

# Evaluation and Analysis of Grain Production Capacity of High-standard Farmland Construction

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## Abstract

High-standard farmland construction is an important way to protect the quality of cultivated land and improve grain production capacity in the new era, and also an important starting point for the practical implementation of the new urbanization construction and rural revitalization strategy. The evaluation and identification of grain production capacity depends on the results of farmland grade evaluation and demonstration, while the grading factors selected for designated crops, such as effective soil layer thickness (cm), surface soil texture, soil salinization degree, soil organic matter content (g/kg), drainage conditions, terrain slope, irrigation guarantee rate and irrigation water source, have a significant impact on farmland grade evaluation. This paper analyzes the new grain production capacity generated by the construction of high standard farmland in a county. After the construction of high standard farmland project, the cultivated land grade in the project area can be increased by 1 grade, and the new grain production capacity is estimated to be 3000 tons. The research method can provide necessary reference for the implementation of similar projects.

## Keywords

High-standard Farmland Construction; Grain Production Capacity; Cultivated Land Grade; Assessment Analysis.

## 1. Introduction

High-standard farmland construction has become an important basis for ensuring farmland productivity and food security. According to the National High-standard Farmland Construction Plan (2021-2030), 1 billion mu of high-standard farmland will be built by 2022, so as to stabilize and guarantee the grain production capacity of more than 1 trillion jin. Because the area of medium-low yield farmland in China accounts for a large proportion of the total farmland area, the overall grain production capacity is low, and there is a long way to go to achieve the goal of high-standard farmland construction. The quality of cultivated land and grain production capacity can be estimated by farmland grade evaluation, and some field engineering measures have a relatively significant impact on the improvement of farmland grade. Therefore, it is also an important goal for the construction of high-standard farmland to improve the grade of cultivated land and promote the grain production capacity through engineering construction. This paper starts with the construction content of high-standard farmland in a county, analyzes the factors that affect the farmland grade in a county, and evaluates the farmland grade and grain production capacity of high-standard farmland after the completion of the project, in order to lay a foundation for the smooth implementation of the project.

## 2. Project Overview

The county is located in the west of Guanzhong Plain in Shaanxi Province, bordering Linyou County in the north, Taibai County in the south, Fufeng County and Meixian County in the east,

and Fengxiang District and Chencang District in the west. It starts from Qilihe in the east, ends at Fengminggou in the west, ends at Wafanggou in the south and ends at Mengjia Mountain in the north, between 107°33'-107°55'E and 34°07'-34°37' N. The project area is located in the East Asian monsoon region, with an annual average temperature of 11.9 °C and obvious seasonal precipitation. The minimum precipitation in winter is 18.4 mm, accounting for 3% of the annual precipitation; Spring increased by 144 mm, accounting for 23% of annual precipitation; Summer precipitation is the largest, 268 mm, accounting for 42% of annual precipitation; The autumn precipitation is 201 mm, accounting for 32% of the annual precipitation, and the annual average wind speed is 2.3 m/s. The project area is located in the piedmont and the upper part of the diluvial and alluvial fan. The soil type is mainly loess, which is a mixture of new loess and old loess; The loess soil layer is deep, with a thickness of more than 60 cm, and high nutrient content. It has the characteristics of virtual upper and solid lower, water and fertilizer conservation, drought and waterlogging resistance. The thickness of the tillage layer is 30 cm, with medium soil, granular and lumpy structure, and the bulk density of the tillage layer and the bottom layer of the plough are 1.25 g/cm<sup>2</sup>~1.42 g/cm<sup>2</sup> and 1.40 g/cm<sup>2</sup>~1.78 g/cm<sup>2</sup> respectively; The porosity is 50.38% and 42.27% respectively; The content of organic matter in the ripening layer is generally 1.0%~1.2%, and the content of total mineral nutrient elements is more, with total nitrogen mostly 0.07%~0.08% and total potassium 2%~3%, but the effective content is lower, with phosphorus deficiency more prominent, and serious boron, zinc and iron deficiency. The replacement amount of salt base in the topsoil is 10 me~14 me/100 g soil, and the pH value is between 8.15 and 8.5. The ability to maintain and supply fertilizer is good. According to the land use change database in 2020, the total cultivated land in the project area is 1502.1730 hm<sup>2</sup>, including 177.6391 hm<sup>2</sup> of irrigated land and 1324.5339 hm<sup>2</sup> of dry land.

### 3. Main Construction Contents in the Project Area

The main problem of grain production in the county is the low land productivity. The reason for the low yield is the low effective utilization rate of water resources, and the situation of water shortage and waste. The effective use of water resources is the main problem that determines the increase of grain production in Changqing Town, Fengxiang District. It is the bottleneck to improve the land productivity. If the effective utilization rate of water is increased by 10%~20% from the current level, the land production potential will have a very significant breakthrough. According to the high standard farmland construction project plan, the county will vigorously promote pipe irrigation in irrigation areas to improve water efficiency; At the same time, we will strengthen the construction of supporting facilities and water-saving transformation in irrigation areas, and improve the water utilization coefficient of the canal system. As the land reclamation rate in the project area is 100%, the crops in the project area are two crops a year, and the cultivated land multiple cropping index is 100%. The land reclamation rate and land utilization rate in the project area are high, but due to the independent development of farmers, the utilization rate of water resources in the project area is low, there are basically no irrigation facilities, the yield rate of cultivated land is low, and the quality grade of dry land is low. Therefore, in the planning and design, the plots in the project area that need to improve supporting facilities should be designed and improved to increase the yield of cultivated land and improve the quality of cultivated land. The construction content of the project mainly includes land leveling, soil improvement, irrigation and drainage, field roads, farmland power transmission and distribution, etc. The details are as follows:

Land leveling is the basis of agricultural mechanized production and irrigation and drainage, road construction, etc., and the purpose is to facilitate mechanized farming, give full play to mechanical production efficiency, improve the quality of mechanized farming, facilitate crop

growth, facilitate soil and water conservation, meet irrigation and drainage, and facilitate field farming and management. The land leveling in the project area is planned in this plan, mainly in the form of small pieces and large pieces. The fine farmland will be consolidated for centralized mechanical cultivation. The land leveling area is 2320 mu, and the earthwork volume is 312425 m<sup>3</sup>.

