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# Research Progress on informatization of irrigation area and optimal allocation of agricultural water resources

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## Abstract

**Irrigation area is our important grain production base. It is of great significance to improve the management level of irrigation water distribution, ensure food security and increase grain output. How to manage irrigation water scientifically under the condition of water shortage has become an urgent need to ensure regional food security and ecological security. This paper discusses the research progress of irrigation area informatization and optimal allocation of water resources in irrigation area.**

## Keywords

**Irrigation area agriculture; Promotion of information technology; Allocation of water resources; Water saving irrigation.**

## 1. Introduction

In recent years, agricultural water accounts for more than 60% of the total domestic water consumption, and more than 90% of agricultural water is used for irrigation. The effective utilization coefficient of irrigation water is about 0.5, which is far from 0.7-0.8 in developed countries. Therefore, under the influence of the uneven temporal and spatial distribution of water resources, the intensification of the contradiction between supply and demand of water resources, and the decline of available water due to the occupation of agricultural water, the research on precision agriculture, including multi-source irrigation, water-saving irrigation and regulated deficit irrigation, continues to be strengthened. Due to the difference of water distribution between South and North China and the water environment pollution caused by industry, production and life, the available water is very limited. As a large agricultural country, irrigation area is our important food production base. It is of great significance to improve the management level of irrigation water distribution, ensure food security and improve food production. How to make rational and efficient use of water resources in the situation of water shortage is worthy of our in-depth study.

At present, there are still many problems in the process of water distribution management in irrigation areas, which makes the utilization efficiency of water resources still very low. For example, the traditional water distribution management mostly adopts irrigation system and irrigation rules for water distribution management, which is not implemented to specific people and things, resulting in extensive management; The traditional irrigation rules are still implemented based on "more water, less water" and more on the practice of "determining the supply according to the demand", which can not realize the way of "determining the supply

according to the demand" for agricultural irrigation [1]; The water use mode of irrigation area is affected by many external environmental factors, climate and geomorphic conditions are the main influencing factors, and the lack of consideration of necessary factors directly leads to the mistakes of follow-up decision-making; Agricultural irrigation is still dominated by traditional surface flood irrigation, which seriously affects water use efficiency [2].

In addition, the rational development and utilization of water resources and rational distribution are the basis for improving water use efficiency. At present, the allocation of water resources is mainly through the preparation of irrigation water plan. The preparation of water plan is based on the analysis of irrigation system of main crops, available water supply sources, canal system engineering, water users and other aspects [3-4]. However, the feasibility of preparing water use plan is not high. Firstly, although the preparation of water use plan has certain reference value, it can not deal with the change of water demand caused by environmental changes during crop growth. Secondly, the analysis of irrigation system is mainly based on the summary and analysis of irrigation quota and irrigation mode; At present, irrigation through irrigation quota can not effectively improve the utilization rate of water resources, because the crop growth process is a dynamic change process. Although it is a certain reference to predict the crop irrigation mode and irrigation amount in advance according to the previous data and information, it is unable to predict the actual demand by considering the changing environment. With the development of social informatization, the application of informatization technology to the field of agricultural irrigation has achieved certain results. However, at present, the information management of the irrigation area is mainly reflected in the water quantity monitoring at the water distribution end, and the real-time monitoring feedback on the water quality and the water demand end cannot be taken.

Agriculture is the largest water user and has always been the "largest waste" of water resources. It is the industry with the most potential for water saving. In 2018, the Party group of the Ministry of water resources defined the general tone and general idea of "making up for weaknesses in water conservancy projects and strengthening supervision in water conservancy industry". In order to respond to the call of the state, implement Xi Jinping's strategy of water control policy and network power strategy in the new era, implement the general keynote of water conservancy reform and development, and promote the modernization of the national water treatment system and governance capacity.

## 2. Analysis of research status and development trends at home and abroad

### 2.1. Research status of irrigation area informatization

The information construction of irrigation area in foreign countries was implemented earlier, and many countries have made a lot of achievements in the application of information in irrigation area[3-4]. For example, according to the agricultural characteristics of Florida, the University of Florida has developed afsirs system which can be used for irrigation water demand in irrigation areas. The system can reasonably distribute irrigation water according to local climate conditions and crop types, and has been widely used in local irrigation areas[5]. Electronic remote control gates and devices for controlling the service time of water pumps are installed at the headworks and sub trunk canals of large irrigation areas in Japan. The use of these devices not only improves the management level and technology of irrigation areas, but also reduces manpower and improves efficiency[6]. The CROPWAT system developed by the international food and Agriculture Organization (FAO) not only has the information of 3262 weather stations in 144 countries, but also can assist irrigation engineers to formulate irrigation planning, which has been widely used in many countries.

