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Impact of Water Supply Guarantee on Grain Production Capacity of High-Standard Farmland Construction

Kehong Sun

Shaanxi Construction Land Survey Planning and Design Institute Co., Ltd. 710075, China

Abstract

China is a large agricultural country, and agriculture is an important industry to promote economic development. In order to promote agricultural economic development and increase agricultural production, the construction of high-standard farmland water conservancy projects is crucial. It belongs to one of the rural grass-roots construction projects, which has an important impact on promoting the economic development of rural areas and improving the current situation of rural development. High-standard farmland water conservancy project has the function of water storage irrigation, and its construction is conducive to the rational use and conservation of water resources.

Keywords

High-standard Farmland; Water Supply Guarantee; Reservoir Resources; Irrigation Assurance Rate; Grain Production Capacity.

1. Introduction

The Party Central Committee and the State Council attach great importance to the protection of cultivated land and the improvement of soil fertility, unswervingly focus on the construction of high-standard farmland, and improve the construction standard and quality.In order to better implement the decision and deployment of the CPC Central Committee and the State Council on strengthening the construction of high-standard farmland, in 2019, the Shaanxi Provincial People's Government issued the Opinions on Steadily Increasing Grain Production Capacity to Ensure Food Security (SZF [2019] No. 16), proposing to integrate projects such as farmland renovation, farmland water conservancy, new grain production capacity of 100 billion kilograms, and farmland quality improvement in accordance with the requirements of "strengthening the foundation, improving production capacity, and ensuring supply", Focus on the grain production functional areas, take the promotion of the whole township and the whole county, and strive to basically build a high-standard grain field suitable for mechanized operation with drought and waterlogging, guaranteed yield and improved soil fertility by one grade within five years.

2. Overview of the Project Area

The project area 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, ends at Mengjia Mountain in the north, and is between 107°33′-107°55′E and 34°07′-34°37′N. The project site belongs to a warm temperate semi-humid climate with distinct cold, warm, dry and wet seasons. In spring (from March to May), the earth warms up, precipitation increases, cold air activities are frequent, daily temperature range is large, and cold wave, strong wind, frost and spring drought are prone to occur; In summer (June to August), the temperature is the highest, the precipitation is the largest, and the light is sufficient. However, due to the difference of terrain

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and thermal effect, the precipitation distribution is uneven. It is dry in early summer and summer, and there are often strong winds, rainstorm, and hail in the later period; In autumn (September to November), the early autumn is overcast and rainy, the temperature drops slowly, the humidity is high, the light decreases, the late autumn is high and cool, the temperature drops sharply, the drought is less rainy, the monsoon is significant, and the continental is strong. In winter (December to February next year), the climate is cold, dry and rainy. Jingdang Pump Station is located in Jingdang Town where the project is located, and Qijiagou Reservoir is located in the south of the project area.

3. Water Supply Guarantee in the Project Area

The facility area of Jingdang Pumping Station is 15540 mu, which mainly irrigates the farmland of Jingdang Township, Qishan County. From the headrace to the north through 845 meters of tunnel, a first-level station is built in Beiqi Village, with a lift of 22.80 meters, five installed units, a capacity of 455 kW, a pumping capacity of 0.66 m^3/s, and a facility irrigation area of 980 mu. The secondary station is located in Yali Village, with a lift of 33.67 meters, 4 installed units, a capacity of 300 kilowatts, a pumping capacity of 0.54 cubic meters per second, and a facility irrigation area of 8500 mu. The tertiary station is built in Xiahe Village, with a lift of 26.50 meters, two installed units, a capacity of 200 kW, a pumping capacity of 0.44 m^3/s, and a facility irrigation area of 1900 mu. The fourth level station is built in Zhonghe Village, with a lift of 28 meters, two installed units, a capacity of 110 kilowatts, a pumping capacity of 0.26 cubic meters per second, and a facility irrigation area of 4160 mu. The supporting works of the canal system include 4 branch canals with a length of 14km; 282 buildings.

Qijiagou Reservoir is located in the north of Qijiagou Village, Qinghua Town, Qishan County. The stake number of the north trunk canal is 33+878~34+268. The project is based on the 26-meter-high earth dam of Qijiagou Reservoir, which was built in Qishan County in 1958. To ensure the water delivery of the North Main Canal and also for comprehensive utilization of fish farming. The drainage area is 35.06 square kilometers, the total storage capacity is 4.27 million cubic meters, and the effective storage capacity is 2 million cubic meters. The project is composed of earth dam, drainage tunnel and inlet channel. The earth dam is 384 meters long, 37.58 meters high, the maximum dam bottom width is 200 meters, the dam crest length is 308 meters, the dam crest width (including the channel mouth) is 22 meters, the left channel embankment is also used as a highway, 7 meters wide, and the right channel embankment is 5 meters wide. The drainage tunnel of the old dam on the right bank is blocked, and a new drainage tunnel is set for irrigation and flood discharge, with a length of 112.57 meters, of which the pressure tunnel is 41.25 meters long and the tunnel diameter is 1 meter; The pressure tunnel is connected with a drainage tower, with a height of 22.38 meters, an inner diameter of 3 meters, and a maximum drainage flow of 7.04 m^3/s. The intake channel at the right dam head consists of the north main canal control gate, the intake gate and the two steep slope intake channels behind the gate. The total length of the intake channel is 187 meters, and the two-stage steep slope enters the reservoir, with a total drop of 21.53 meters, a design flow of 19 m^3/s, and an increased flow of 23 m^3/s.

