High Standard Farmland Construction and Soil Conservation Evaluation

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Abstract. In China, the quality of cultivated land is reduced, and the available cultivated land area is reduced. In order to ensure food security, the country has orderly promoted the construction of high standard basic farmland. However, there is a lack of reasonable evaluation on the high standard farmland. The evaluation of high standard farmland mainly focuses on the natural conditions of farmland and the suitability of farmland to social and economic conditions. A large number of recent studies have found that soil microorganisms have a significant impact on the quality of cultivated land. In order to evaluate the high standard farmland more reasonably, this paper attempts to add microbial factors to the high standard farmland construction evaluation, and build a more reasonable high standard farmland evaluation system.

1. Introduction

Food security is the top priority of the country's governance, and the food problem is of great importance in the country's development. General Secretary Xi Jinping always regards solving the problem of people's eating as the primary task of governing the country and the state. The 13th five year plan proposes to adhere to the strictest cultivated land protection system, adhere to the red line of cultivated land, implement the strategy of "storing grain in the land, storing grain in technology", and improve grain production capacity [1]. To store grain in the land is to stick to the red line of cultivated land and ensure that the number of cultivated land does not decrease. The key is to guarantee the number of cultivated land and improve the quality of cultivated land [2], construct the high standard farmland. Cultivated land, as the cream of land and resources, is the most important strategic resource to ensure food security. However, the cultivated soil in China is gradually becoming shallower, soil hardening, soil acidification, soil salinization, soil erosion, inorganic organic pollution and other phenomena, which pose a serious threat to food security. To this end, we must strictly implement the general secretary Xi Jinping's ecological civilization and implement the strategy of rural revitalization, and actively promote the construction of high standard farmland. High standard basic farmland refers to the basic farmland formed through land renovation in a certain period of time, which is centralized and contiguous, with
supporting facilities, high and stable yield, good ecology, strong disaster resistance, and suitable for modern agricultural management mode [3]. At present, the evaluation units of high standard farmland construction in different regions are different, and administrative villages, grids and map spots are all selected; The first mock exam is inconsistent with the evaluation index, and the single factor model is more important than the natural factors such as the quality of cultivated land and site conditions [4]. The evaluation methods are inconsistent, and the weight standards determined by Delphi, AHP and entropy [5-7] are not clear. This paper studies the determination of high standard farmland construction evaluation system in order to provide a reasonable idea for the national food security and the construction of high standard farmland.

2. Evaluation unit
The evaluation unit is the smallest unit in the quality evaluation system. The natural and socio-economic characteristics of topography, soil and climate in the evaluation unit are relatively uniform. Evaluation units are mainly concentrated on grid unit [8], cultivated land map spot [9] and administrative village unit [10]. However, the grid unit has the defect that the land is artificially divided, and the evaluation result is not easy to land. The number of cultivated land map spot units is more fragmented, while the scale of administrative village unit is larger, and the difference of internal field block characteristics is not considered enough. If all cultivated land within the administrative village is taken as the construction area, the error is larger. Therefore, in the evaluation of high standard farmland construction system, on the basis of reasonable evaluation, select the most appropriate evaluation unit.

3. Evaluation index
According to the standard for construction of high standard basic farmland (TD / t1033-2012), the construction of high standard farmland should attach equal importance to quantity, quality and ecology, improve the supporting degree of infrastructure, improve the conditions of agricultural mechanization and large-scale production, and promote the stability of quantity, quality, landscape optimization and good ecology of basic farmland [11, 12]. According to the land evaluation and site assessment (LESA) system, and fully considering whether the evaluation indicators are representative, the differences of each indicator and the availability of data, the indicators are selected from the natural conditions of cultivated land and the suitability of cultivated land to social and economic conditions. Because the influence of soil microorganism on soil quality is significant, microbial factors are added in the selection of indicators [11]. See the table below for specific indicators [13-16]:

| Table 1. Basic evaluation indexes of high standard farmland construction |
|---------------------------------|------------------------|
| Index composition |
| Natural conditions of cultivated land |
| Site condition suitability index (positive type) |
| Suitability of cultivated land to social and economic conditions |
| Evaluation factors |
| Effective thickness of soil layer |
| Surface soil texture |
| Profile form |
| Organic matter content |
| pH |
| Soil microbial biomass carbon |
| Soil respiration (25 °C) |
| slope |
| Irrigation assurance rate |
| Drainage conditions |
| Cultivation distance |
| Operating benefits |
| Road accessibility |
| Altitude |
| GDP per capita |
| Road network density |
| Urbanization rate |
| External traffic convenience |
| Influence degree of central town |
According to the different attributes of each evaluation factor, the single factor evaluation and function score evaluation are carried out by using the grading method, the diffusion method and the data standardization method respectively. For the quantitative expression factors, we use the grading method to divide different levels according to the actual situation and data distribution, and then give corresponding function scores to each level according to its influence degree. For the diffusion factor, the diffusion scoring method is used to calculate the element factor action score (formula (1) ~ (2)) by linear or exponential decay model. For the evaluation factors with no significant action interval and no obvious action mutation, the data standardization method is used to evaluate single factor and assign action score (formula (3)). There is no clear evaluation method for soil microbial biomass and soil respiration. In order to accurately evaluate its impact on soil quality, data standardization method is also used for single factor evaluation and action score evaluation (formula (3)).

Table 2. Scoring rules of soil quality evaluation indexes [17]

| Score | Effective thickness of soil layer (cm) | Surface soil texture | Profile form | Organic matter content (g/kg) | pH       |
|-------|----------------------------------------|----------------------|--------------|-------------------------------|----------|
| 100   | >150                                   | Loam                | all loam     | >40                           | 6.0-7.9  |
| 90    | 100-150                                | Clay                 | Loam / clay / loam | 30-40                     | 5.5-6.0,7.9-8.5 |
| 80    |                                         |                     | Loam / sand / loam | 20-30                     | 5.0-5.5,8.5-9.0 |
| 70    | 60-100                                 | Sand                | Sand / clay / sand | 10-20                     |          |
| 60    |                                         |                     | Soil / sand / sand | 6-10                       | 4.5-5.5  |
| 50    | 30-60                                  | Clay / sand / clay  | Clay / sand / clay | ≤6                        |          |
| 40    |                                         |                     | Clay / sand / sand | ≤4.5,9.0-9.5               |          |
| 30    | ≤30                                    | Gravelly soil       | All sand      |                               | >9.5     |
| 10    |                                        |                      | All gravelly soil |                             |          |

Table 3. Scoring rules of suitability index

| Score | Slope (°) | Irrigation assurance rate | Drainage conditions | Altitude | Road network density | Urbanization rate (%) |
|-------|-----------|----------------------------|---------------------|----------|----------------------|-----------------------|
| 100   | <2        | Full satisfaction          | Sound system        | >175     | >7.5                 | >0.45                 |
| 85    |           |                            |                     |          | 3.8-7.5              | 0.35-0.45             |
| 80    | ≥2-5      | Basically satisfied        | Basically sound     | 119-175  | 1.4-3.8              |                       |
| 75    |           |                            |                     |          | 0.7-1.4              |                       |
| 65    | ≥5-8      | General satisfaction       | General conditions  | 83-119   |                      | 0.2-0.35              |
| 55    |           |                            |                     |          | <0.7                 |                       |
| 45    | ≥8-15     | No irrigation conditions   | Unconditional       |          | <0.1                 |                       |
| 40    |           |                            |                     | 57-83    | 0.1-0.2              |                       |
| 20    |           |                            |                     | <57      |                      |                       |
| 0     | ≥15       | No irrigation conditions   | Unconditional       |          | <0.1                 |                       |

The following formula is adopted for the score of cultivation distance, road accessibility and external traffic convenience:

\[ f_i = M \times (1 - r), r = \frac{D_i}{D} \]  

(1)
In the formula, FI is the action score of factor I; m is the function score of diffusion source; R is the relative distance of factor influence; Di is the distance of factor influence; D is the radius of factor influence.

The function score of the influence degree of the central town is calculated by the following formula:

\[ f_i = M^{(1-r)} \]  

The scores of operation benefit, GDP per capita, soil microbial biomass and soil respiration are calculated by the following formula:

\[ f_i = 100 \times \frac{x_i - x_{\min}}{x_{\max} - x_{\min}} \]  

In the formula: \( x_i \) is the actual value of the evaluation unit; \( x_{\min} \) is the minimum value; \( x_{\max} \) is the maximum value.

4. Evaluation method

The evaluation index selection methods mainly include the minimum data set method and the total data set method. Select a reasonable evaluation method to evaluate after determining the evaluation index. The common soil evaluation methods include soil quality index, fuzzy mathematics, multivariate statistical analysis, factor analysis, cluster analysis, principal component analysis, etc. After selecting the evaluation index, the high standard farmland was compared with the undisturbed farmland, and the high standard farmland was evaluated reasonably.

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