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The impact of high standard farmland construction on soil quality and cultivated land

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Abstract

Cultivated land is the material foundation for human survival and development, and the quality of cultivated land is directly related to national food security, social stability, and sustainable agricultural development. In order to achieve dynamic balance between the quantity and quality of farmland in the project area, build high standard farmland, improve the basic soil fertility of farmland, enhance the comprehensive agricultural production capacity, promote the improvement of soil fertility of newly added farmland, further improve the land use efficiency of newly added farmland, and build stable and high-yield farmland, it is necessary to manage and protect the project area after rectification, and establish a management and protection mechanism.

Keywords

High standard farmland; Soil quality; Farmland classification; Grain production capacity.

1. Introduction

The construction of high standard farmland is a key measure to ensure food security and an inevitable requirement for agricultural modernization. In recent years, the construction of high standard farmland in our province has achieved good results, and the disaster prevention and reduction capabilities of farmland infrastructure have gradually increased, making important contributions to stabilizing the province's food production. However, there are still problems such as inactive mechanisms, insufficient quantity, and low quality. The main purpose of its construction is to build the demonstration area into a modern agriculture with stable and high yield irrigated land through projects such as field improvement, intelligent water-saving irrigation for improving farmland fertility, field roads, and farmland protection, providing replicable and promotable experience for other regions to play a demonstration role in the construction of high standard farmland in hilly areas; By implementing projects such as field improvement, soil improvement, emergency irrigation, field roads, and farmland protection, the project area will be transformed into a high standard farmland for stable and dry farming.

2. Project area overview

The project area is located in Baoji City, Shaanxi Province, on the western edge of the Weibei Plateau, at longitude 106 ° 26'32 "~1078'11" east and latitude 34 ° 35'17 "~35 ° 6'45" north. Belonging to the loess erosion landform in the northern part of the Wei River, the terrain is complex and diverse. The project area is located in a hilly and gully area, sloping from northwest to northeast, with an altitude of 1068 to 1460 meters and an area of 778.92 square kilometers, accounting for 34.06% of the total area of the county. The soil layer is relatively thin, with many stones, less vegetation, and severe soil erosion. The slope surface is fragmented, and the area of cultivated land with ravines and ridges accounts for 51.36% of the total area. It is a potential agricultural area for excavation in the county.

The project area has an altitude of 800.2-2466 meters and an elevation difference of 1655.8 meters. It belongs to the warm temperate continental monsoon climate zone. According to the

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characteristics of the terrain and landforms, the area can be roughly divided into three climate zones from north to south: I, the northern semi-arid mild climate zone; I. Warm and cool semi humid areas in the shallow mountains of central and southern China; II Southern Zhongshan humid and cold area. The project area is located in the northern semi-arid mild climate zone. The project area has an average annual temperature of 10.5 ℃, an extreme maximum temperature of 40.3 ℃, an extreme minimum temperature of -19.9 ℃, an average accumulated temperature of 4000 ℃ above 0 ℃, an average accumulated temperature of 3400 ℃ above 10 ℃, an average annual rainfall of 608.2 millimeters, a frost free period of 200 days, an average annual sunshine of 2033.3 hours, a sunshine percentage of 46%, an average sunshine of 1605.5 hours during periods above 0 ℃, and an average sunshine of 1103.8 hours during periods above 10 ℃, making it suitable for the development of planting industry. The main soil types in the project area are loess soil and laterite. Loess soil develops in the juvenile soil of loess parent material or secondary loess parent material. Due to the strong anti ripening effect, the soil formation time is generally short, and the soil formation process is relatively small. There is no obvious hierarchical differentiation in the entire profile. Generally, the soil layer is deep and poor, with a light and loose texture. It is permeable and breathable, and has good tillage properties. Organic matter is deficient in ammonia elements, lacking phosphorus and severely lacking in iron and zinc. The soil fertility is poor, and the erosion pattern of soil and water loss is large. The water and fertilizer retention performance is poor, and the stamina is insufficient. It is suitable for the development of small crops, but not suitable for the growth of old seedlings. Red soil is a lithological soil formed by the exposure of ancient soil layers to the surface. Poor fertility, lack of nitrogen and phosphorus, heavy texture, poor permeability, dense and compact, hard and tight texture, severe compaction, high tillage resistance, shallow tillage, affecting crop emergence and root development.