China also has a large number of research institutions and scholars committed to the research, aiming at the development level and actual operation status of China's irrigation areas, supporting the water conservancy information system suitable for China's irrigation areas, and have achieved good results. Li Guanjun and others realized the effective combination of irrigation area management and office automation [7-8]. Li Dexing and others have studied and realized the application of WebGIS platform and Java technology in water conservancy information system[9]; The real-time optimal allocation of water resources in the irrigation area designed by Zhu Xinfeng realizes the optimal water distribution and modifiable irrigation decision[10].

However, due to the unique geographical location, climatic conditions and socio-economic conditions of different irrigation areas, the difficulty and application level of information system construction are different. It is necessary to adjust measures to local conditions to make the information management of irrigation areas meet the needs of local water resources management and economic development[11], so it is impossible to establish a general irrigation area management system, Most irrigation areas in China still have backward management and low information level. In some areas, due to the shortage of funds, they can not afford the cost of Water Conservancy Informatization Transformation in irrigation areas, which restricts the informatization construction of irrigation areas to a certain extent. Even in better large-scale irrigation areas, although they have local area networks, due to the relatively independent irrigation areas and poor resource sharing, a single irrigation area is in a blocked state, and there is a lack of public information platform for information resource sharing and sharing.

## 2.2. Research Progress on optimal allocation of water resources in irrigation areas

Since the 1940s, the earliest water resources allocation in irrigation areas is to study the optimal operation of reservoirs and the rational allocation of water resources based on water resources system analysis[12]. Due to the development of computer technology and system analysis, foreign water resources system simulation technology and water resources system analysis are developing rapidly. Researchers in Colorado first began to simulate the water demand of various industries and future planned water demand [13]. Since the 1960s, the methodology of water resources system has been studied. In 1974, the United Nations Hydrological Planning Committee (IHP) emphasized the link between water resources planning and management and hydrology[14]. In 1985, Chaves et al.[15] sought the optimal scheme of water distribution and planting with the goal of maximizing the benefits of the irrigation system. After the 21st century, with the increasing maturity of computer technology, some new model algorithms appear, such as artificial neural network, genetic algorithm, fractional programming method, etc. these more advanced algorithms are applied to water resources optimization. Shyam[16] et al. Distributed irrigation water in the Indian canal irrigation area through the linear programming model to maximize the economic benefits of the irrigation area. In order to solve the real-time water distribution problem in irrigation area, Wardlaw[17] constructed different linear and nonlinear objective functions and solved them by genetic algorithm. In 2005, Masoud et al.[18] constructed interval parameter fuzzy two-stage stochastic programming based on interval parameter and fuzzy programming technology under uncertain regional environment for the planning of water resources management system. In 2010, brown[19] and others took farmers' economic benefits as the objective function and used simulated annealing to optimize decision variables to solve the problem of seasonal water shortage in irrigation areas.

Since the 1960s, the optimization of water resources allocation in irrigation areas has been studied in China. In the 1980s, the increasingly perfect simulation technology and system theory were applied to the optimal allocation of water resources in irrigation areas[20-22]. Huang

Baoquan and Shen Juyan[23] optimized the available water supply in each period of irrigation area based on tensen model. Ma Jianqin et al.[24] established a multi-objective fuzzy model based on social, economic and environmental benefits to optimize the distribution of crop planting area and water volume in the irrigation area, which is conducive to the sustainable utilization of water and soil resources. Since entering the 21st century, the research method of optimal allocation of agricultural water resources in irrigation areas has developed into the combination of mathematical programming, intelligent algorithm and random simulation. For the allocation of water resources in irrigation areas, especially the application of large-scale system optimization theory and computer technology, it can easily deal with the complex problems of multi-objective, multi-scale and multi-level optimal allocation of water resources in irrigation areas.

## 3. Conclusion and Prospect

As a large agricultural country, irrigation area is our important food production base. It is of great significance to improve the management level of irrigation water distribution, ensure food security and improve food production. How to manage irrigation water scientifically under the condition of water shortage has become an urgent need to ensure regional food security and ecological security. The research on multi-source intelligent water distribution mode and the research and development of water distribution system are the difficulties and technical key points to realize the optimal allocation of water resources system and the scientific, reasonable and efficient utilization of water resources in irrigation areas.

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