4. Analysis of Project Construction Conditions

The main factors affecting the project construction include infrastructure construction conditions, land use restrictions and public participation. Among them, the infrastructure construction conditions are mainly analyzed from three aspects: transportation facilities, irrigation and drainage pipe network facilities and power facilities to judge the development and use status of infrastructure in the project area; The limiting factors of land use are analyzed from the aspects of natural limiting factors, agricultural facilities limiting factors and other

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limiting factors to determine the main factors restricting the development of high standard farmland; Public participation is based on the will of the people to understand the essence of the construction of the project area. Starting from these three directions, we should reasonably analyze the current situation, find out the problems and find solutions, and provide a solid basis for the later development and construction planning of high-standard farmland.

5. Balance Analysis of Water and Soil Resources

Jingdang Pump Station is located in Jingdang Town where the project is located, and Zhujing Reservoir and Qijiagou Reservoir are located in the south of the project area.The facility area of Jingdang Pumping Station is 15540 mu, which mainly irrigates the farmland of Jingdang Township, Qishan County. From the headrace to the north through 845 meters of tunnel, a first-level station is built in Beiqi Village, with a lift of 22.80 meters, five installed units, a capacity of 455 kW, a pumping capacity of 0.66 m^3/s, and a facility irrigation area of 980 mu. The secondary station is located in Yali Village, with a lift of 33.67 meters, 4 installed units, a capacity of 300 kilowatts, a pumping capacity of 0.54 cubic meters per second, and a facility irrigation area of 8500 mu. The tertiary station is built in Xiahe Village, with a lift of 26.50 meters, two installed units, a capacity of 200 kW, a pumping capacity of 0.44 m^3/s, and a facility irrigation area of 1900 mu. The fourth level station is built in Zhonghe Village, with a lift of 28 meters, two installed units, a capacity of 110 kilowatts, a pumping capacity of 0.26 cubic meters per second, and a facility irrigation area of 4160 mu. The supporting works of the canal system include 4 branch canals with a length of 14km; 282 buildings.

Zhujing Reservoir has an effective storage capacity of 900000 cubic meters, and Qijiagou Reservoir is upstream for water replenishment. Qijiagou Reservoir is located in the north of Qijiagou Village, Qinghua Town, Qishan County. The stake number of the north trunk canal is 33+878~34+268. The project is based on the 26-meter-high earth dam of Qijiagou Reservoir, which was built in Qishan County in 1958. To ensure the water delivery of the North Main Canal and also for comprehensive utilization of fish farming. The drainage area is 35.06 square kilometers, the total storage capacity is 4.27 million cubic meters, and the effective storage capacity is 2 million cubic meters. The project is composed of earth dam, drainage tunnel and inlet channel. The earth dam is 384 meters long, 37.58 meters high, the maximum dam bottom width is 200 meters, the dam crest length is 308 meters, the dam crest width (including the channel mouth) is 22 meters, the left channel embankment is also used as a highway, 7 meters wide, and the right channel embankment is 5 meters wide. The drainage tunnel of the old dam on the right bank is blocked, and a new drainage tunnel is set for irrigation and flood discharge, with a length of 112.57 meters, of which the pressure tunnel is 41.25 meters long and the tunnel diameter is 1 meter; The pressure tunnel is connected with a drainage tower, with a height of 22.38 meters, an inner diameter of 3 meters, and a maximum drainage flow of 7.04 m^3/s. The intake channel at the right dam head consists of the north main canal control gate, the intake gate and the two steep slope intake channels behind the gate. The total length of the intake channel is 187 meters, and the two-stage steep slope enters the reservoir, with a total drop of 21.53 meters, a design flow of 19 m^3/s, and an increased flow of 23 m^3/s.

6. Project Layout

6.1. Land Leveling Works

According to the terrain and planting structure of the project area, the fields of other grasslands in the project area shall be leveled. The fields shall be arranged according to the requirements of facilitating mechanized farming, giving full play to mechanical efficiency, improving the quality of mechanized farming, and meeting the requirements of self-flow irrigation and self-flow drainage in the fields. In each flat field, the excavation and filling balance of the earth shall

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be maintained, and it is not necessary to take a large amount of soil from outside the area or transport it out in a large amount, so as to reduce the project investment. Topsoil stripping shall be carried out before land leveling. Topsoil stripping is to strip and stack the existing soil with high fertility in the project area first, and then cover it back into the project area as a cultivation layer after land leveling; The land leveling project is the main project. The original ground slope of other grasslands in the project area is relatively large. In order to meet the needs of agricultural production, it is determined to level other grasslands in the project area into strip fields. Considering the reasonable distribution and the balance of excavation and filling nearby, the optimal allocation between the field leveling and the minimum amount of earthwork is to minimize the amount of work. The design is to level the plots in the project area separately to balance the amount of excavation and filling earthwork in the plots. It is required that the sorted fields are conducive to the normal growth of crops, conducive to field mechanical farming, and meet the needs of irrigation and drainage.The land leveling area of the project area is 4.2527hm^2, the topsoil stripping earthwork volume is 12758m^3, and the moving earthwork volume is 25516m^3.