3. Current situation of the project area

3.1. Current Status of Fields

The project area is located in the hilly and gully area in the north of Longxian County. Slope farmland accounts for more than 61.9% of the total area of the project area. In rainstorm weather, soil erosion is serious. The slope of some existing terraced fields in the project area is unreasonable, with damaged or no water storage ridges, which is prone to soil erosion and poor water and fertilizer retention capacity; Part of the fields are divided into small pieces, which are not concentrated and contiguous, which is not conducive to mechanical harvesting or has low harvesting efficiency.

3.2. Soil fertility

According to relevant data, the organic matter nitrogen element in the cultivated land in the project area is poor, lacking phosphorus, severely lacking iron and zinc, with poor soil fertility, large soil erosion patterns, poor water and fertilizer retention performance, and insufficient momentum. The average soil organic matter content in the project area is only 10g/kg.

3.3. Water conservancy facilities

The project area is located in a dry farming area with few irrigation measures, mostly 10-20m of rainwater collection capacity, which is used for pesticide spraying in some plots of land. In addition, there are few existing water cellars that cannot meet the basic water needs of the project area, and some water cellars are no longer usable due to long-term disrepair.

3.4. Field road engineering

There are cement roads connecting villages in the project area, and most of the existing field roads are dirt roads. The roads are narrow, severely damaged, and overgrown with weeds,

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which cannot meet the requirements of mechanical operations and transportation. In rainy and snowy weather, it is difficult to enter and exit, and machinery and transportation vehicles are difficult to enter the fields, which affects the transportation and sales of agricultural products and restricts the further development of efficient agriculture.

4. Soil testing formula fertilization

According to the National Technical Specification for Soil Testing Formula, the Technical Specification for Soil Testing Formula Fertilization (NY/T1118-2006), and the Research Report on the Guidance System for Soil Nutrient Rapid Testing Fertilization, the balanced fertilization method is selected for this plan. According to the difference between the planned fertilizer demand and the soil fertilizer supply, fertilization can be used to supplement. This requires understanding several parameters such as the planned fertilizer demand. As for the planned yield, based on the average crop yield in the first three years of the local area, an additional 10% -15% is added as the planned yield or target yield for the current year. Then, the total amount of nutrients required to achieve the planned yield is calculated using the nutrient coefficient; Multiply the measured values of soil nutrients by a conversion coefficient (0.15), and then multiply them by a soil nutrient correction coefficient to obtain the total amount of soil nutrient supply. Subtract the total amount of soil nutrient supply from the total amount of nutrients required for the target yield to obtain the total amount of nutrients that should be applied to the soil. Based on the type, variety, nutrient content, and relevant conditions of fertilizer utilization, calculate the amount of fertilizer that should be applied.

The nutrients absorbed by corn throughout the entire growth process are mainly nitrogen, phosphorus, and potassium. The total amount absorbed increases with the increase of yield level. The demand for nitrogen fertilizer is determined based on the seed yield per mu, and then phosphorus and potassium fertilizers are mixed in proportion. There is a high demand for phosphorus and potassium fertilizer during the seedling stage, which can be used together with base fertilizer and seed fertilizer. Nitrogen fertilizer is needed throughout the entire growth period of corn, but it is most needed during the jointing, flowering and filling stages, and can be applied in stages. Staged fertilization can be divided into basal fertilizer, stem fertilizer, and ear fertilizer based on the growth period of corn. Organic fertilizer contains a lot of nutrients but has a relatively low content and slow release, while chemical fertilizers have a high unit nutrient content, fewer components, and fast release. The two can be used in a reasonable combination and complement each other. The organic acids produced by the decomposition of organic matter can also promote the dissolution of mineral nutrients in soil and fertilizers. Organic fertilizer and chemical fertilizer promote each other, which is beneficial for crop absorption and improves fertilizer utilization efficiency. Therefore, following the principle of increasing the application of organic fertilizer and promoting the combination of organic and inorganic fertilizers, increasing the application of organic fertilizer to replace some of the chemical fertilizers and reducing the amount of chemical fertilizers used.

5. Factors affecting the quality of cultivated land

(1) Effective soil layer thickness: the total thickness of soil above the parent material layer that crops can utilize; When there is an obstacle layer, the thickness of the soil layer above the obstacle layer. The effective soil layer thickness refers to the sum of the thickness of the soil layer and the loose parent material layer, which is divided into 5 levels. The effective soil layer thickness in the project area is 109cm, with an average of 90 points.

