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Exploration into the Production Capacity of High Standard Farmland in Xi'an City

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Abstract

As the foundation of agricultural production, the quality of farmland directly affects the yield and quality of crops. Building high standard farmland is a key measure to consolidate and improve grain production capacity and ensure national food security. The implementation of high standard farmland construction projects not only ensures that the cultivated land area is not reduced, but also increases the retention of high-quality cultivated land resources in China. With the help of infrastructure construction and farmland water conservancy facilities, the planting conditions in cultivated areas have been improved, which not only improves the quality of cultivated land, but also promotes agricultural income to a certain extent and promotes rural revitalization. This article analyzes the impact of the high standard farmland construction project in Xi'an on grain production capacity. After the project was implemented, it improved agricultural production conditions, enhanced the quality of arable land, increased farmers' income, and greatly improved the efficiency of project construction.

Keywords

High Standard Farmland; Cultivated Land Productivity; Key Technologies.

1. Introduction to Farmland Capacity

The grain production capacity of arable land (hereinafter referred to as "arable land capacity") depends on the area and quality of arable land, as well as the level of agricultural technology. For a piece of farmland, its production capacity refers to the ability of the farmland to produce food under the optimal conditions of crop production management inputs such as fertilizers and pesticides at the current technological level. The production capacity of arable land is measured by the amount of grain that can be produced per unit area of arable land, expressed in kilograms per hectare or kilograms per acre. The current level of technology referred to here refers to the optimal crop varieties and the production management measures such as irrigation, fertilizers, pesticides, and cultivation that are compatible with the optimal crop varieties. For a region, its arable land capacity depends on the total production capacity of all arable land in the region.

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The broad category of grain includes three types of crops: grains, potatoes, and legumes. The growth period of various food crops is different. Among them, areas with high accumulated temperature have greater freedom in choosing to plant crops; In areas with low accumulated temperature, there is less freedom in choosing to plant crops. For example, corn and rice with long growth periods can be planted in the central and southern parts of Heilongjiang Province, while soybeans with short growth periods can only be planted in the northern regions. In certain regions (such as plateaus and high mountains), only barley and buckwheat with shorter growth periods can be planted.

The author believes that the quantity and quality of arable land are influenced not only by natural resource conditions such as climate, terrain, geology, soil, hydrology, but also by socio-economic conditions, namely the demand for cultivation and the construction of farmland infrastructure after cultivation.

Firstly, the quantity of arable land is constrained by natural resource conditions and the demand for arable land from social development. China has a vast land area, but due to the mismatch between water and thermal resources and land space, as well as the impact of large mountainous areas, the cultivated land area is not large, accounting for only 13.31% of the land area, and some of it is formed due to excessive cultivation caused by high food demand pressure.

Secondly, although the quality of arable land mainly depends on natural conditions, human activities such as irrigation, drainage, road construction, land leveling, and soil improvement also have a significant impact on the quality of arable land.

Finally, the level of agricultural production technology has a significant impact on the productivity of arable land. The level of agricultural technology includes crop varieties, fertilizers, pesticides, agricultural machinery, etc. Although China's agricultural production started early, the level of agricultural production technology has always been low in history, resulting in low per unit yield of arable land. It has been relying on expanding arable land to maintain the livelihoods of tens of millions of people. After the introduction of high-yield crops such as corn and sweet potatoes into China, especially the widespread use of fertilizers and pesticides, it has greatly increased the yield of grain and enabled people to live a well fed and well fed life. Since the reform and opening up, China's total grain output has grown rapidly and continuously, and the level of agricultural production technology during this period has made a greater contribution to the capacity of arable land.

The annual grain yield of cultivated land is influenced by planting structure, management input, and climate of the year. On the one hand, in actual production, not all arable land is used for grain production. Some cultivated land is used for growing crops such as vegetables, cotton, oilseeds, and even fruits. The planting area ratio of various crops such as grain, cotton, rapeseed, fruits, etc. is called planting structure in the agricultural field. Farmers will often spontaneously adjust their planting structure according to market demand, and agricultural and rural authorities will also focus on "rice bags" and "vegetables".

2. Capacity Calculation Method

Fit the formula to establish the quantitative relationship between the comprehensive index of cultivated land quality evaluation and grain production capacity; Substitute the comprehensive index of cultivated land quality into the fitted function to calculate the grain yield of each plot.

2.1. Fitting Formula

The country is divided into 9 first level agricultural areas and 37 second level agricultural areas. Multiple rounds of scoring are conducted according to the Delphi method to provide the annual grain yield corresponding to each level (5 or more comprehensive indices). The collected and summarized results of quantitative judgment usually follow a normal distribution. Remove 25%

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of the opinions from each paragraph, find the most concentrated range of opinions, and provide evaluation and judgment again. As shown in Table 8-1, the annual grain yield corresponding to each level (average comprehensive index) of 10 sets of secondary agricultural areas is finally given.

