurate estimates provide basic data.

2. Materials and methods

2.1 Overview of the study area

Chengcheng County is located in the east of Shaanxi Province. The geographical coordinates are: 109° 46' 30" to 110° 05' 50" (east longitude) and 34° 55' 45" to 35° 27' 05" (north latitude). The terrain is high in north and low in south. Four rivers divide Chengcheng County as "three ridges and one plain." The county belongs to a warm temperate sub-humid monsoon region in Guanzhong Plain. The average annual temperature is 12 °C, precipitation is 680 mm, frost free period is 204 days, and the temperature difference between day and night is large. With 2616 annual sunshine hours, the sea level is 406.9-1268 meters, which is the center of highest value of thermal radiation to the south of Yan'an of Shaanxi Province. Chengcheng county land consolidation project is a key investment project in Shaanxi Province, with tens of millions RMB of investment and 560 hm² construction area. This paper selects Chengcheng county remediation project of the abandoned homesteads as a case of study and through the analysis the change of soil organic carbon and the potential of soil carbon sequestration after remediation of abandoned homestead, in order to provide reference for the estimation of soil carbon sequestration potential of new cultivated land after remediation of abandoned homestead in Weibei Loess Upland.

2.2 Sampling and Measurement

Based on the field investigation, Chengcheng County abandoned Homestead land consolidation Project in Weibei Loess Upland District was selected as the research object. There were 15 remediation projects were selected to collect samples in this county and 3 samples were collected from each project. Mixed soil samples were collected from 0-60 cm by diagonal sampling method. A total of 45 samples were obtained and brought the soil back to the laboratory for air drying. The experimental methods used to analyze soil samples mainly refer to "soil agrochemical analysis". Soil organic carbon was oxidized by potassium dichromate-external heating method. The data analysis was completed by applying SPSS 20.0 and Excel 2016

2.3 Sampling and Processing

2.3.1 The Placement of Sampling Points. Through 45 sample points were arranged in the five types of abandoned homestead disposal areas in the whole county and the spatial distribution was approximately

well-distributed, so as to ensure that the layout of the sample points could meet the requirements of the remediation time limit. Three layers of samples were collected from each sample: 0-20cm, 20-40cm and 40-60cm. (Table 1).

Table 1. Layout of Sample Points

Remediation Time Limit of Abandoned Homestead	0-20cm/20-40cm/40-60cm
Not Remedied	3/3/3
1 Year after Remediation	3/3/3
5 Years after Remediation	3/3/3
10 Years after Remediation	3/3/3
Maturity Cultivated Land	3/3/3
Total	45

2.3.2 Sample Collection. Samples were collected in Chengcheng County in July 2017 to screen out the soil samples of 0~20 cm, 20~40 cm and 40~60cm soil layer of 0~20 cm, 20~40 cm and 4~60cm soil layer, respectively, which were cultivated for 1 year, 5 years and 10 years after remediation. The physical geographical factors, such as longitude, latitude, altitude, geographical location, topography, slope, slope direction were recorded for each sample. The soil descriptive index database was constructed by investigating the local tillage system, field fertilization management, normal yield level, irrigation conditions.

2.4 Sample Analysis and Data Processing

2.4.1 Sample analysis. Potassium dichromate-calorimetry was adopted to measure the SOC and soil total carbon(TC) is determined by TOC analyzer

2.4.2 Data Processing. ArcGIS 10.2, SPSS 20.0, Excel 2016, were adopted for Data processing and mapping.

3. Results and Analysis

3.1 Changes of SOC and soil total carbon before and after Remediation of Abandoned Homestead.

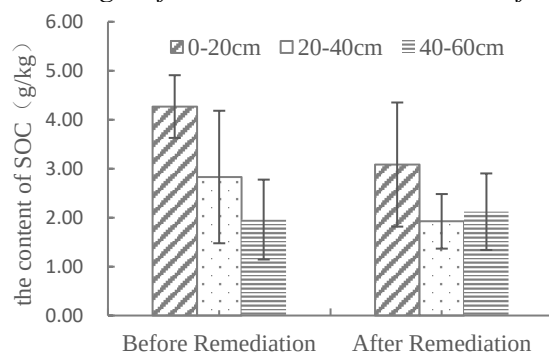


Figure 1. Comparison of SOC Changes before and after Remediation of Abandoned Homestead.