(2) Surface soil texture: The surface soil texture generally refers to the texture of the cultivated soil, which is divided into four levels: sandy soil, loam soil, clay, and gravel soil. Level 1, loam

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soil; Level 2, clay; Level 3, sandy soil; Grade 4, gravelly soil. The surface texture of the project area is loam soil.

(3) Soil salinization degree: Soil salinization refers to the process in which the salt content in the bottom layer of soil or groundwater rises to the surface with capillary water, evaporates, and accumulates in the surface soil. It refers to the phenomenon or process of the accumulation of soluble salts on the surface of soil, also known as salinization. There is no soil salinization in the project area.

(4) Soil organic matter content: Soil organic matter is an important component of the solid phase of soil and one of the main sources of plant nutrition. It can promote the growth and development of plants, improve the physical properties of soil, promote the activity of microorganisms and soil organisms, promote the decomposition of nutrients in soil, and improve soil fertility and buffering. It is closely related to the structure, aeration, permeability, adsorption, and buffering of soil. Usually, under similar or identical conditions, within a certain range of content, the content of organic matter is positively correlated with soil fertility level. The organic matter content in the project area ranges from 8.88 to 9.45g/kg, with an organic matter content of 60 points.

(5) Drainage conditions refer to artificial measures that remove excess surface water, soil water, and groundwater from farmland, improve the water, fertilizer, air, and heat relationships of the soil, and facilitate crop growth. There is no drainage system or simple drainage ditch in the project area, but there is no flood hazard.

(6) Terrain slope: After rectification, the terrain slope of the project area is less than 2 °.

(7) Irrigation guarantee rate: There are no irrigation conditions in the project area.

(8) Irrigation water source: a water body in natural water resources that can be used for irrigation. There are two forms of surface water and groundwater, with surface water being the main form. Surface water includes river runoff, lake runoff, and surface runoff intercepted during confluence processes; Groundwater mainly refers to shallow groundwater. Sewage and return water are used for irrigation, which is the reuse of water resources. The project area mainly relies on natural precipitation.

6. Result analysis

After comprehensive land improvement, the project area has been transformed into high standard farmland. After calculation, the comprehensive national natural grade of cultivated land in the project area is 11.0, the comprehensive national utilization grade is 11.0, and the comprehensive national economic grade is 11.0.

After reviewing the evaluation results of the 2019 annual update on the quality of cultivated land in the project area, it was found that the national natural grade of adjacent cultivated land in the project area was 11.0, the national utilization grade was 11.3, and the national economic grade was 11.5.

Due to the use of land leveling engineering during the development process, the project area has been improved in terms of flatness. Through land plowing and soil improvement, the surface soil quality has been improved and the organic matter content has been increased; Overall, the scores of the two factor indicators that affect the quality of cultivated land have all improved. By calculation and comparison, the national average utilization level of cultivated land in the project area is the same as the average utilization level of adjacent cultivated land in the surrounding area.

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7. Benefit analysis

Analyze from the aspects of increased arable land production capacity, social benefits, economic benefits, and ecological benefits.

1. Social benefit analysis

After the implementation of the project, it will significantly improve the infrastructure of farmland; Will make the original inefficient. The aging garden has been transformed into farmland; Improving the quality of cultivated land and the index of multiple cropping, increasing the sowing area and grain yield, will play a positive role in ensuring national food security; This will increase the per capita net income of farmers, creating favorable conditions for stabilizing social stability, leading local people out of poverty and becoming prosperous, expanding employment, and promoting the rapid development of the city's agricultural economy.

2. Ecological benefit analysis

Through the implementation of the project, water and soil resources can be reasonably utilized, planting area can be increased, green vegetation coverage in the project area can be increased, ecological environment can be improved, land reclamation rate can be improved, and a good environment can be provided for crop growth and local residents.

3. Economic benefits

Through the implementation of land consolidation projects, the cultivated land area in the project area has significantly increased, agricultural infrastructure has been improved, agricultural production conditions and ecological environment have been improved. In conjunction with the adjustment of agricultural industrial structure, the economic benefits of cultivated land in the project area will be significantly improved.

The project area, after land development, has added arable land for agricultural production, which plays a crucial role in improving the local food production capacity.

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