2.2. Calculate the Grain Yield of Each Plot

37 membership function models were fitted nationwide (Taiwan's agricultural and forestry regions did not participate in the evaluation), and the comprehensive score of each cultivated land plot was substituted into the formula to calculate the grain production capacity of each cultivated land.

$$y = \begin{cases} y_{min} \cdots\cdots u \leq u_1 \\ \dfrac{b}{1+a(u-c)^2} \cdots\cdots u_1 < u < u_2 \\ y_{max} \cdots\cdots u \geq u_2 \end{cases}$$

In the formula, y is the level of grain production capacity, ymin is the production capacity calculated based on the average of the lowest level comprehensive index, ymax is the production capacity calculated based on the average of the highest level comprehensive index, u is the comprehensive index score, u1 is the average of the lowest level comprehensive index, u2 is the average of the first-class comprehensive index, a and b are coefficients, and c is the standard value.

The grain production capacity potential (Yp) of each plot is calculated by multiplying the grain production capacity level (y) of the plot by the plot area (S).

2.3. Statistical Summary

Sum up the potential grain production capacity of all high standard farmland plots in a region, $\sum Y_p$, to obtain the total grain production capacity of high standard farmland in that region, which is the theoretical annual total yield that the region should have under the current maturity system and natural conditions that meet crop growth.

The average production capacity level of high standard farmland in a region (Yg) can be calculated by dividing the total yield ($\sum Y_p$) by the total area of high standard farmland ($\sum S$), using the formula Yg=$\sum Y_p \,/ \sum S$.

The high standard farmland in Xi'an belongs to the agricultural area of the Fenwei Valley in the Loess Plateau region. Therefore, the fitting formula for the Fenwei Valley agricultural area is selected as follows:

y=b /((1+a(u-c)2))

3. Discussions

3.1. Production Capacity of High Standard Farmland in Xi'an City from 2020 to 2022

Through comparative analysis of cultivated land production capacity before and after construction, it is found that the average cultivated land production capacity before the construction of high standard farmland in Xi'an City from 2020 to 2022 was 925 kg/mu, and the average cultivated land production capacity after construction was 996 kg/mu, which increased by 70 kg/mu in the evaluation of cultivated land quality and production capacity.

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3.2. Production Capacity of High Standard Farmland in Xi'an City in 2022

The average cultivated land energy before the construction of high standard farmland in Xi'an in 2022 is 1010 kilograms per mu. Among them, Yanliang District with the highest average production capacity level (30089.48 acres) reached 1256 kilograms per acre; The average production capacity levels of Lintong District (25040.69 mu) and Chang'an District (10494.68 mu) are 1105 kg/mu and 941 kg/mu, respectively; The lowest average production capacity level is in Lantian County (13010.30 acres), at 795 kilograms per acre. After the construction of high standard farmland in Xi'an, the average arable land production capacity is 1091 kilograms per mu. Among them, Yanliang District with the highest average production capacity level (30089.48 acres) reached 1316 kilograms per acre; The average production capacity levels of Lintong District (25040.69 mu) and Chang'an District (10494.68 mu) are 1178 kg/mu and 973 kg/mu, respectively; The lowest average production capacity level is in Lantian County (13010.30 acres), at 901 kilograms per acre. By comparing and analyzing the production capacity of cultivated land before and after construction, it was found that the average production capacity of cultivated land before construction was 1010 kg/mu, and after construction it was 1091 kg/mu. This represents an increase of 81 kg/mu in the evaluation of cultivated land quality and production capacity.

3.3. High Standard Farmland Production Capacity in Xi'an City in 2021

Before the construction of high standard farmland in Xi'an, the average cultivated land capacity was 900 kilograms per mu. Among them, the highest average production capacity level is achieved in Yanliang District's high standard farmland (5000.00 acres), which reaches 1098 kilograms per acre; Next is the high standard farmland in Lintong District (37000.00 mu) with an average production capacity of 1094 kg/mu, Gaoling District (18875.55 mu) with an average production capacity of 926 kg/mu, Huyi District (20100.00 mu) with an average production capacity of 860 kg/mu, Lantian County (23900.00 mu) with an average production capacity of 858 kg/mu, Chang'an District (26000 mu) with an average production capacity of 820 kg/mu, and Zhouzhi County (29434.61 mu) with the lowest average production capacity of 740 kg/mu. After the construction of high standard farmland in Xi'an, the average arable land production capacity is 964 kilograms per mu. Among them, the highest average production capacity level is achieved in Yanliang District's high standard farmland (5000.00 acres), which reaches 1180 kilograms per acre; Secondly, the average production capacity level of high standard farmland in Lintong District (37000.00 mu) is 1149 kg/mu, in Gaoling District (18875.55 mu) is 998 kg/mu, in Lantian County (23900.00 mu) is 946 kg/mu, in Huyi District (20100.00 mu) is 913 kg/mu, and in Chang'an District (26000.00 mu) is 875 kg/mu. The lowest average production capacity level is in Zhouzhi County (29434.61 mu), with an average production capacity level of 802 kg/mu.