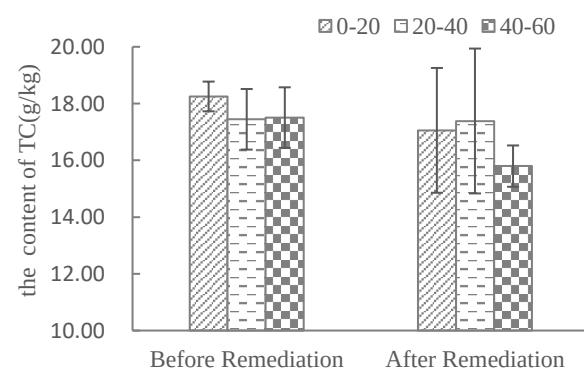


Figure 2. Comparison of total carbon Changes before and after Remediation of Abandoned Homestead.

The change of SOC and total carbon before and after remediation of abandoned homestead is shown in Figure 1 and Figure 2. The average value of SOC in 0-20cm soil layer decreases from 4.27g/kg to 3.08 g/kg and the decline is 38.6%. The average soil total carbon content in the 0-20cm soil layer decreases from 18.25g/kg to 17.06g/kg, which is 6.55%, 20-40cm soil layer. The average value of SOC in 20-40cm

soil layer decreases from 2.83g/kg to 1.92g/kg and the decline is 47.3%. The average soil total carbon content decreased from 17.45 g/kg to 17.39 g/kg, a decrease of 0.34%. The average content of SOC in soil layer of 40-60cm soil increased from 1.96g/kg to 2.12g/kg and the increase was 7.5%. The average total carbon content of soil in 40-60cm soil layer increased from 17.51g/kg to 15.80g/kg, with a decrease of 9.77%. In general, soil organic carbon content increased by 20-40cm>0-20cm>40-60cm. The soil total carbon content of the soil decreased by 40-60cm>0-20cm>20-40 cm.

3.2 Change of SOC and soil total carbon in different tillage years after remediation of abandoned homestead

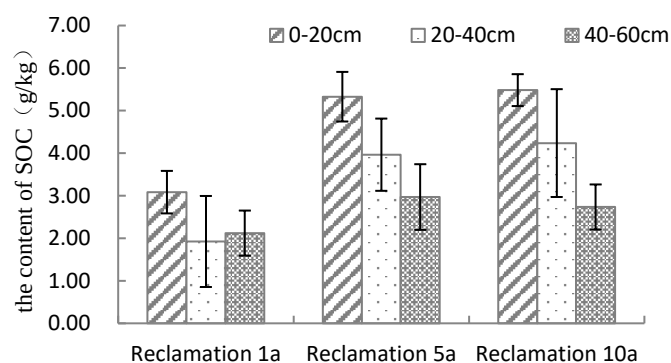


Figure 3. SOC content of each layer in different reclamation years.

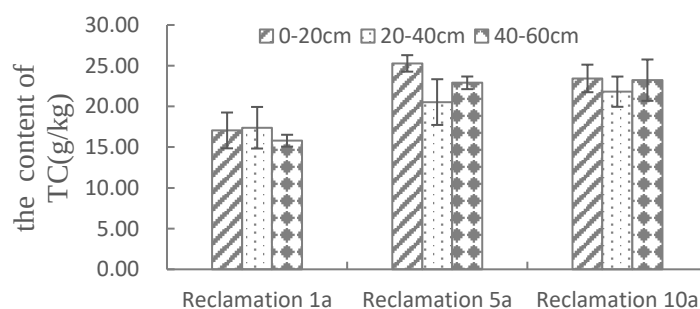


Figure 4. Soil total carbon content of each layer in different reclamation years.

With the extension of reclamation time, SOC and total carbon content will also change, as shown in Figure 3. After 5 years of reclamation, the highest soil organic carbon content is 0-20 cm and 5.33g/kg. The largest increase in soil organic carbon content was 20-40cm and the increase was 106.03% of SOC content after one year reclamation. The slowest increase in the three soil layers is 40-60cm and the increase is 40%. After 10 years of reclamation, the highest organic carbon content in the soil is still 0-20 cm, and 5.48g/kg. The soil organic carbon content of all layers was 0-20cm > 20-40cm > 40-60 cm and the increase of organic carbon content was 20-40cm > 0-20cm > 40-60cm.

With the accumulation of reclamation years in abandoned homestead, the total carbon content of the soil will change with the accumulation of farming years. As shown in Figure 4, after 5 years of reclamation, the soil with the highest total carbon content is 0-20 cm. It is 22.59 g/kg. The largest increase in total carbon content in the soil is also 0-20 cm, which is an increase of 48.26% of the total carbon content of the soil at the time of reclamation. The slowest increase in the three soil layers is 20-40 cm, which is 18.12%. After 10 years of reclamation, the highest total carbon content in the soil is still 0-20 cm, which is 23.44 g/kg. The soil total carbon content of each layer of soil showed 0-20cm>40-60cm>20-40cm, and the total carbon content increased by 20-40cm>40-60cm>0-20cm, of which 0-20cm showed a decreasing trend.