According to the collected soil related data, the content of soil nutrients and organic matter is low, nitrogen and phosphorus nutrients are deficient, potassium content is high, the soil trace elements are rich in copper and iron, and boron, zinc and manganese are deficient. This soil improvement is mainly aimed at the serious imbalance of soil nitrogen in the project area. Soil structure improvement: soil structure improvement is to promote the formation of soil aggregates, improve soil structure, improve fertility, fix topsoil, protect soil topsoil and prevent soil erosion by applying natural soil improvers (such as humic acid, cellulose, biogas residue, etc.) and artificial soil improvers (such as polyvinyl alcohol, polyacrylonitrile, etc.). The soil was improved by adding organic fertilizer, covering an area of 1470 mu. A new pumping station will be built, with 800m of DN500 straight steel pipes, 3230m of DN400 straight steel pipes and 3230m of DN350 straight steel pipes. 4554 m of dn225UPVC pipes and 14987 m of dn160UPVC pipes are laid for the main water transmission pipe project, 32300 m of dn110UPVC pipes are laid for the irrigation pipe network project, 367 valve wells and 1100 sets of water hydrants. 5.7 km of 4m wide field road and 15.9 km of 4m wide production road were renovated. 2323 platycladus orientalis and 1523 plum trees were planted in the road protection forest. A new S13M-4000/35/10kv transformer will be built, with 4.3 km of 10kV cable, 5.6 km of 380V cable, 5 km of 35kV line and 1.23 km of communication cable.

#### 4. Assessment Method

According to the Grading Rules for Agricultural Land Quality (GB/T 28407-2012), the cultivated land quality grade of the land improvement project is evaluated by the multifactor comprehensive analysis method. The new grain production capacity is calculated according to the increase of 100 kg/mu for each grade of cultivated land.

Based on the current land use map in the project area, the 25 assessment units are those with relatively concentrated and contiguous cultivated land, consistent land types, little difference in the current situation, and consistent grading factor indicators. According to the actual situation of the project, the QS County High-standard Farmland Construction Project is located in the east and north of the county, involving 5 administrative villages. The cultivated land improvement project is divided into 25 evaluation units according to the cultivated land map spots.

**Table 1.** Specified crop grading factors and weights in the Weihe Plain in Guanzhong

factor crop	Effective soil layer thickness(cm)	Topsoil texture	Salinization degree of soil	Soil organic matter content(g/kg)	Drainage conditions	Terrain slope	Irrigation assurance rate	Irrigation water source
winter wheat	0.17	0.07	0.10	0.18	0.07	0.10	0.25	0.06
Summer corn	0.15	0.07	0.09	0.16	0.07	0.10	0.29	0.07

The grading factors for the selection of designated crops in the Guanzhong Weihe Plain where the county is located are: effective soil layer thickness (cm), surface soil texture, soil salinization degree, soil organic matter content (g/kg), drainage conditions, terrain slope, irrigation assurance rate and irrigation water source. In the Guanzhong Weihe Plain where QS County is

located, the grading factors and their weights of designated crop and cultivated land are shown in Table 1.

## 5. Results and Analysis

The cultivated land in the project area is evaluated by the "multifactor comprehensive evaluation method" in strict accordance with the Grading Rules for Agricultural Land Quality (GB/T 28407-2012). After the implementation of the project, the national natural quality grade is between 8-9, the national utilization grade is between 9-10, the national economic grade is between 10-11, the national natural quality grade of the original cultivated land in the project area is between 8-12, the national utilization grade is between 9-12, and the national economic grade is between 10-12. It is estimated that the new grain production capacity will be 3000 tons. After the implementation of the project, the output value can be increased by 9 million yuan, with considerable economic benefits. The construction quality and later management and protection of the project are closely related to the quality of cultivated land. Therefore, in order to ensure that the quality of cultivated land after the implementation of the project meets the design requirements, it is recommended that the implementation of the project strictly follow the design of the project construction drawings, combine with the current technical specifications, standards, etc., formulate strict quality supervision standards, strictly control the construction quality, and establish and improve the project management and protection system, clarify the management and protection unit, the main responsible person, the management and protection responsible person and their respective rights Responsibilities, etc. In addition, it is also necessary to establish a project management and protection fund guarantee system, clarify the funding channels, and establish the collection, use, approval, and supervision responsibilities of funds. At the same time, high standard basic farmland construction projects focus on four types of farmland construction projects: land leveling, irrigation and drainage, farmland roads, farmland protection and ecological environment maintenance. However, some engineering construction contents, such as farmland roads, cannot reflect their construction effects through existing grading index factors. In addition, there are certain difficulties in significantly improving the content of farmland organic matter within a certain period of time, it is also an important research content for further evaluation of cultivated land in the future.

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