3.4. Production Capacity of High Standard Farmland in Xi'an City in 2020

Before the construction of high standard farmland in Xi'an, the average cultivated land capacity was 1046 kilograms per mu. Among them, the highest average production capacity level is in Yanliang District's high standard farmland (10014.80 acres), reaching 1170 kilograms per acre; Next is the high standard farmland (10000.00 mu) in Fengxi New City, Xixian New Area, with an average production capacity of 1061 kg/mu. The lowest average production capacity level is 910 kg/mu in Qinhan New City, Xixian New Area (4985.08 mu). After the construction of high standard farmland in Xi'an, the average arable land production capacity is 1104 kilograms per mu. Among them, the highest average production capacity level is the high standard farmland (10000.00 acres) in Fengxi New City, Xixian New Area, reaching 1219 kilograms per acre; Next is the high standard farmland (10014.80 acres) in Yanliang District, with an average production capacity of 1179 kilograms per acre. The lowest average production capacity level is in Qinhan

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New City, Xixian New Area (4985.08 acres), with an average production capacity of 912 kilograms per acre.

4. The Main Technologies Involved in Soil Improvement in the Construction of Four High Standards

4.1. Quantity of Soil Improvement Projects in High Standard Implementation

In the implementation process of high standard farmland in 2022, soil improvement mainly includes soil improvement and soil fertility enhancement. Among them, Yanliang District has improved soil fertility through measures such as returning straw to the field, deep loosening technology, and increasing the application of organic fertilizers, with a designed area of 30000 acres for soil fertility cultivation; Lantian County designed soil improvement for 13000 acres; Lintong District has improved the quality and fertility of farmland through soil testing and fertilization, using drones to apply microbial agents, covering a total of 18000 acres; Chang'an District distributed 60kg of organic fertilizer per mu and plowed and rotated soil improvement plots, resulting in a total of 10000 mu of soil improvement. In the construction of high standard farmland in Xi'an in 2022, a total of 71000 acres of soil will be improved.

4.2. Main Technologies for Soil Improvement

The main content of soil improvement projects in the construction of high standard farmland in Xi'an city is soil improvement and soil fertility enhancement.

The main methods include returning straw to the field, deep loosening technology, soil testing and fertilization, unmanned aerial vehicle application of microbial agents, and increasing the application of organic fertilizers to improve soil fertility, and plowing and rotating soil improvement plots.

① Straw scale mechanical crushing, composting and returning to the field

About 80% of the nutrients absorbed by plants, including potassium, 35% of nitrogen, and 20% of phosphorus, are stored in straw. Returning straw to the field can return nutrients, effectively improve soil quality, and reduce the amount of chemical fertilizers used in crop cultivation. Vigorously promote the technology of straw crushing and returning to the field, as well as the technology of straw and decomposed returning to the field. Promote the use of operating machinery that integrates straw weighing, application of decomposed agents, deep plowing of soil, and leveling to improve the effectiveness of straw returning to the field. After the crops are ripe, a combine harvester can be used to chop the crop straw while harvesting, evenly cover it on the surface, and flip it into the soil for burial. Before spring sowing, apply organic fertilizer based on soil fertility and fertilizer requirements. By applying straw returning technology, the total amount of fertilizer applied can be effectively reduced.

② Organic fertilizer

Vigorously promote the use of organic fertilizers, also known as farmyard manure. Common organic fertilizers are mainly made by fermenting and maturing animal manure and urine compost. After applying organic fertilizer, the amount of chemical fertilizer used can be reduced. Strengthen the scientific application of soil testing and formula fertilization technology, grasp the total amount of fertilizer required for crops, and clarify the application amount of organic and chemical fertilizers.

③ Drone application of microbial agents

Adjusting soil acidity and alkalinity, some Bacillus subtilis contained in microbial agents can produce various organic acid substances during the growth and reproduction of plant rhizosphere, thereby fine-tuning the acidity and alkalinity of plant rhizosphere in alkaline environments; In acidic environments, beneficial bacteria in this product can use organic acids

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as carbon sources for growth metabolism, thereby reducing acidity and regulating the acidity of plant rhizosphere under acidic conditions. The level of humus content in soil is an important indicator of soil fertility, and the conversion of organic matter to humus requires a series of biochemical reactions. If Ye Hong light microbial agent is applied, on the one hand, beneficial bacteria secrete various enzymes, which will enhance soil enzyme activity; On the other hand, due to the massive proliferation of beneficial bacteria, the microbial community expands, accelerating the conversion of humic acid in the soil, providing substrates for enzyme activity, which in turn stimulates and enhances soil enzyme activity, thereby accelerating the conversion of organic matter to humus.

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