ISSN: 2414-1895 DOI: 10.6919/ICJE.202203_8(3).0021

The Practice on Water-saving Irrigation System in the Northwest China

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Abstract

In view of the increasing tension of agricultural water resources in China, which had posed a serious threat to social and economic development. Improving the utilization rate of water resources, adopting different water-saving irrigation techniques, applying advanced water-saving irrigation products and taking the road of water-saving agriculture was the only way to the sustainable development of Chinese agriculture. However, the current automatic irrigation control system in China was generally not high enough in terms of technical maturity and the technology promotion and practice of related products was still at a low level. In this investigation, we set up a efficient water-saving irrigation system and had the practice in the Northwest China.Moreover, the strength and threats of our newly setup system were also considered in the research.Our products not only improved the utilization rate of agricultural resources, but also contributed to the development of high-yield, high-efficiency, high-quality and intensive modern agriculture in China.

Keywords

Agriculture; Water Conservation; Irrigation System.

1. Introduction

Water is one of the natural resources closest to human beings and the condition of water resources determines the life and death of the country and the nation. By 2020, water resources in China were about 2,300 cubic meters per person, regarding as one of 13 water-poor countries and ranking 121st in the world. The situation of water resource would be more serious in the northwest China. Agricultural irrigation referred to the irrigation of agricultural cultivation areas. It can be divided into traditional surface irrigation, general sprinkler irrigation and micro-irrigation. Traditional surface irrigation includes border irrigation, furrow irrigation, flood irrigation and diffuse irrigation, but these irrigation methods were often very water-intensive and had a low water use capacity, making them a very unreasonable form of agricultural irrigation. In addition, common sprinkler irrigation technology was a more common form of irrigation in Chinese agricultural production. However, the water utilization efficiency of common sprinkler irrigation technology was also low even in the northwest

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area. When irrigating dry-lands, the use of ordinary watering methods tended to result in low water utilization due to the dryness of the ground and the lack of water, which resulted in wasted water resources and inconvenient use. Therefore, the way out of the water shortage problem was to develop water-saving agriculture, promoting water-saving irrigation in the northwest of China, even throughout the country.

Compared to traditional irrigation methods, the application of this system can achieve 50% water saving, 30%-40% fertilizer saving, 50% reduction in pesticide application (including pesticides, herbicides, etc.), 10% increase in land utilization, higher yields and improved quality, reduced labor intensity and digital management of irrigation. In addition, it can effectively solve the current problems of sloppy, wasteful and inefficient agricultural irrigation, fertilization and management, and is of great significance in guiding farmers to carry out scientific and reasonable irrigation and management, and increasing the international competitiveness of agricultural products.

2. Methods

This intelligent irrigation and fertilizer system was an agricultural high-tech product integrating many technologies such as machinery, water conservancy, plants, soil, automatic control, microelectronics and detection, etc. It integrated the functional characteristics of advanced automatic control irrigation systems at home and abroad. The whole control system has four irrigation control modes: timing control, cycle control, manual control and condition control, each control mode can operate individually or in a mixture of several control modes. At the same time, it realized the unification of fertilization and filtration functions, which not only had the significant features of saving water, fertilizer, increasing yield and improving quality, reducing labor intensity and realizing digital management of irrigation, but also effectively solved the current problems of sloppy, wasteful and inefficient agricultural irrigation, fertilization and management. It was important to guide farmers in scientific and rational irrigation and management, and to increase the international competitiveness of agricultural products.

The layered distributed computer-controlled intelligent irrigation and fertilizer system was a key technology supported and developed by the state, and was a key product for high-tech agriculture, which was in line with the development direction of "two highs and one excellent" in modern agriculture, and can completely replace imported products. During the development stage, the system has been successfully promoted in Beijing, Hebei, Gansu, Inner Mongolia and other places for dozens of sets, and had a broad market application prospect.

3. Results

According to the experimental results, each crop of cucumber saved 60.0 m3 /mu of water, and two crops were grown in a year. As water costs increased, the water-saving benefit of using a computer-controlled intelligent irrigation and fertilizer system will become more apparent. Fertilizer application at the same time as irrigation improves the uniformity of fertilizer application and the utilization rate of fertilizer, which help to reduce the occurrence of diseases and improve the soil environment. Each cucumber crop saved 30kg/mu of fertilizer basis on manual fertilization, and the fertilizer cost was calculated at RMB1.6/kg, saving RMB96 per mu per year. The use of intelligent irrigation and fertilizer systems has greatly reduced the number of daily management staff. In Beijing, normally one planting manager is needed for every three greenhouses, but with this system, one planting manager was needed for every five greenhouses. At a salary of 600 RMB per month per manager, labor costs can be reduced by 960 RMB per mu per year. If the system was applied to a large planting area, there will be significant labor savings and reduced irrigation management costs. It was expected that with this system, each cucumber crop will yield 90 kg/mu more than with the micro-irrigation system, resulting in an additional income of $180 per mu. The increase in yield will be even more obvious due to the improved quality and increased market price.