3.3 SOC and Soil Total Carbon Content of After Remediation of Abandoned Homestead in Different Reclamation Years

It can be seen that the soil organic carbon content in the two soil layers (0-20cm and 20-40cm) decreased

at first and then increased gradually after the land remediation in Figure 5. The average soil organic carbon 0-20cm for 10 years of reclamation was 5.48g/kg, compared with only 62.6% of the average level of organic carbon in maturity soil. After 10 years of reclamation, the average value of soil organic carbon in 20-40cm soil layer is 4.24g/kg, which is 50.6% of the average content of organic carbon in maturity soil. The average value of soil organic carbon in 40-60cm soil layer is 2.73g/kg, compared with maturity soil, of which organic carbon content is only 43.9% of the average value.

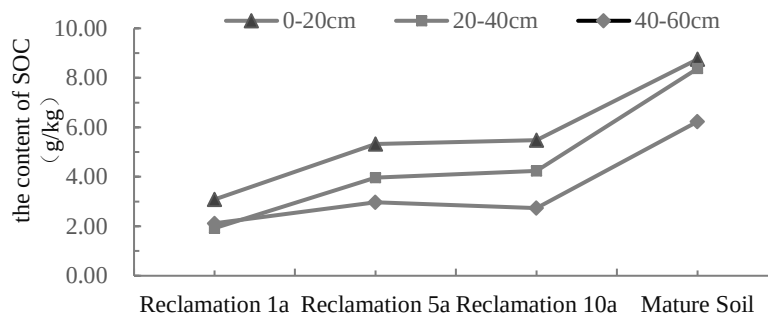


Figure 5. the content of SOC in different reclamation years.

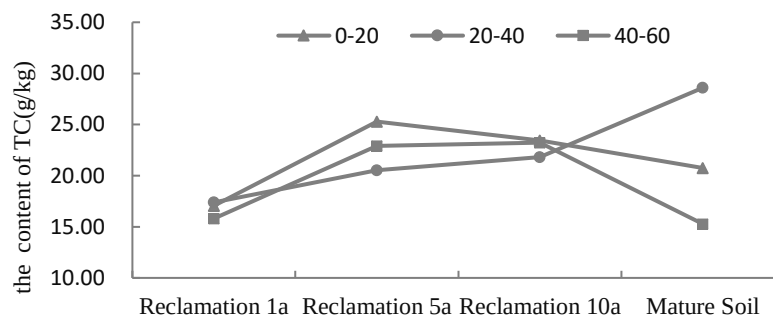


Figure 6. the content of soil total carbon in different reclamation years.

It can be seen from Figure 6, that after the land is rectified, the total carbon content of the soil in the two soil layers of 20-40cm and 40-60cm increases with the reclamation time. During the 10 years of reclamation, the total carbon content of the soil increases continuously. The trend, which increased by 18.12% and 44.98% in the first five years, was 6.22% and 1.43% in the next five years. The total carbon content of soil in 0-20cm soil layer increased first and then decreased in 10 years. The growth rate in the first five years was 48.26%, showing a downward trend in the next five years, with a decrease of 7.31%. The average total carbon content of the mature soil in the soil layers of 0-20cm, 20-40cm and 40-60cm was 20.74g/kg, 28.60g/kg and 22.13g/kg, respectively. Compared with the total carbon content of mature soil, the total carbon content of 0-20cm and 40-60cm soil may decrease, and the total carbon content of 20-40cm soil has a large room for improvement.

4. Conclusion

Through the research and analysis of the changes in the content of SOC and soil total carbon before and after the remediation of the abandoned homestead in Chengcheng County, and SOC and soil total carbon changes after nearly ten years reclamation, the paper makes a thorough investigation of influence of the pre-remediation and post-remediation of abandoned homestead together with many years reclamation on the change of SOC and soil total carbon content, before and after being remedied and after many years of reclamation. The result shows that:

(1) The total soil carbon content of abandoned house sites in the weibei tableland was 18.25g/kg, 17.45g/kg, and 17.51g/kg in three layers of 0-20cm, 20-40cm, and 40-60cm respectively.

(2) After 10 years of cultivation, the soil in the 0-20cm layer has the highest total carbon content, which is 23.44g/kg. The total carbon content in each layer is 0-20cm>40-60cm>20-40cm. The total carbon content increased by 20-40cm>40-60cm>0-20cm, of which 0-20cm presented a decreasing trend

compared with five years ago.

(3) The average soil total carbon content of mature cultivated land in Chengcheng county was 20.74g/kg, 28.60 g/kg, and 15.18 g/kg in three soil layers, respectively. Compared with mature cultivated land, the total carbon content of soil in 20-40cm layer had the greatest potential to increase.

Acknowledgments

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