6.2. General Exploration and Restoration of Cultivated Land Quality

The general exploration project in the project area is mainly to investigate and collect relevant natural, geographical, agricultural, economic, social and other information, and focus on the site survey and sampling analysis of the soil foundation in the project area, select typical points as fixed monitoring points, and provide detailed basic data basis for the project design. The cultivated land quality restoration project in the project area will carry out targeted remediation for various obstacles such as hardening, saline-alkali and pollution found in the general exploration in the project area, and improve the soil structure by appropriate tillage, and increase the soil fertility by applying organic fertilizer, chemical fertilizer and microbial inoculants. After the restoration of cultivated land quality, the quality of cultivated land in the region shall be monitored and controlled for at least three years. After the completion of land leveling, the quality of cultivated land in the project area will be restored to improve the quality of cultivated land. The soil structure is improved by appropriate tillage, and the soil fertility is improved by applying organic fertilizer, chemical fertilizer and microbial agent. The improvement standard should meet the requirements of improving soil organic matter, and the bio-organic fertilizer should be applied according to the standard of 150kg/mu.

6.3. Irrigation and Drainage Works

The layout design idea of this irrigation project is to use the surface water around the project area, lift the water to the regulating tank through the new pump station, and then connect the low pressure pipeline for self-flow irrigation. The station site will demonstrate the technical reliability and economic rationality of water intake in the reservoir area according to the relative location of the irrigation area and the reservoir, the geological conditions and the change of the reservoir water level, and select the location where the bank slope is stable, close to the irrigation area, the water intake is convenient, and is not or less affected by sediment deposition and freezing. The irrigation water intake pump station in the project area takes water from Zhujing Reservoir. A pontoon pump station is set in the reservoir to lift the water to the secondary pump station, and then the secondary pump station supplies water to 10 high level regulating tanks. Each regulating tank is connected to the low pressure pipeline to irrigate the cultivated land automatically. For the planned field irrigation and water distribution project, the length of DN 63UPVC pipeline is 12463m, the length of DN 75UPVC pipeline is 15687m, the length of DN 90UPVC pipeline is 3807m, the length of DN 110UPVC pipeline is 18503m, the length of DN 125UPVC pipeline is 8556m, the length of DN 140UPVC pipeline is 3751m, the length of DN 160UPVC pipeline is 3675m, and the length of DN 180UPVC pipeline is 2859m. 3 two-way gate valve wells (inner diameter 600mm), 25 two-way gate valve wells (inner

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diameter 800mm), 13 three-way gate valve wells (inner diameter 600mm), 78 three-way gate valve wells (inner diameter 800mm), and 3 four-way gate valve wells (inner diameter 600mm); There are 19 pressure relief valves, 147 drain wells, 201 DN 63 outlet piles, 257 DN 75 outlet piles and 470 DN 90 outlet piles.

7. Analysis of Grain Production Capacity and Economic Benefits

Table 1. Calculation of cultivated land value before project implementation

Crop name	seeded areahm²		per unit area yield	unit-price	value of output	Average production cost per mu	production costs	Net profit
			kg/mu	yuan/kg	10000 yuan	yuan	10000 yuan	10000 yuan
winter wheat	Irrigate the land	675.4	400	3	1215.80	580	587.64	425.61
Summer corn	Irrigate the land	675.4	500	2.5	1266.46	550	557.24	480.53
winter wheat	dry farm	302.3	280	3	380.90	300	136.03	62.15
Summer corn	dry farm	302.3	380	2.5	430.78	280	126.97	77.12
amount to					3293.94		1407.88	1886.06

Table 2. Calculation of cultivated land value after project implementation

Crop name	seeded areahm²		per unit area yield	unit-price	value of output	Average production cost per mu	production costs	Net profit
			kg/mu	yuan/kg	10000 yuan	yuan	10000 yuan	10000 yuan
winter wheat	Irrigate the land	1007.2	550	3	2493.00	550	831.00	1662.00
Summer corn	Irrigate the land	1007.2	650	2.5	2455.23	530	800.78	1654.45
amount to					4948.23		1631.78	3316.45

After the implementation of the general exploration and restoration project of cultivated land quality, irrigation and drainage project, and farmland power transmission and distribution project, the dry land in the project area is planned to improve the quality of cultivated land by 0.77 after irrigation compared with that before implementation. According to each grade of cultivated land, the new grain capacity will be 100 kg, and the new grain capacity will be 1163 t after the implementation of the project.

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