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4. Discussion

4.1 Opportunities

The Chinese government has always invested heavily in agriculture and has provided policy support to companies engaged in the production and sale of agricultural equipment. In 2005, the Central Committee of the Communist Party of China listed "building a new socialist countryside" as one of the top ten strategies for scientific development in the next five years. In 2021, the No. 1 document of the Central Government proposed to speed up the modernization of agriculture and rural areas by comprehensively promoting the revitalization of the countryside. The initiative.

China's agricultural water resources were tight and the development of water-saving agriculture was imperative. For agricultural water resources, the problem was not an only shortage, but also the fact that in the 21st century, with the development of social and economic development and the improvement of people's living standards, the water demand has increased dramatically. In China, the place where water resources were relatively poor, industrial and domestic water use will rise sharply as a result of sustained and steady socioeconomic development and accelerated urbanization. Given the limited total amount of water available, agricultural water use was bound to decrease. In this sense, agricultural water resources will experience negative growth.

Moreover, water was the lifeblood of national economic and social development, and even more so of agriculture. Poor management of agricultural water resources has prevented advanced agricultural water conservation techniques and modern management measures from being applied and promoted on a large scale, resulting in extremely serious wastage of water resources. The water utilization coefficient of the canal system in China's major irrigation areas was only 40% to 60%, which meant that about half of the water is wasted. Field irrigation was used to large borders. Each time the irrigation volume was too large and the total irrigation quota was also on the high side. The irrigation quota in the northern irrigation areas was two to five times higher than the actual needs of the crop, and the waste was staggering. It has been estimated that 100 billion m3 of water was wasted in agriculture each year, and the increasing tension in China's agricultural water resources has posed a serious threat to social and economic development. Therefore, improving the utilization of water resources, applying water-saving irrigation products and following the path of water-saving agriculture was the way to sustainable agricultural development in China.

4.2 Threats

With the popularity of computer-controlled intelligent irrigation and fertilizer systems, more and more domestic companies will focus on this market, and companies originally already engaged in researching similar systems will accelerate the transformation of their product achievements, and new products and technologies will come out enthusiastically, thus forming potential competition. At present, most of the computer-controlled intelligent irrigation and fertilizer systems on the domestic market are foreign products, mainly from the USA and Israel. Agricultural automation in the USA and Israel has been developed to a high degree of maturity and these products are more assured in terms of quality. However, Agricultural users were accustomed to the old way of irrigation with large amounts of water and it took a long time for the products to be accepted by the market. The transition from something new to something old often took a long time and it was unlikely that agricultural users would accept our products immediately within a short period of time, they were still used to the traditional irrigation methods and the market acceptance time may be longer.

During the company's start-up period, it was not large and resources were relatively tight, making it inappropriate to get involved in markets that were too fragmented. Beijing, Tianjin, Gansu and Shanghai were four major municipalities with serious water shortages, and the government strongly supported the development of water-saving irrigation. Moreover, these four regions were more economically developed, which had a high level of agricultural high technology and attached great importance to urban gardening, so the market demand was relatively large. Generally, a set of intelligent irrigation and fertilization system controlling 8 stations costs 18-20 million yuan, not

including the additional costs for technical training, operation and maintenance, and equipment replacement. This was not affordable for the average small to medium-sized agricultural company or unit. Usually, these products in the other countries were sold in China through.

5. Summary

Water conservancy projects were major national project, and the research and implementation of water-saving irrigation systems for water conservancy projects were of great practical significance. From the current development of China in this regard, the design and planning of water-saving irrigation systems still have a series of problems. if we did not solve these problems in a timely manner, it will directly lead to the waste of irrigation water resources, the decline of economic benefits of water conservancy projects, and slowing down the development of the rural economy. Therefore, it was necessary to design and plan of water-saving irrigation in China, especially in the northwest of China. Our group developed an newest water-saving irrigation and made it available in the Gansu farmland. This product not only improved the utilization rate of agricultural resources, but also contributed to the development of high-yield, high-efficiency, high-quality and intensive modern agriculture in China.

Acknowledgments

This work was supported by the Natural Science Foundation Project of Fujian Province (Grants No.2020J05210, 2021J011105), the Key Research Project of Putian Science and Technology Bureau (Grants No. 2020NP001) the Regional Key Projects in Putian (Grants No. 2020GJQ005) and the National Project Fund for Student Innovation and Entrepreneurship (202111498024X) and Fujian Science and Technology Commissioner authorized by Jing Huang.

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